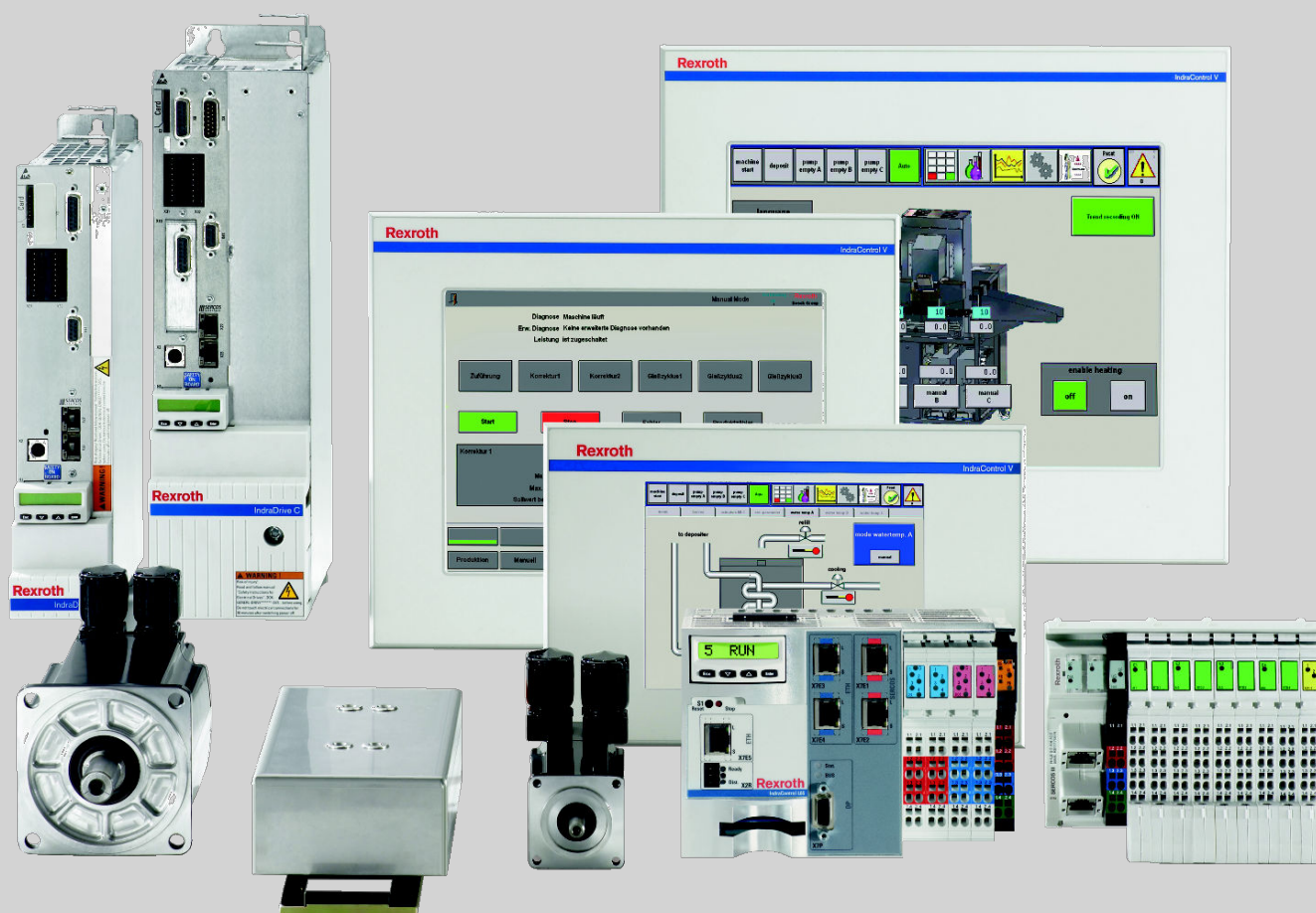


IndraLogic XLC IndraMotion MLC 14VRS

Functional Description

Application Description
R911341700

Edition 12



Title	IndraLogic XLC IndraMotion MLC 14VRS Functional Description
Type of Documentation	Application Description
Document Typecode	DOK-XLCMLC-FUNC****V14-AP12-EN-P
Internal File Reference	RS-f2da2332cdb715150a6846a501ab99fc-12-en-US-3
Change Record	Edition 12, 2020-03 Refer to tab. 1-1 "Change Record" on page 1
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Editorial Department	Development Automation Systems - Solution Integration Control Hardware, PLC and Safety Control (GeKue/MePe) Technical Editing (MiNi/MePe)

Table of Contents

	Page
1 About this documentation.....	1
1.1 Validity of the documentation.....	3
1.2 Documentation structure.....	4
1.3 Using safety instructions.....	4
1.3.1 Structure of the safety instructions.....	4
1.3.2 Explaining signal words and safety alert symbol.....	5
1.3.3 Symbols used.....	6
1.3.4 Explaining the signal alert symbol on the device.....	6
1.4 Required and supplementing documentation XLC/MLC.....	6
1.5 Names and abbreviations.....	12
1.6 Customer feedback.....	12
2 System overview.....	15
2.1 Hardware.....	15
2.2 Firmware.....	23
2.3 Software.....	26
3 Commissioning and operation.....	29
3.1 General information.....	29
3.2 IndraLogic XLC/IndraMotion MLC – Basic sequences, general information.....	29
3.3 IndraLogic XLC/IndraMotion MLC L45/L65/L75 – Commissioning.....	30
3.3.1 General information.....	30
3.3.2 Connections of the control.....	30
3.3.3 Response of the ready contact.....	30
3.3.4 Control startup.....	31
3.3.5 Operating the control display.....	31
3.3.6 Setting the IP address.....	33
3.3.7 "BOOTSTOP" menu.....	37
3.3.8 Response in case of a fatal exception (SysError).....	40
3.3.9 Deleting control memory.....	40
3.3.10 Locking display keys.....	41
3.3.11 Generating a core dump.....	41
3.3.12 Adding the Sercos bus.....	42
3.3.13 Replacing hardware.....	42
3.4 IndraMotion MLC XM – Commissioning.....	43
3.4.1 Commissioning steps.....	43
3.4.2 Notes on the initial/system firmware.....	43
3.4.3 Connections of the control.....	45
3.4.4 Setting the IP address for the XF5 port.....	47
3.4.5 IndraWorks Engineering via the interface Prog (XF31).....	47
3.4.6 Operating and display elements.....	48
3.4.7 "BOOTSTOP" menu	53
3.4.8 Behavior in case of fatal exception (SysError).....	54

	Page
3.4.9	Locking the operation mode switch SF1..... 55
3.4.10	Creating a core dump..... 56
3.4.11	Initial firmware..... 56
	General information..... 56
	LED states..... 56
	Starting and opening the initial firmware..... 57
	Creating a backup using IndraControl FirstTouch..... 58
	Restoring a backup using IndraControl FirstTouch..... 58
	Installing backup from external SD card..... 58
	Licenses..... 59
3.4.12	Bootling..... 59
3.4.13	Fallback mode..... 59
3.4.14	Backing up and restoring..... 59
3.4.15	IndraControl First Touch..... 62
	General information..... 62
	Hardware data..... 63
	Network settings..... 63
	Firmware management..... 64
	File manager..... 68
	Managing a core dump..... 68
3.4.16	IndraWorks Engineering..... 69
	General information..... 69
	Firmware download..... 70
3.4.17	Backing up remanent data..... 73
3.4.18	Real-time clock..... 73
3.4.19	XF30: Using USB memory media..... 73
3.4.20	XG10: Using SD card memory media..... 74
3.4.21	Error causes and troubleshooting..... 74
3.5	IndraMotion MLC VPx – Commissioning..... 75
3.5.1	Commissioning steps..... 75
3.5.2	Software tools..... 76
	Standard software tools..... 76
3.5.3	Connections of the control..... 76
3.5.4	Setting the IP address for the XETH2 connection..... 78
3.5.5	Operating and error displays..... 78
3.5.6	Hypervisor..... 80
3.5.7	Network File System (NFS)..... 82
3.5.8	Initial firmware..... 82
	General information..... 82
	Starting and opening the initial firmware..... 82
	Licenses..... 82
3.5.9	IndraControl First Touch..... 83
	General information..... 83
	Hardware data..... 84
	Network settings..... 84
	Firmware management..... 84

	Page
File manager.....	88
Managing a core dump.....	89
3.5.10 Operating and display elements of the IndraControl SysTray.....	90
3.5.11 "BOOTSTOP" menu	93
3.5.12 Generating a core dump.....	94
3.5.13 IndraWorks Engineering.....	97
General information.....	97
Firmware download.....	98
3.5.14 Backing up remanent data.....	101
3.5.15 Behavior in case of fatal exception (SysError).....	101
3.5.16 Error causes and troubleshooting.....	101
3.6 Installing and starting IndraWorks.....	103
3.7 Overview on the IndraWorks interface.....	106
3.8 Creating a project.....	107
3.9 Offline parameterizing.....	110
3.10 Creating a control.....	113
3.11 Creation based on templates.....	119
3.12 Creating a function module.....	121
3.13 I/Os and field buses.....	124
3.13.1 Creating Onboard I/Os.....	124
3.13.2 Creating Inline I/Os.....	127
3.13.3 Creating Profibus I/Os.....	134
3.13.4 Creating a Profinet I/O Controller.....	135
3.13.5 Creating Sercos III I/Os.....	136
3.14 IP communication	141
3.14.1 Overview.....	141
3.14.2 Basics.....	142
3.14.3 Default setting.....	143
3.14.4 IndraWorks commissioning dialogs.....	147
3.14.5 Automatic IP address generation.....	149
3.14.6 Configuring the bridge.....	150
3.14.7 Involved IP communication parameters.....	150
3.14.8 Ethernet ports and firewall.....	151
3.14.9 More information on the use of Ethernet-based interfaces.....	152
3.15 Axes.....	153
3.16 Creating a kinematics.....	153
3.17 Using a Robot Control V1 kinematics in compatibility mode.....	155
3.18 Protocols - System security.....	155
3.18.1 General information.....	155
3.18.2 Network security.....	156
Secure command line: Secure Shell (SSH).....	156
Secure data transfer: Secure File Transfer Protocol.....	157
Secure data transfer: MLPIS.....	157
3.18.3 Integrity and data security.....	157
3.18.4 Security in practice.....	158
Disabling unsecure protocols.....	158

	Page
Enabling disabled protocols.....	159
IndraWorks Engineering.....	159
External file access.....	159
Using the function blocks of the RIL_SocketComm.library in the PLC.....	159
4 Control.....	161
4.1 Project structure.....	161
4.2 Toolbar of the control.....	162
4.3 Control - Nodes.....	163
4.3.1 Overview on nodes.....	163
4.3.2 Logic.....	165
"Logic" subfolder.....	165
"Logic" – Context menu.....	165
Application – Toolbar.....	166
Application – Context menu.....	167
4.3.3 Motion.....	168
General information.....	168
Motion – Context menu.....	170
4.3.4 Technology.....	171
Introduction.....	171
Context menu.....	173
"Options" menu.....	173
Technology wizards.....	174
General information.....	174
Example of the "winder" technology wizard.....	175
Dialogs.....	178
Dialogs, general.....	178
"AxisInterface" group.....	180
"Web Tension" Group.....	182
"Register Control" group.....	183
"Touch Probe" group.....	184
"Winder" group.....	184
"SmartBelt" group.....	185
"Sag Control" group.....	186
4.3.5 Robot.....	186
General information.....	186
Robot - Context menu.....	186
4.3.6 Onboard I/Os.....	187
4.3.7 Inline I/Os.....	188
4.3.8 S20 I/O.....	188
4.3.9 Profibus/M.....	188
4.3.10 Profinet I/O controller.....	188
4.3.11 Function modules.....	189
4.3.12 Sercos.....	189
General information.....	189
Sercos - Context menu.....	191

	Page
Overview on menu items.....	191
Open (double-click).....	191
Context menu item "Set Device".....	196
Context menu item "Bus Address Overview".....	196
Context menu item "Scan Bus Configuration".....	197
Sercos configuration.....	201
Configuring the drive bus (Sercos II).....	203
Firmware download on Sercos devices.....	203
Sercos - Toolbar.....	205
4.4 Control – Context menu.....	206
4.4.1 Overview on menu items.....	206
4.4.2 Device editor.....	209
Device editor - General information.....	209
Applications	209
Log	210
PLC settings.....	211
Information	212
4.4.3 Communication.....	213
TCP settings.....	213
Interfaces.....	214
User control ID.....	214
Overview.....	214
Managing user control ID.....	215
Exchanging hardware.....	216
Protocols.....	216
4.4.4 Language settings.....	216
4.4.5 Cam explorer.....	217
4.4.6 Parameters.....	222
Parameter editor.....	222
Parameter group.....	224
Finding parameters.....	226
Parameter adjustment.....	226
Saving parameters in drives.....	230
Parameters - Export.....	231
Parameters - Import.....	232
4.4.7 Diagnostics.....	234
Device status.....	234
Load.....	236
Clearing errors.....	238
Error/diagnostic memory.....	238
Overview.....	238
Messages.....	238
Filters.....	239
"View" Area.....	240
"Control" Area.....	240
Context menu of the diagnostic list.....	241

	Page
Invalid parameters.....	241
Task list/configuration.....	242
Task viewer.....	242
MLPI connections.....	243
4.4.8 Multi-device.....	244
Introduction.....	244
Multi-device functionality with SafeLogic.....	245
Brief description of the multi-device table.....	246
Multi-device functionality in detail.....	247
Version control system (VCS).....	247
Difference: Multi-device disabled ⇔ enabled.....	247
Basic behavior of the multi-device table.....	248
Describing columns of the multi-device table.....	248
I/O configuration file to disable field bus slaves.....	252
Disabling slaves of different field buses.....	252
Managing the configuration file "UserDefs.cfg".....	253
4.4.9 Firmware management.....	253
4.4.10 Drive firmware management.....	256
4.4.11 Device data.....	259
Archiving.....	259
Restoring.....	263
Explorer.....	265
4.4.12 Simulation.....	268
4.4.13 Reset device origin [device name].....	268
4.4.14 Exporting.....	268
4.4.15 Importing.....	270
4.4.16 Comparing/merging.....	272
General information.....	272
Control.....	273
Axes.....	273
Robot (only for MLC).....	273
Function modules.....	274
4.4.17 Runtime licenses.....	274
4.4.18 Print preview.....	274
4.4.19 Printing.....	276
4.4.20 Control properties.....	277
4.5 Access protection to devices.....	281
4.5.1 General information	281
4.5.2 Users, groups and rights.....	282
4.5.3 Delivery state/default user.....	282
4.5.4 Login user to the device.....	282
4.5.5 Configuring the access protection.....	284
Configuration dialog.....	284
'User' tab.....	287
'Groups' tab.....	292
'Rights' tab.....	297

	Page
Rights categories - Overview.....	299
Individual rights - Overview.....	299
4.5.6 Access protection in practice.....	304
Manually store login information.....	304
Insufficient user rights of stored login information.....	305
Delete login information.....	306
4.5.7 Make devices safe.....	307
4.5.8 Devices notes - Restrictions.....	307
Note to devices with 14V20 firmware.....	307
Note on firmware update on controls.....	307
4.6 Version control of the control.....	308
4.6.1 Introduction.....	308
4.6.2 Special features.....	308
Project management.....	308
Using controls.....	309
Motion Connection with Version-controlled Project.....	309
PLC connection with version-controlled project.....	309
Using multi-device configurations.....	309
4.7 Complete data backup.....	309
4.7.1 General information.....	309
4.7.2 Complete backup.....	310
4.7.3 Restoring a project.....	314
4.8 Multicore.....	318
4.8.1 Configuration.....	318
4.8.2 Load of individual processor cores.....	318
4.8.3 TaskExecutionViewer.....	318
4.8.4 Known problems.....	319
F5180005 Cycle time exceeded for Motion kernel after updating to 14V22.....	319
5 PLC programming.....	321
5.1 General information.....	321
5.2 Creating PLC programs.....	321
5.2.1 Opening PlcProg object	321
5.2.2 Declaring variables.....	321
5.2.3 Editing instruction.....	322
5.2.4 Compiling programs.....	322
5.2.5 Loading a PLC program to the control.....	323
5.3 Library management.....	323
5.3.1 General information.....	323
5.3.2 Library overview.....	324
5.3.3 Installing on the system and integrating into a project	325
5.3.4 Referenced libraries.....	326
5.3.5 Library versions.....	326
5.3.6 Unique access to library function blocks (namespace).....	327
5.3.7 Creating libraries.....	328
5.3.8 Converting IndraLogic 1.x libraries.....	328

	Page
5.3.9 Integrating external code.....	329
5.4 Task system	329
5.4.1 General information.....	329
5.4.2 Node "Task configuration".....	332
General information.....	332
Configuration examples.....	333
5.4.3 Task editor.....	335
General information.....	335
Configuring a task	336
5.4.4 "Properties" dialog.....	338
5.4.5 Task list/configuration.....	338
5.4.6 Task viewer.....	340
5.4.7 I/O turn-around times.....	341
General information.....	341
Profibus, Profinet and Inline I/Os.....	343
Sercos III I/Os.....	343
Onboard and Fast I/Os.....	344
5.4.8 System tasks.....	345
5.4.9 CPU load of the control.....	350
5.5 I/O access.....	352
5.6 Memory organization and pointer programming.....	354
5.6.1 Memory alignment.....	354
5.6.2 Byte order.....	355
5.6.3 Pointer addressing.....	355
6 Axes.....	359
6.1 Introduction and overview.....	359
6.2 Axis overview.....	361
6.3 Real axis.....	364
6.3.1 General information.....	364
6.3.2 Error reaction of axis.....	369
6.3.3 Creating a real axis.....	370
6.3.4 Real axis – Dialogs.....	373
Overview on dialogs.....	373
6.3.5 Real axis – Context menu.....	376
Overview on menu items.....	376
Initial Commissioning.....	377
Parameters.....	378
Loading basic parameters.....	378
Drive password - Change password.....	379
Save mode.....	380
Saving parameters in the drive.....	380
Communication.....	380
Cyclic Sercos channel.....	380
Signal status word.....	382
Signal control word.....	384

	Page
Diagnostics.....	385
Status.....	385
IDN list of invalid operating data.....	387
Clearing Errors.....	387
Error/diagnostic memory.....	387
Average value filter display.....	388
Axis properties.....	389
6.4 Virtual axis.....	391
6.4.1 General information.....	391
6.4.2 Creating a virtual axis (virtual master axis).....	391
6.4.3 Virtual axis - Dialogs.....	394
Overview on dialogs.....	394
6.4.4 Virtual axis - Context menu.....	395
Overview on menu items.....	395
Loading basic parameters, general.....	397
6.5 Controller axis.....	398
6.5.1 General information.....	398
6.5.2 Creating a controller axis.....	399
Creating axis in the Project Explorer.....	399
Step 1: General settings.....	400
Step 2: Configuration.....	402
Step 3 (central controller/Sytronix controller): Signal handling.....	403
Step 4 (central controller/Sytronix controller): Signal assignment.....	405
Step 5 (Sytronix controller): Axis assignment.....	408
Step 3 (synchronization controller): Axis assignment.....	408
Last step: Summary.....	409
6.5.3 Controller axis - Dialogs.....	410
Controller axis (freely programmable) – Overview on dialogs.....	410
Controller axis (hydraulic central controller) – Overview on dialogs.....	411
Controller axis (hydraulic synchronization controller) – Overview on dialogs.....	412
Controller axis (central Sytronix controller) – Overview on dialogs.....	412
Controller axis (central Sytronix controller) – Dialog: Extend Sytronix.....	414
6.5.4 Controller axis - Context menu.....	415
Overview on menu items.....	415
Initial commissioning.....	416
Diagnostics.....	416
Status.....	416
Clearing errors.....	417
6.5.5 Controller axis – Use cases.....	418
Controller axis to couple devices coupled as PLC device to the MLC.....	418
Connecting a Sercos encoder with a controller axis.....	418
Connecting a drive as PLC device via a controller axis.....	419
6.6 Link axis.....	421
6.6.1 General information.....	421
6.6.2 Creating a link axis.....	422
Settings at the consumer.....	422

	Page
Settings at the producer.....	425
6.6.3 Link axis - Dialogs.....	425
Overview on dialogs.....	425
6.6.4 Link axis – Context menu.....	425
Overview on menu items.....	425
6.7 Encoder axis.....	427
6.7.1 General information.....	427
6.7.2 Creating an encoder axis (real master axis).....	427
Creating an axis in the Project Explorer.....	427
Configuring the measuring encoder.....	431
6.7.3 Encoder axis - Dialogs.....	431
Overview on dialogs.....	431
6.7.4 Encoder axis - Context menu.....	432
Overview on menu items.....	432
6.8 Dialogs.....	433
6.8.1 Overview on dialogs.....	433
6.8.2 Operation mode settings.....	437
Status information based on the command values or on the command and actual values.....	439
6.8.3 Motor.....	443
6.8.4 Motor temperature monitoring.....	444
6.8.5 Brake.....	445
6.8.6 Measuring systems.....	445
Motor encoder.....	445
Optional encoder.....	446
6.8.7 Scaling/units settings.....	447
6.8.8 Scaling/units extended.....	449
6.8.9 Mechanical gear.....	451
6.8.10 Closed-loop control.....	452
6.8.11 Settings of status messages.....	453
6.8.12 Drive halt.....	454
6.8.13 Establishing dimensional reference.....	455
Motor encoder.....	455
Optional encoder.....	456
6.8.14 Error response.....	456
Drive.....	456
Power section.....	458
6.8.15 E-Stop function.....	459
6.8.16 Motion limit values.....	460
6.8.17 Initial values.....	462
6.8.18 Compensation functions/corrections.....	463
Encoder correction.....	463
Backlash on reversal correction.....	464
6.8.19 Drive-integrated command value generator.....	465
6.8.20 Cam table.....	465
General information.....	465
Master axis position offset.....	467

	Page
Gear settings.....	467
Cam table phase offset.....	468
Dynamic phase offset.....	469
Cam table selection.....	469
Dynamic synchronization - phase synchronization.....	470
6.8.21 MotionProfile.....	471
General information.....	471
Master axis position offset.....	473
Gear settings.....	474
Cam table phase offset.....	474
Dynamic phase offset.....	475
MotionProfile overview.....	475
Dynamic synchronization – Phase synchronization.....	477
6.8.22 FlexProfile.....	478
General information.....	478
Master axis position offset.....	480
Gear settings.....	481
Cam table – Phase offset, begin of table.....	481
FlexProfile overview.....	482
Dynamic synchronization - Phase synchronization.....	484
6.8.23 Gear with velocity synchronization.....	485
General information.....	485
Master axis position offset.....	487
Gear settings.....	488
Dynamic synchronization.....	489
6.8.24 Gear with phase synchronization.....	489
General information.....	489
Master axis position offset.....	491
Gear settings.....	492
Dynamic synchronization.....	492
6.8.25 Axis configuration.....	493
6.8.26 Drive-integrated safety engineering.....	495
6.8.27 Position switching point.....	496
6.8.28 Touch probe.....	496
6.8.29 Jogging (Robot Control V1).....	499
6.9 Drive as PLC device.....	500
6.9.1 General information.....	500
6.9.2 Sercos II drive as PLC device.....	501
Sercos III drive as PLC device – Overview.....	501
Sercos II drive as PLC device – Parameterization.....	502
Sercos III drive as PLC device – Configuring cyclic data.....	504
Sercos III drive as PLC device – PLC parameterization.....	508
6.9.3 Drive as PLC device – More field buses.....	511
6.10 PowerSupply as PLC device.....	511
6.10.1 General information.....	511
6.10.2 Power supply as PLC device – Parameterization.....	512

	Page
6.10.3 Power supply as PLC device – Configuring cyclic data.....	513
6.10.4 Power supply as PLC device – PLC programming.....	516
7 Motion functionality.....	519
7.1 General information.....	519
7.2 Cycle times.....	519
7.3 Parameters.....	520
7.4 Parameter overview.....	521
7.5 Parameterization level.....	522
7.6 Modes for project editing.....	523
7.6.1 Introduction.....	523
Offline mode.....	523
Online mode.....	524
7.6.2 Transitions between modes.....	526
Mode switching.....	526
Adjustment of command/actual configuration.....	526
Scanning bus configuration.....	530
Axis synchronization dialog.....	530
Switching online.....	530
Adjusting the behavior of the axis synchronization dialog.....	531
7.6.3 Comparing control and project configuration.....	532
7.6.4 Comparing Motion project data and control data.....	534
7.7 Axis modes.....	535
7.7.1 Deactivated axis.....	535
7.7.2 Parking axis.....	536
7.7.3 Notes on the use of deactivated and parking axes.....	536
7.7.4 Command value decoupling.....	537
Mode of operation.....	537
Displaying command value decoupling.....	537
7.7.5 Axis in parameterization mode.....	539
7.8 Single-axis modes.....	539
7.8.1 Overview.....	539
7.8.2 Operation modes.....	540
7.9 Operation modes for synchronous motions with electronic gear function.....	546
7.10 Boundary conditions for an axis velocity specification in the PLCopen state "Synchronized Motion".....	553
7.11 Axis commissioning.....	554
7.11.1 Overview.....	554
7.11.2 Safety functions.....	555
7.11.3 Enabling an axis.....	556
7.11.4 Velocity control.....	557
7.11.5 Positioning.....	557
7.11.6 Velocity synchronization.....	558
7.11.7 Position synchronization.....	558
7.11.8 Phase offset.....	558
7.11.9 FlexProfile.....	559

	Page
7.11.10 Stop.....	559
7.12 Validating Motion configuration.....	560
7.12.1 Overview.....	560
7.12.2 Error messages.....	561
General information.....	561
Axis error messages.....	562
MLs-E0A0001: The axis name '<Name>' is not IEC-compliant.....	562
MLs-E0A0002: The axis name <Name> below the control is not unique.....	562
MLs-E0A0004: The axis <Name> and a kinematics have the same name	562
MLs-E0A0005: The axis <Name> and a drive have the same name.....	562
MLs-E0A0010: The number of projected axes (<Digit1>) is higher than the maximum number of axes allowed (<Digit2>).....	562
MLs-E0A0012: The axis number <Digit> is invalid.....	562
MLs-E0A0013: The axis number <Digit> below the control is not unique.....	563
MLs-E0A0014: The axis name <Name> is longer than permitted (maximum <Digit> characters)	563
MLs-E0A0015: The axis identification <Unique ID> below the control is not unique.....	563
MLs-E0A0020: The encoder axis <Name1> is assigned to the real axis <Name2> This axis does not support any encoder axes.....	563
MLs-E0A0021: The encoder axis <Name> is not assigned to a real axis.....	563
MLs-E0A0022: The axis <Name> does not match the projected Sercos protocol.....	563
MLs-E0A0024: The firmware <Name1> of the axis <Name2> is invalid.....	563
MLs-E0A0030: For this axis, the control only supports the basic package "Closed Loop".....	564
MLs-E0A0100: A conversion error was determined causing missing internal axis data.....	564
MLs-E0A0500: The axis number <Digit1> is invalid for <ControllerType>. The axis number has to be in the range from 1 to <Digit2>.....	564
MLs-E0A0501: The maximum number of <Digit> controller axes of the type <ControllerType> was exceeded.....	564
MLs-E0A0502: The task configuration required for the controller axes is incorrect.....	565
MLs-E0A0504: The hardware connection <Name> selected in the controller axis is not supported in this version!.....	565
MLs-E0A0505: The controller type '<Name>' is not supported by controls of type '<DeviceType>'.....	565
MLs-E0A0511: The program implementation of the controller axes is incorrect: <Detailed-Message>.....	565
MLs-E0A0520: The input or output assignment determined in the controller axis is incorrect..	565
MLs-E0A0521: The axis configuration of the project changed.....	565
MLs-E0A0590: No controller application is specified for the controller axis.....	566
MLs-E0A0591: There are several controller applications (<App1>,<App2>).....	566
Control error messages.....	566
MLs-E0C0001: The control name <Name> is not IEC-compliant.....	566
MLs-E0C0002: The control name <Name> in the project is not unique.....	566
MLs-E0C0003: The hardware "VEP" is not supported as control by IndraWorks.....	566
MLs-E0C0004: A control firmware of the version {VersionNumber} is not supported by this IndraWorks version.....	566
MLs-E0C0005: The device <Hardware> (<Version>) is not installed.....	566
MLs-E0C0006: The firmware release <Firmware> is not supported.....	567

	Page
MLs-E0C0007: The projected firmware of the control (<Firmware>) does not match the compiler version <Version>.....	567
MLs-E0C0008: The configured control (<Firmware>) supports a maximum of n application(s).....	567
MLs-E0C0010: The IP address <IP address> of the control is not unique in the project.....	567
MLs-E0C0014: The control name <Name> is longer than permitted (maximum <Digit> characters)	567
MLs-E0C0101: Without the selected "Motion" function package, the external event of the "GATMotionSyncTask" task has to be of type "EVENT_OP_MODE_SERCOS_CYCLIC".....	568
MLs-E0C0102: With the selected "Motion" function package, the external event of the "GATMotionSyncTask" task has to be of the type "EVENT_OP_MODE_MOTION_CYCLIC"..	568
MLs-E0C0103: For the TECHTEMPLATE library lower than 14VRS, the initializations of the units have to be adapted.....	568
MLs-E0C0104: For the TECHTEMPLATE library higher than 13VRS, the initializations of the units have to be adapted.....	568
MLs-E0C0105: The global axis <Name> assigned to the GAT axis <Name> does not exist...	569
MLs-E0C0106: For the TECHINTERFACE library lower than 14V06, the implementation has to be adapted.....	569
MLs-E0C0108: The global kinematics '<Name>' assigned to the GAT kinematics '<Name>' does not exist.....	569
MLs-E0C0110: The initializations of the axes have to be adapted for the SEQPROG library lower than 14V08.....	569
MLs-E0C0111: The initializations of the axes have to be adapted for the SEQPROG library higher than or equal to 14V08.....	569
MLs-E0C0112: The implementation of the HydraulicBasic plugin has to be adapted for the SEQPROG library lower than 14VRS.....	570
MLs-E0C0113: The implementation of the HydraulicBasic plugin has to be adapted for the SEQPROG library higher than or equal to 14VRS.....	570
Function module error messages.....	571
MLs-E0F0010: The number of projected function modules (<Digit1>) is greater than the maximum permissible number of function modules (<Digit2>).....	571
MLs-E0F0011: More than the valid number (<Digit>) of function modules of type <Name> were projected.....	571
MLs-E0F0012: The slot <Digit> is not valid for the function module <Name>.....	571
MLs-E0F0013: The function module <Name> on the slot <Digit> has to be plugged in as last function module	571
MLs-E0F0020: The function module <Name> is not valid for the current control type.....	571
MLs-E0F0021: The device description file for the device <Name> is not installed.....	571
Extension module error messages.....	572
MLs-E0E002: The slot (<Digit1>) of the extension module below the control is not unique.....	572
MLs-E0E0010: The number of projected extension modules (<Digit1>) is higher than the maximum number of extension modules permitted (<Digit2>).....	572
MLs-E0E0011: More extension modules of the type <Name> were projected than permitted (<Digit>).....	572
MLs-E0E0020: The extension module <Name> is not permitted for the current control type...	572
MLs-E0E0021: The device description file for the device <Name> is not installed.....	572
Kinematic error messages (only IndraMotion MLC).....	572
MLs-E0K0001: The kinematic name <Name> is not IEC-compliant.....	572
MLs-E0K0002: The kinematic name <Name> below the control is not unique.....	572

	Page
MLs-E0K0005: The RCL program name <Name> below the control is not unique.....	573
MLs-E0K0006: The axis name <Name> does not comply with the RCL naming conventions..	573
MLs-E0K0010: The number of projected kinematics (<Digit1>) is greater than the maximum permissible number of kinematics (<digit2>).....	573
MLs-E0K0012: The kinematic number <Digit> is invalid.....	573
MLs-E0K0013: The kinematic number <Digit> below the control is not unique.....	573
MLs-E0K0020: The axis assignment to position <Digit> is missing under the properties of the kinematics.....	573
MLs-E0K0021: The first axis has to be configured as positioning axis.....	573
MLs-E0K0022: No kinematics was configured with the number <Digit>.....	574
MLs-E0K0023: The axis <Name> is not unique in the kinematics.....	574
MLs-E0K0024: Belt axes <Digit1> were configured. Only a maximum of <Digit2> belt axes is permitted.....	574
MLs-E0K0025: Only <Digit1> positioning axes were configured. At least <Digit2> positioning axes are required for the kinematics.....	574
MLs-E0K0027: The axis on position <Digit> cannot be configured after an empty axis.....	574
MLs-E0K0028: The positioning axis on position <Digit> cannot be configured after an orientation axis.....	574
MLs-E0K0029: The axis on position <Digit> is no belt axis and can thus not be configured after a belt axis.....	574
MLs-E0K0030: 0 has to be entered as control number for the axis on position <Digit>, as it is no belt axis.....	575
MLs-E0K0031: The axis <Name> is impermissibly used in several kinematics (<kinematic list>).....	575
MLs-E0K0032: The axis <Name> is already used as belt axis in the kinematics (<KinematicList>).....	575
MLs-E0K0033: The number of coordinates does not match the number of axes.....	575
MLs-E0K0034: The coordinate name <Name> below the control is not unique.....	575
MLs-E0K0035: The coordinate name <Name> does not comply with the RCL naming conventions.....	575
MLs-E0K0037: The coordinate name <Name> is identical to an RCL keyword.....	576
MLs-E0K0038: No axis type was configured for the axis on position <Digit>.....	576
MLs-E0K0039: The kinematic name <Name> does not comply with the RCL naming conventions.....	576
MLs-E0K0040: The kinematic name <Name> is identical to an RCL keyword.....	576
MLs-E0K0041: The axis name <Name> is identical to an RCL keyword.....	576
MLs-E0K0042: The transformation number <Digit1> is smaller than the maximum valid value <Digit2>.....	576
MLs-E0K0047: The kinematic version <Version> is not supported by the control.....	576
MLs-E0K0048: The axis type <Type2> is invalid for the axis on the position <Number> (kinematic axis type <Type1>).....	577
MLs-E0K0049: The kinematics <Name> with the version "Robot Control V2" has a lower number (<Digit>) than at least one other kinematics with the version "Robot Control V1".....	577
MLs-E0K0050: Only <Digit1> orientation axes were configured. At least <Digit2> orientation axes are required for the kinematics.....	577
MLs-E0K0053: The transformation scheme <Digit> of the kinematics is not supported by the control.....	577
MLs-E0K0054: The transformation scheme <Digit> of the kinematics is only supported from a control firmware version <Version>.....	577

	Page
MLs-E0K0055: The transformation scheme <Digit> of the kinematics is only supported from a control firmware version <Version> or lower	577
Cross communication error messages (only IndraMotion MLC)	578
MLs-E0L0012: The CrossComm Sercos III control address <digit> is invalid.....	578
MLs-E0L0020: The control does not simultaneously support a Sercos II and a Sercos III cross communication.....	578
MLs-E0L0021: A Sercos III cross communication is only possible if the master communication also takes place via Sercos III.....	578
MLs-E0L0022: A Sercos III cross communication is only possible with the "Motion" function package.....	578
MLs-E0L0023: A Sercos III cross communication is only possible with an activated Sercos master.....	578
Sercos device error messages.....	578
MLs-E0S0010: The number of projected Sercos devices (<Digit1>) is greater than the maximum permissible number of Sercos devices (<Digit2>).....	578
MLs-E0S0012: The Sercos address <Digit> is invalid.....	579
MLs-E0S0013: The Sercos address <Digit> below the control is not unique.....	579
MLs-E0S0014: The logic address <Digit> in the PLC devices of the control is not unique.....	579
MLs-E0S0015: The axis number <Digit1> overlaps with the logic address of the PLC device <Name> with the Sercos address <Digit2>.....	579
MLs-E0S0022: The I/O device <Name> does not match the projected Sercos protocol.....	579
MLs-E0S0023: The logic address <Digit> is invalid.....	580
Safety error messages.....	580
MLs-E0Y0010: The number of gateways "SLC-3-GS3S" (<Digit1>) is greater than the maximum permissible number (<Digit1>).....	580
MLs-E0Y0011: The number of "CIP Safety on Sercos" targets (<Digit1>) is greater than the maximum permissible number of "CIP Safety on Sercos" targets (<Digit2>).....	580
MLs-E0Y0012: The target number <Digit1> is outside the valid range (1..<Digit2>).....	580
MLs-E0Y0013: The target number <Digit> was specified multiple times.....	580
MLs-E0Y0014: "CIP Safety on Sercos" was projected for the axis, even though it is not supported by the axis.....	580
MLs-E0Y0015: The axis is assigned to the gateway "SLC-3-GS3S" which does not exist anymore. The gateway name was <Name>, the Sercos address was <Digit>.....	581
MLs-E0Y0100: "CIP Safety on Sercos with SafeLogic" was projected for the axis, but the required function module "Safety CPU" is missing.....	581
MLs-E0Y0101: "CIP Safety on Sercos with SafeLogic" was projected for the axis, but no Safety profile was selected.....	581
MLs-E0Y0102: The Safety profile <Name> selected for the axis is invalid.....	581
MLs-E0Y0103: The device description file for the device <Name> is not installed.....	581
EtherCAT error messages.....	581
MLs-E0T0001: An EtherCAT master is only possible with the "ECAT"function package.....	581
7.12.3 Information messages.....	582
General information.....	582
Non-object-related information messages.....	582
MLs-I0X0001: The following error <Identification> is temporarily only considered as warning.....	582
MLs-I0X0002: An internal error was detected during validation. Double-click to display details.....	582
7.12.4 Warning messages.....	582

	Page
General information.....	582
Axis warning messages.....	582
MLs-W0A0020: The configured function package of the axis <Name> is not enabled in the corresponding drive.....	582
MLs-W0A0021: The projected axis name <Name1> does not match the axis name in the control <Name2>.....	582
MLs-W0A0022: An encoder is configured in the drive <Name>, even though the function package "Open Loop" is set.....	583
MLs-W0A0200: The projected axis is a axis different than the axis configured in the control (name: <Name>, axis number: <Digit>).....	583
MLs-W0A0201: The projected axis is not available in the control.....	583
MLs-W0A0202: An axis <Name> (axis number <Digit>) is in the control that is not in the project.....	583
MLs-W0A0203: The axis of the drive projected in the control with the Sercos addresses <Digit1> and <Digit2> are assigned to multiple connected drives.....	583
MLs-W0A0501: The maximum number of <Digit> controller axes of the type <Controller-Type> was exceeded.....	584
MLs-W0A0502: The task configuration required for the controller axes is incorrect.....	584
MLs-W0A0503: The library configuration required for the controller axes is incorrect.....	584
MLs-W0A0504: The hardware connection <Name> selected in the controller axis is not supported in this version!.....	584
MLs-W0A0510: The "HydrControl" directory for the program implementation of the controller axes is not present.....	584
MLs-W0A0511: The program implementation of the controller axes is incorrect: <Detailed-Message>.....	585
MLs-W0A0520: The input or output assignment determined in the controller axis is incorrect.....	585
MLs-W0A0521: The axis configuration of the project changed.....	585
MLs-W0A0522: In the input/output assignment, no signals are assigned to the controller axis.....	585
MLs-W0A1000: The controller type '<Name>' (ID:<Digit>) could not be loaded.....	585
MLs-W0A1001: The controller type '<Name>' is not supported by the control firmware '<Firmware>'.....	585
Control warning messages.....	586
MLs-W0C0020: A higher device version (<Version>) is available for the control.....	586
MLs-W0C0021: The connected control has a lower firmware release (<Firmware>) than projected (<Firmware>).....	586
MLs-W0C0022: Not all IndraWorks online functions are available, as the configuration of the IndraWorks project differs from the control configuration.....	586
MLs-W0C0023: The hardware version <Value> of the connected control is syntactically incorrect.....	586
MLs-W0C0024: The scope of the project parameters is not up-to-date and should be adjusted.....	587
MLs-W0C0109: To eliminate some compiler warnings, adjustments have to be made in the PLC applications.....	587
MLs-W0C0114: The present GAT template is only supported by "IndraMotion MLC" controls.....	587
MLs-W0C0200: The Motion project in the control (<Name>) does not match the Motion project in IndraWorks.....	587
Function module warning messages.....	587

	Page
MLs-W0F0020: An SRAM function module was projected, even though the control is provided with an already integrated SRAM.....	587
MLs-W0F0021: If the control is switched off, kinematic data is lost as no SRAM function module is projected.....	588
MLs-W0F0022: An SRAM function module was projected, but no kinematic data.....	588
Kinematic warning messages (only IndraMotion MLC)	588
MLs-W0K0001: The axis <Name> is also used in user-defined kinematics (<KinematicList>).	588
MLs-W0K0002: Global kinematic data is configured, but no corresponding kinematics of the version "Robot Control V1".....	588
MLs-W0K0003: The "Global data" node is not supported by the set control version.....	588
Cross communication warning messages (only IndraMotion MLC)	588
MLs-W0L0020: The produced axis with the number <Digit> is not projected.....	588
MLs-W0L0022: The produced axis with the number <Digit> is not in the control.....	589
MLs-W0L0023: The Motion cycle time (<Digit1> ms), the Sercos cycle time (<Digit2> ms) and the cross link cycle time (<Digit3> ms) differ.....	589
MLs-W0L0024: The link axis with the number <Digit> is not in the control.....	589
MLs-W0L0026: The control address in the link (<Digit1>) is greater than the maximum permissible control address (<Digit2>).....	589
MLs-W0L0027: Link axes were configured for the control. However, no function module of type "CrossComm Sercos II" was configured.....	590
Sercos device warning messages.....	590
MLs-W0S0013: Several devices with the Sercos address <Digit> are connected to the control.....	590
MLs-W0S0020: The device with the Sercos address <Digit> is disabled, even though it is connected to the control.....	590
MLs-W0S0021: The device with the Sercos address <Digit> is connected to the control, but not configured in the control.....	590
MLs-W0S0023: The Motion cycle time (<Digit1> ms) is no multiple of the Sercos cycle time (<Digit2> ms).....	590
MLs-W0S0024: The device with the Sercos address <Digit> is configured in the control, but not connected.....	591
MLs-W0S0200: For the I/O device (Sercos address <Digit>), the device identification in the project (<Name1>) does not match the device identification (<Name2>) configured in the control.....	591
MLs-W0S0201: The projected I/O device (Sercos address <Digit>) is not configured in the control.....	591
MLs-W0S0202: In the control, an I/O device (device identification <Name>) is configured to the Sercos address <Digit>, but it is not in the project.....	591
MLs-W0S0203: For the I/O device (Sercos address <Digit>), the activation in the project does not match the activation in the control.....	591
Safety warning messages.....	592
W0Y0010: "CIP Safety on Sercos" was projected for the axis, but the actually connected drive does not support this functionality.....	592
W0Y0011: No "CIP Safety on Sercos" target was assigned to the gateway "SLC-3-GS3S"....	592
W0Y0012: The configured drive type <Type1> does not match the connected drive <Type2>.....	592
7.13 Electronic cams.....	592
7.13.1 General information.....	592
7.13.2 Cam solutions.....	593

	Page
7.13.3	Electronic cam..... 595
7.13.4	Use cases..... 596
7.13.5	Centralized and decentralized cam concept..... 596
7.13.6	FlexProfile – Basic functionalities 596
	General information..... 596
	Basic structure of synchronous operating states"FlexProfile"..... 597
	Profile configuration..... 597
	Time master 598
	Motion laws..... 598
	Default motion laws..... 598
	Extended motion laws..... 599
	Flex step..... 600
	Motion law boundary conditions..... 602
	Switching and synchronizing FlexProfile..... 607
	Selecting the coordinate system..... 607
	Switching and synchronizing..... 608
	Processing type..... 613
	Event control 614
	Characteristics of the event control..... 614
	Assigning MotionProfile and axis..... 617
	FlexProfile – Configuration..... 618
	Overview..... 618
	Configuring via PLC function blocks..... 618
	Configuring via IndraWorks 619
	Configuring via CamBuilder..... 624
7.14	Touch probe..... 624
7.14.1	Introduction..... 624
7.14.2	Features..... 625
7.14.3	Functional description..... 625
7.14.4	Accuracy..... 627
7.14.5	Data acquisition of the touch probe..... 627
	Activating measured value acquisition..... 627
	Selecting measuring signal..... 628
	Measured value acquisition mode..... 628
	Saving measured values..... 629
	Dead time compensation..... 629
	Restarting or disabling measured value acquisition..... 630
	Measured value status..... 631
7.14.6	Touch probe expectation window..... 631
	Using the expectation window..... 631
	Setting the expectation window..... 631
	Marker detection..... 631
7.14.7	Overview on M-Parameters..... 632
	M-0-0000, Dummy, M-parameter..... 632
	M-0-0001, Logic touch probe number..... 632
	M-0-0002, Touch probe name..... 632

	Page
M-0-0005, Input selection.....	632
M-0-0006, Signal selection.....	632
M-0-0007, Control word.....	633
M-0-0009, Osci: list of all M-parameters that can be oscilloscoped.....	635
M-0-0010, List of all M-parameters.....	635
M-0-0016, Project identification number.....	635
M-0-0021, Status word.....	635
M-0-0024, Command: Activation.....	636
M-0-0130, Measured value, positive edge.....	637
M-0-0131, Measured value, negative edge.....	637
M-0-0132, Difference value.....	638
M-0-0133, Time difference.....	638
M-0-0140, Time stamp, positive edge.....	639
M-0-0141, Time stamp, negative edge.....	639
M-0-0200, Dead-time compensation, positive edge.....	639
M-0-0201, Dead-time compensation, negative edge.....	639
M-0-0202, Starting position of the expectation window, positive edge.....	639
M-0-0203, End position of the expectation window, positive edge.....	640
M-0-0204, Starting position of the expectation window, negative edge.....	640
M-0-0205, End position of the expectation window, negative edge.....	640
M-0-0206, Maximum number of marker failures.....	641
M-0-0224, Number of marker failures, positive edge.....	641
M-0-0225, Number of marker failures, negative edge.....	641
M-0-0401, Input status.....	642
M-0-0405, Enabling.....	642
M-0-0409, Counter of measured values, positive edge.....	643
M-0-0410, Counter of measured values, negative edge.....	643
M-0-0411, Counter of difference values.....	643
M-0-1000, Command: Load basic touch probe parameters.....	643
M-0-2100, List of all backup operation M-parameters.....	644
7.14.8 Function blocks for touch probes.....	644
7.15 Programmable limit switch.....	644
8 Kinematics (Robot Control V2).....	647
8.1 General information.....	647
8.2 Menu structure of the kinematics.....	647
8.2.1 Menu item: Robot.....	647
8.2.2 Adding a new kinematics.....	648
8.2.3 Kinematic commissioning.....	650
Overview.....	650
Safety functions.....	651
Grouping a kinematics.....	652
Jogging.....	653
Positioning.....	654
Belt configuration.....	655
Product coordinates.....	656

	Page
PLC configuration.....	657
8.2.4 Menu item: Kinematics.....	657
8.3 Kinematics – Context menu.....	658
8.3.1 Kinematics – Context menu or context menu item "Kinematics", general information.....	658
8.3.2 Initial Commissioning.....	658
8.3.3 Diagnostics.....	658
8.4 Kinematics – Dialogs.....	660
8.4.1 Overview on dialogs.....	660
8.4.2 Scaling/units.....	660
8.4.3 Axis lengths and couplings.....	660
8.4.4 Motion limit values.....	661
8.4.5 Coordinate offset.....	662
9 CamBuilder.....	663
9.1 CamBuilder functionality.....	663
10 Oscilloscope.....	665
10.1 Oscilloscope functionality.....	665
11 Error cases.....	667
11.1 Introduction and overview.....	667
11.2 Error categories.....	667
11.2.1 Exception in IEC application.....	667
11.2.2 SysError.....	669
11.2.3 Spontaneous control reboot.....	670
11.3 Core dump.....	670
12 User-defined languages for parameter names, units, diagnostics and menu texts...	671
12.1 General information.....	671
12.2 File management.....	671
12.3 File structure.....	671
12.4 Function.....	672
12.5 Node names for units.....	674
12.6 Node names for menu texts (display texts).....	675
13 Remote support.....	677
13.1 Definition of terms and introduction.....	677
13.2 Connecting via internet.....	677
13.3 Related documentation.....	677
14 Cross communication between controls - CrossComm Sercos III.....	679
14.1 General information on cross communication between controls.....	679
14.2 Link as line, double line or ring.....	681
14.3 Configuration.....	682

	Page
14.3.1 Creating and configuring the CrossComm Sercos III.....	682
14.3.2 Configuring the link and link devices.....	688
14.4 Parameters for the link.....	689
14.5 Diagnostic messages for the link.....	690
14.6 Link - PLC components	691
14.6.1 Binary PLC outputs/binary link inputs.....	691
14.6.2 Link - Binary PLC inputs in the link/binary status in the link.....	693
14.6.3 Link, mode of operation for the synchronous link Inputs.....	698
14.6.4 Link – Data of remote axes.....	699
14.7 Link – Redundancy and error tolerance.....	700
14.8 Link - Configuration examples.....	702
14.8.1 Modularly-structured system.....	702
14.8.2 Rotary printing with two outputs (changed path control).....	703
14.9 Procedure to convert the cross link Sercos II to the Cross Link Sercos III.....	704
14.9.1 General information.....	704
14.9.2 Removing link axes.....	705
14.9.3 Replacing the function modules.....	706
14.9.4 Adapting the PLC program.....	709
14.10 Procedure to convert a cross link of Sercos III MLC 04VRS to Sercos III ≥ MLC 10VRS.....	710
14.11 CrossComm Sercos III (CFL01.1-R3, XFE01.1-FB-01) - Context menu.....	711
 15 Service and support.....	 713
 Index.....	 715

1 About this documentation

Editions of this documentation

Edition	Release Date	Note
01	2014-12	First edition
02	2015-08	Additions, revisions
03	2015-09	Additions, revisions
04	2015-12	Additions
05	2016-03	Additions
06	2016-08	Update: Controller axes New: Firmware download on Sercos devices
07	2017-01	New: - Chapter "Protocols - System security" - Chapter "Operation mode settings" Revision/supplement: - Chapter "Hardware" Implementing an IndraControl XM12 - Chapter "Firmware" Implementing an IndraControl XM12 - Chapter "Validating Motion configuration" Error messages MotionAnalyzer - Chapter "Firmware management" - Chapter "Operating and display elements" XM flashing codes LED "DIA2" Error recovery: - Multi-device configuration table (Defdb00190953)
08	2017-11	New: - User management on the control - Integration of the VPB 40.4 hardware Revision/supplement: - IndraControl XM12 removed - Chapter "Error case/core dump" - Chapter "Remote support/I-remote"

Edition	Release Date	Note
09	2018-05	New: • Cross communication between controls - CrossComm Sercos III Refer to: chapter 14 "Cross communication between controls - CrossComm Sercos III" on page 679 Revision/supplement: • Control property "Offline parameterization for drives" See: – chapter 3.10 "Creating a control" on page 113 – chapter "Parameter adjustment" on page 226 – chapter 4.4.20 "Control properties" on page 277 • Access protection to devices Refer to chapter 4.5 "Access protection to devices" on page 281 • Settings of the operation mode selection of the drive Refer to "Settings of the operation mode selection of the drive" on page 438 • Additional conditions/error messages for axis commissioning when using the control property "Device application" See: – chapter 7.11 "Axis commissioning" on page 554 – chapter "Axis error messages" on page 562 – chapter "Axis error messages" on page 562
10	2018-10	New: • Chapter Offline parameterization, see chapter 3.9 "Offline parameterization" on page 110 • Chapter Multi-device functionality with SafeLogic, see chapter "Multi-device functionality with SafeLogic" on page 245 Revision/supplement: Generally: Extension of control type IndraControl XM4* • System overview: – IndraControl L25 is not supported anymore from version 14V22, see "Control hardware" on page 15 – Technical data (extension IndraControl XM42 and VPB40.4), see "Technical data" on page 17 – Firmware (extension IndraControl XM42 and VPB40.4), see chapter 2.2 "Firmware" on page 23 • IndraMotion MLC XM - Commissioning: – Control connections, see "Ports XM42" on page 47 – XF30: use of USB storage media, see chapter 3.4.19 "XF30: Using USB memory media" on page 73 – XG10: Use of SD card storage media, see chapter 3.4.20 "XG10: Using SD card memory media" on page 74 • Protocols - System security, see chapter 3.18 "Protocols - System security" on page 155 • Chapter control properties, supported hardware, see "Hardware/communication tab" on page 277

Edition	Release Date	Note
11	2019-04	New: - Command 'Rest device origin' Refer to chapter 4.4.13 "Reset device origin [device name]" on page 268 Revision: - Discontinuation of control type IndraControl L25
12	2020-03	New: chapter 3.4.2 "Notes on the initial/system firmware" on page 43 chapter "Creating a backup using IndraControl FirstTouch" on page 58 chapter "Restoring a backup using IndraControl FirstTouch" on page 58 chapter 3.4.14 "Backing up and restoring" on page 59 chapter 4.8 "Multicore" on page 318

Tab. 1-1: Change Record

1.1 Validity of the documentation

Overview on target groups and product phases

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

Example: In the product phase "Mounting (assembly/installation)", the target group "mechanic/electrician" can execute the activity "install" using this documentation.

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

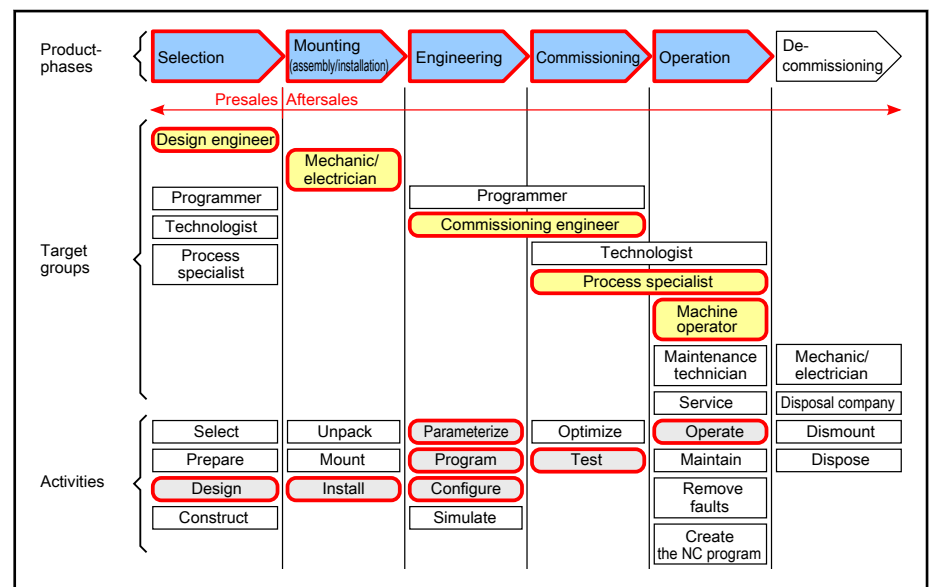


Fig. 1-1: Assigning the present documentation to the target groups, product phases and activities of the target group

Purpose This documentation describes the following elements of an IndraLogic XLC/ IndraMotion MLC 14VRS:

- Wizards

- Context menus
- Dialogs
- Frequently required sequences
- Device configuration
- Functionalities

1.2 Documentation structure

The [chapter 2 "System overview" on page 15](#) includes information on the control.

The overview is structured as follows:

- Hardware
- Firmware
- Software

The [chapter 3 "Commissioning and operation" on page 29](#) and [chapter 4 "Control" on page 161](#) contain descriptions on the commissioning and operation as well as on the IndraWorks user interface.

The [chapter 5 "PLC programming" on page 321](#) provides an overview on the PLC programming.

The [chapter 6 "Axes" on page 359](#) describes the functionalities of the different axis types.

The [chapter 7 "Motion functionality" on page 519](#) describes the Motion functionality.

The [chapter 8 "Kinematics \(Robot Control V2\)" on page 647](#) provides an overview on the Robot functionality of the Robot Control V2.

The [chapter 9 "CamBuilder" on page 663](#) and [chapter 10 "Oscilloscope" on page 665](#) contain document specifications describing the respective function.

The [chapter 11 "Error cases" on page 667](#) describes how to react if an error is reported.

The [chapter 12 "User-defined languages for parameter names, units, diagnostics and menu texts" on page 671](#) describes the use of user-defined languages.

The [chapter 13 "Remote support" on page 677](#) describes the remote access to an IndraLogic XLC/IndraMotion MLC.

For information on the customer service helpdesk, refer to [chapter 15 "Service and support" on page 713](#).

1.3 Using safety instructions

1.3.1 Structure of the safety instructions

The safety instructions are structured as follows:

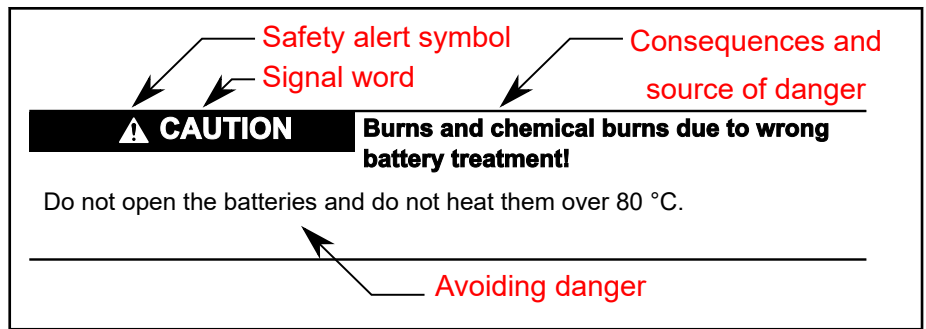


Fig. 1-2: Structure of the safety instructions

1.3.2 Explaining signal words and safety alert symbol

The safety instructions in this documentation contain specific signal words (danger, warning, caution, notice) and, if necessary, a safety alert symbol (according to ANSI Z535.6-2006).

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

1.3.3 Symbols used

Pointers are displayed as follows:



This is a note.

Tips are displayed as follows:



This is a tip.

1.3.4 Explaining the signal alert symbol on the device



If this symbol is on your device, you have to observe the documentation on the device. The respective documentation informs on the type of hazard as well as the steps required to avoid this hazard.

1.4 Required and supplementing documentation XLC/MLC

Documentation titles with type codes and part numbers

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

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

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

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

Engineering
IndraWorks 14VRS Software Installation DOK-IWORKS-SOFTINS*V14-CORS-EN-P, R911344286 This documentation describes the IndraWorks installation.
IndraWorks 14VRS Engineering DOK-IWORKS-ENGINEE*V14-APRS-EN-P, R911343566 This documentation describes the application of IndraWorks in which the Rexroth Engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.
IndraLogic XLC IndraMotion MLC 14VRS Function Description DOK-XLCMLC-FUNC***V14-APRS-EN-P, R911341700 This documentation describes wizards, context menus, dialogs, control commissioning, device configuration and functionalities of the IndraMotion MLC.

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

Diagnostics and service
IndraLogic XLC IndraMotion MLC 14VRS Diagnostics DOK-XLCMLC-DIAG***V14-RERS-EN-P, R911341481 This documentation includes all control diagnostics implemented in the control systems IndraLogic XLC and IndraMotion MLC.
IndraLogic XLC IndraMotion MLC 14VRS Parameters DOK-XLCMLC-PARAM***V14-RERS-EN-P, R911341479 This documentation describes the parameters of the XLC/MLC systems as well as the interaction between parameterization and programming. It includes the axis parameters, control parameters, kinematic parameters, touch probe parameters and programmable limit switch parameters.
IndraLogic XLC IndraMotion MLC 14VRS Commissioning DOK-XLCMLC-STARTUP*V14-CORS-EN-P, R911341502 This documentation describes the steps to commission and service the IndraMotion MLC and IndraLogic XLC systems. It includes checklists for frequent tasks and a detailed description of the steps.
WebAssistant DOK-GENERL-WEB*ASSIST*-APRS-EN-P, R911381469 This documentation describes the WebAssistant. The WebAssistant is a webbased diagnostic tool used to access a control system via an Ethernet highspeed connection. The WebAssistant allows OEMs, end users and service engineers to access and to remotely diagnose a system. A PC with Internet Explorer version 11 or higher, Firefox version 45 or above or Google Chrome version 54 or above is required. The following control variants are supported: • IndraMotion MLC L45/L65/L75/XM21/XM22/XM42/VPx • IndraLogic XLC L45/L65/L75/VEP
IndraWorks IndraMotion Service Tool DOK-IWORKS-IMST*****-APRS-EN-P, R911341383 This documentation describes the IndraMotion Service Tool (IMST). IMST is a web-based diagnostic tool used to access a control system via an Ethernet high-speed connection. The IMST allows OEMs, end users and service engineers to access and remotely diagnose a system. The PC has to use at least Internet Explorer 8, Firefox 3.5 or a higher version. The following control variants are supported: • IndraMotion MLC L45/L65/L75/XM21/XM22/XM42/VPx • IndraLogic XLC L45/L65/L75

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

Firmware
Rexroth IndraDrive MPx-20, Functions ¹⁾ DOK-INDRV*-MP*-20VRS**-AP01-EN-P, R911345608 This documentation describes all functional properties of the IndraDrive firmware in the variants MPB-20, MPM-20, MPC-20 and MPE-20.
Rexroth IndraDrive MPx-16 to MPx-20 und PSB, Parameters DOK-INDRV*-GEN1-PARA**-RERS-EN-P, R911328651 This documentation contains the descriptions of all parameters implemented in the firmware for drive controllers of the IndraDrive range. It supports the drive controller parameterization.
Rexroth IndraDrive MPx-16 to MPx-20 and PSB, Diagnostic Messages DOK-INDRV*-GEN1-DIAG**-RERS-EN-P, R911326738 This documentation contains the descriptions of all diagnostic messages implemented in the following firmware products: • Drive controller firmware variants MPx-16 to MPx-20 • PSB firmware variants for "HMU05" and "KMV03" type supply units • Firmware variants for "HMF01" type supply units It assists machine operators and installation programmers with troubleshooting.
Hardware
Rexroth IndraDrive Control Sections CSB02, CSE02, CSH02, CDB02 DOK-INDRV*-Cxx02*****-PRRS-EN-P, R911338962
Rexroth IndraDrive Cs Drive Systems with HCS01 DOK-INDRV*-HCS01*****-PRRS-EN-P, R911322210
Rexroth IndraDrive Mi Drive Systems with KCU02, KSM02, KMS02/03, KMV03 DOK-INDRV*-KCU02+KSM02-PRxx-EN-P, R911335703
Rexroth IndraDrive ML Drive Systems with HMU05 DOK-INDRV*-Hxx05*****-PRxx-EN-P, R911344279

1)

In preparation

Tab. 1-6:

Overview of documentations for drive controllers

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

Tab. 1-7:

XCL/MLC documentation overview - PLC

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

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

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

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

Technology
IndraLogic XLC IndraMotion MLC 14VRS Generic Application Template DOK-XLCMLC-TF*GAT**V14-APRS-EN-P, R911341487 This documentation provides a structured template to the IndraLogic PLC programmer. This template can be used to add and edit the PLC programming code. It includes the template, the template wizard and example applications.
IndraMotion MLC 14VRS Technology Libraries DOK-MLC***-TF*LIB**V14-LIRS-EN-P, R911341511 This documentation describes the function blocks, functions and data types of the "ML_TechInterface.library", "ML_TechMotion.library", "RMB_TechCam.library" and "ML_TechBase.library". It also includes libraries for the winder functionality, register controller functionality and CrossCutter functionality.
IndraWorks 14VRS Energy Efficiency Management DOK-IWORKS-4EE*****V14-APRS-EN-P, R911339229 This documentation describes the HMI connection of the energy management system and the function blocks, functions and data types of the "RIL_4EE " library. The documentation also includes the error reactions of the function blocks.
Rexroth IndraMotion MLC 14VRS RegisterControl (Library) DOK-MLC***-REGI*CO*V14-LIRS-EN-P, R911341509 This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.
IndraMotion MLC 14VRS RegisterControl (Application Description) DOK-MLC***-REGI*CO*V14-APRS-EN-P, R911341507 This documentation describes the application of the integrated register control for a rotogravure printing machine. The components of the mark stream sensor, the HMI application and the error recovery options are described. This instruction provides information on how to operate the register control, react to errors and query diagnostics. This documentation is written for machine setters and machine operators.
Rexroth IndraMotion MLC 14VRS Winder Function Application DOK-MLC***-TF*WIND*V14-APRS-EN-P, R911341513 This application-related system documentation describes the application of the winder technology functions.
Rexroth IndraWorks CamBuilder 13VRS DOK-IWORKS-CAMBUIL*V13-APRS-EN-P, R911336291 This documentation describes the basic principles and operation of the CamBuilder, the cam editing tool.
IndraMotion MLC 14VRS Robot Control V2 DOK-MLC***-ROCO****V14-RERS-EN-P, R911341588 This documentation provides information about the Robot Control V2. The focus is on PLCopen programming. The program structure, variables, functions, motion statements and the required system parameters are described. This documentation also includes the description of the "ML_Robot" library. Robot Control V2 is supported by a kinematic interface. The components of this interface are described in the "ML_KinTech" library.

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

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

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

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

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

Hardware
Rexroth IndraControl L45/L65/L85 Control DOK-CTRL-ICL45L65L85-PRxx-EN-P, R911332116 This documentation describes the IndraControl L45/L65/L85 controls.
Rexroth IndraControl Lxx 14VRS Function Modules DOK-CTRL-FM*LXX**V14-APRS-EN-P, R911341583 This documentation describes all function modules of the Lxx controls including engineering and diagnostics.
IndraControl XM21, XM22 Controls DOK-CTRL-IC*XM2*****-ITRS-EN-P, R911340667 This documentation describes the IndraControl XM21/XM22 controls.
IndraControl XM42 Controls DOK-CTRL-XM4X*CTRL**-ITRS-EN-P, R911345566 This documentation describes the IndraControl XM42 controls.
IndraControl XFE 01.1 Extension Modules Profibus, RT-Ethernet, Sercos, CAN DOK-CTRL-XFE**EXTMOD-ITRS-EN-P, R911345570 This documentation describes all extension modules of the XM controls.

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

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

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

1.5 Names and abbreviations

Term	Explanation
AxisInterface	The AxisInterface pools and extends PLCopen motion function blocks and provides an easy-to-operate interface for the drive functionality
Imc interface	The Imc interface provides an easy-to-operate interface for the control functionality. The Imc interface includes control signals and parameters for the diagnostics and administration of the control
IndraMotion MLC	Compact Motion Logic systems with Motion, Robot and Logic Control functionalities
IndraLogic XLC	Compact PLC system with integrated Motion functionality
IndraWorks Engineering Framework	Project planning and commissioning tool of Bosch Rexroth
IndraDrive	Drive controller
HydraulicDrive	Hydraulic drive controller
Wizard	Wizard guiding through several dialogs for an ergonomic data input
Function block	Provides application-specific functionalities
IEC	International Electrotechnical Commission
IAC	Integrated axis controller
Sercos	Sercos (serial real-time communication system) interface is a world-wide standardized interface for the communication between controls and drives
XML	Extensible Markup Language (XML). It is a markup language to represent hierarchical structured data as text data
Master communication	Master communication

Tab. 1-15: Names and abbreviations used

1.6 Customer feedback

Customer requests, comments or suggestions for improvement are of great importance to us. Please email your feedback on the documentations to

Feedback.Documentation@boschrexroth.de. Directly insert comments in the electronic PDF document and send the PDF file to Bosch Rexroth.

2 System overview

2.1 Hardware

Control hardware The IndraMotion MLC system provides control hardware based on IndraControl and the corresponding system firmware.

IndraMotion MLC L45/L65/L75, IndraMotion MLC XM21/XM22/XM42 and IndraMotion MLC VPB40.4 are modular and scalable controls. These controls combine the benefits of an embedded PC architecture with a standardized terminal-based technology I/O system. The IndraMotion MLC can be used as a universal hardware platform for Motion applications.



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

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

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

IndraMotion MLC L45:

- The main features of an embedded control hardware IndraControl L45 in the middle performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

IndraMotion MLC L65:

- The main features of an embedded control hardware IndraControl L65 in the upper performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

IndraMotion MLC L75:

- The main features of an embedded control hardware IndraControl L75 in the upper performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

IndraMotion MLC XM21/XM22/XM42:

- The main characteristics of an embedded control hardware based on IndraControl XM21/XM22 in the lower/middle performance segment and IndraControl XM42 in the upper performance segment are:
 - Degree of protection: IP 20
 - Giga bit Ethernet
 - Sercos Onboard as universal automation bus for a system-comprehensive networking
 - Firmware operation via 1 GB read-only memory (internal) for XM21/XM22 and 4 GB read-only memory (internal) for XM42
 - Modular extension via S20 I/O modules
 - Modular extension of XM21/XM22/XM42 via XM extension modules (Profibus DP/Profinet IO and EtherNet/IP)
 - Extended temperature range from -25 °C to +60 °C

The high performance control **IndraMotion MLC VPB40.4** is based on the devices of the Rexroth industrial PC variants IndraControl VPB 40.4. This control combines the advantages of an industrial PC for HMI applications with the functionality of a modern, high-performance MotionLogic control.

IndraMotion MLC VPB40.4:

- The main characteristics of a control hardware based on the IndraControl VPB 40.4 in the upper performance segment are:
 - Degree of protection: IP 20
 - Parallel operation of HMI and control on a common hardware with exclusive resource assignment
 - Sercos III onboard as universal automation bus for a system-comprehensive networking
 - Firmware operation via 4 GB ROM (internal)
 - Field bus technology (Profibus DP/Profinet I/O and EtherNet/IP)

IndraLogic XLC L45/L65/L75 are modular and scalable controls. These controls combine the benefits of an embedded PC architecture with a standardized terminal-based technology I/O system. These controls can be used as a universal hardware platform for Logic applications.

IndraLogic XLC L45:

- The main features of an embedded control hardware IndraControl L45 in the middle performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

IndraLogic XLC L65:

- The main features of an embedded control hardware IndraControl L65 in the upper performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

IndraLogic XLC L75:

- The main features of an embedded control hardware IndraControl L75 in the upper performance segment are:
 - Ethernet 10/100 MBit
 - Onboard I/O
 - Onboard Profibus DP master or slave
 - Onboard Sercos III interface (Ethernet)
 - Profinet IO and EtherNet/IP
 - Firmware on a 1 GB Compact Flash Card
 - Inline I/O terminals (possible I/O extensions on the right side of the control)
 - Modular extension via function modules (on the left side of the control)

Technical data

Comparison of technical data of the IndraMotion MLC hardware:

IndraControl	CML45.1-3P	CML65.1-3P	CML75.1-3P
Processor (compatible)	AMD LX800 500 MHz	Intel Celeron M 1 GHz	Intel E3827 1.75 GHz
RAM	256 MB	512 MB	1 GB

IndraControl	CML45.1-3P	CML65.1-3P	CML75.1-3P
Remanent memory	256 kB		
S-RAM on board, battery-buf-fered	8 MB, optional	8 MB, optional	-
Removable storage	1GB (CF card)		
Ready contact	•	•	•
Interfaces			
Ethernet 10/100 MBit	•	•	•
Sercos III	•	•	•
CrossComm (C2C) Sercos III	○	○	○
Profinet I/O (controller/device)	•	•	•
Profibus DP (master/slave)	•	•	•
EtherNet/IP			
Master (scanner)	•	•	•
Slave (adapter)	•	•	•
USB	-	-	-
Inputs/outputs	8DI+8DO	8DI+8DO	8DI+8DO
I/O extension (Inline terminals)	Up to 64 bytes		
Connection for function modules	• Up to four modules can be connected		
Other			
Max. number of axes	32	64	64
Operating system	VxWorks		
Display	Diagnostics Display		
Supports Robot Control	Yes		

• Default function

○ Option

- Not available

Tab. 2-1: Technical data of the IndraMotion MLC based on the IndraControl L hardware

IndraControl	XM21	XM22	XM42	VPB 40.4
Processor (compatible)	Intel Atom, 600 MHz	Intel Atom, 1300 MHz	Core™ i3-6100U 2.3 GHz	Core™ i7-6820EQ 2.8 GHz
RAM	512MB		2GB	1 GB for the control

IndraControl	XM21	XM22	XM42	VPB 40.4
Remanent memory	128KB		4MB	1 MB
S-RAM on board, battery-buffered	-			-
Removable storage (SD card)	•			-
S-RAM on board, battery-buffered	-			-
Ready contact	-			-
Interfaces				
Ethernet 10/100/1000 MBit	•			•
Sercos III	•			•
CrossComm (C2C) Sercos III	○ (XM-Extension module XFE01.1-FB-01			-
Profinet I/O controller	○ (XM extension modules XFE01.1-FB-03)			○
Profinet I/O device	○ (XM extension modules XFE01.1-FB-03 or XFE01.1-FB-04)			○
Profibus DP master	○ (XM extension modules XFE01.1-FB-10)			○
Profibus DP slave	○ (XM extension modules XFE01.1-FB-10 or XFE01.1-FB-11)			
EtherNet/IP scanner	○ (XM extension modules XFE01.1-FB-03)			○
EtherNet/IP adapter	○ (XM extension modules XFE01.1-FB-03 or XFE01.1-FB-04)			○
USB Host/ Device	•			-
Inputs/outputs	-			-
I/O extension	Data amount up to 1 Kbyte with 63 devices			-
Connection for extension modules	Max. 3			Max. 4
Other				
Max. number of axes	40		99	99

IndraControl	XM21	XM22	XM42	VPB 40.4
Operating system	VxWorks			VxWorks
Display	-			Software IndraControl Systray
Diagnostic LEDs	•			Software IndraControl Systray
Operation mode switch	•			Software IndraControl Systray
Supports Robot Control	○			○

- Default function
- Option
- Not available

Tab. 2-2: Technical data of the IndraMotion MLC based on the IndraControl XM and IndraControl VPB 40.4 hardware

Comparison of technical data of the IndraLogic XLC hardware:

IndraControl	CML45.1		CML65.1		CML75.1	
	NP	3P	NP	3P	NP	3P
Processor (compatible)	AMD LX800 500 MHz		Intel Celeron M 1 GHz		Intel E3827 1.75GHz	
RAM	256 MB		512 MB		1024 MB	
Remanent memory	256 kB					
Removable storage (Compact Flash card)	1 GB					
Ready contact	●		●		●	
Interfaces						
Ethernet 10/100 MBit	●		●		●	
Sercos III	-	●	-	●	-	●
Profinet I/O	●	●	●	●	●	
Profibus DP	●	●	●	●	●	
EtherNet/IP						
Master (scanner)	●	●	●	●	●	
Slave (adapter)	●	●	●	●	●	
USB	-		-		-	
Inputs/outputs	8DI+8DO		8DI+8DO		8DI+8DO	
I/O extension (Inline terminals)	Up to 64 bytes					

IndraControl	CML45.1	CML65.1	CML75.1
Connection for function modules	• Up to four modules can be connected		
Other			
Max. number of axes	32	64	64
Operating system	VxWorks		
Display	Diagnostics Display		

- Default function
- Option
- Not available

Tab. 2-3: Technical data of the IndraLogic XLC

Communication interfaces in comparison:

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

- Default function
- Option
- Not available



For more information on the IndraLogic XLC/IndraMotion MLC systems, refer to the documentation "IndraLogic XLC IndraMotion MLC 14VRS System Overview" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

IndraControl L function modules

By connecting a function module to CML45, CML65 and CML75, the functionality of the control can be extended. Currently, the following function modules are available:

IndraLogic XLC:

- High-performance programmable limit switch PLS (CFL01.1-N1); with a sample rate of 125 µs and 16 outputs
- Fast I/O (CFL01.1-E2); 8 inputs, 8 outputs, 8 freely programmable I/Os
- Real-time Ethernet (CFL01.1-TP); Real-time Ethernet und Profibus DP master or slave functionality
- Safety CPU (CFL01.1-F1), Safety PLC control acc. to SIL3

IndraMotion MLC

- CrossComm Sercos II (CFL01.1-Q2); to establish an MLC cross link via Sercos fiber optic cable rings (single or double ring) to the IndraMotion MLC L45/L65/L75 equipped with onboard Sercos III interface
- CrossComm Sercos III (CFL01.1-R3) to establish an MLC cross link (C2C) via Sercos III
- Sercos II (CFL01.1-Q2); to connect Sercos II drives to the control equipped with onboard Sercos III interface
- High-performance programmable limit switch PLS (CFL01.1-N1) with a sample rate of 125 µs and 16 outputs
- Fast I/O (CFL01.1-E2); 8 inputs, 8 outputs, 8 freely programmable I/Os
- S-RAM module (CFL01.1-Y1) 8 MB memory extension, battery-buffered, to save RoCo projects
- Real-time Ethernet (CFL01.1-TP); Real-time Ethernet und Profibus DP master or slave functionality
- Safety CPU (CFL01.1-F1), Safety PLC control acc. to SIL3



For the project planning of the function modules, refer to [chapter 3.12 "Creating a function module" on page 121](#).

For more information on function modules, refer to the documentation "Rexroth IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Extension modules for IndraControl XM

Connecting an extension module to the IndraControl XM hardware extends the functionality of the IndraMotion MLC. Currently, the following extension modules are available:

- XFE01.1-FB-01: CrossComm Sercos III; to establish an MLC cross link (C2C) via Sercos III
- XFE01.1-FB-10: Profibus DP module. It can be configured as master or slave
- XFE01.1-FB-11: Profibus DP module. It can only be operated as Profibus DP slave

- XFE01.1-FB-03: RT-Ethernet module. It can be configured as Ethernet/IP scanner or adapter or as Profinet controller or Profinet device respectively
- XFE01.1-FB-04: RT-Ethernet module. It can be configured as Ethernet/IP adapter or Profinet device



For more information on the extension modules, refer to the operating instructions "IndraControl XFE01.1 Extension Modules", part no. [R911345570](#) and the project planning manual "IndraLogic XLC IndraMotion MLC 14VRS System Overview", chapter "Extension Modules for hardware basis IndraControl XM" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Accessories for the IndraControl VPB

Install extension cards in the IndraControl VPB to extend the functionality of the IndraMotion MLC VPB. Currently, the following extension cards are available:

- PFC01.1-FB-13 (RT-Ethernet and Profibus)
- PFC01.1-FB-01 (Sercos III)
- PFC01.1-SY-01: Safety module



For more information on the extension cards, refer to the operating instructions "IndraControl PFC01.1-SY-01 Safety extension card", part no. [R911373152](#) and "IndraMotion MLC IndraControl VPB", part no. [R911371306](#).

I/O periphery IndraControl L

The following bus systems are provided for the I/O extension of the IndraMotion MLC and IndraLogic XLC:

- Inline, Profibus, Sercos III, Profinet

The project planning of this hardware is described in

- Inline I/O - [chapter 3.13.2 "Creating Inline I/Os" on page 127](#)
- Profibus I/O - [chapter 3.13.3 "Creating Profibus I/Os" on page 134](#)
- Sercos III I/O - [chapter 3.13.5 "Creating Sercos III I/Os" on page 136](#)
- Profinet I/O - [chapter 3.13.4 "Creating a Profinet I/O Controller" on page 135](#)

Visualization devices

A variety of HMI devices are available for visualization.

IndraMotion MLC L45/L65/L75/XM21/XM22/XM42/VPB40.4 and IndraLogic XLC L45/L65/L75 support the following devices:

- IndraControl VCP - protocol: BRC symbolic via
 - Ethernet
 - Profibus DP
- IndraControl VEP - Ethernet via WinStudio to project the HMI
- IndraControl VR
- IndraControl VPP/VPB

2.2 Firmware

Compact Flash card IndraControl L/internal memory IndraControl XM/VPB

To operate the control on the basis IndraControl L45/L65/L75, a Compact Flash card with system firmware (runtime) is required.

The controls based on IndraControl XM and IndraControl VPB (only available for IndraMotion MLC) are provided with an onboard memory.

For all controls, the respective ROM is divided in three partitions:

Partition	Capacity				Description
	IndraControl Lxx	IndraControl XM2x	IndraControl XM4x	IndraControl VPB40.4	
USER partition	665MB	512MB	1728MB	2GB	User data (recipes, process data, etc.) is stored in this partition. The USER partition is accessed from the user program via the respective library functions (SysLibFile.lib, SysLibFileAsync.lib). The partition of the CF card of the IndraControl L is visible in Windows using standard card reader devices
SYSTEM partition	128MB	256MB	768MB	768MB	The system firmware (operating system, IndraLogic Runtime) is stored in this partition. Note: The SYSTEM partition may not be modified by the user
OEM partition	128MB	128MB	1024MB	1 GB	All application data is stored in this partition. The data is accessed via the "Load PLC program" function (refer to chapter 5.2.5 "Loading a PLC program to the control" on page 323)

Tab. 2-4: Partitions of the IndraControl ROM

Application data on the OEM partition is stored on all controls in the following folder and storage structure:

Folder	Description
/ProjectDataProtected/	In this folder, all application data of the XLC/MLC system, which may not be deleted after reset to delivery state (parameter C-0-1019: "Command: Restart or reset to default") or when deleting the OEM partition (parameter C-0-1006: "Command: Delete files on OEM partition"). These are for example the Ethernet settings for the controls based on IndraControl XM/VPB
/ProjectData/	All application data of the XLC/MLC system is stored in this folder. Note: This folder is deleted with all its subfolders when resetting to delivery state (parameter C-0-1019: "Command: Restart or reset to default") or when deleting the OEM partition (parameter C-0-1006: "Command: Delete files on OEM partition")

/ProjectData/bundles/	The bundles created by the customer are stored in this folder
/ProjectData/CertificateStore/	The certificates for OPC-UA are stored in this folder (only for controls based on IndraControl XM/VPB)
/ProjectData/PAR/	The parameter data of memory type "Flash" of the XLC/MLC system is stored in this folder
/ProjectData/PLC/	PLC application data is stored in this folder. These are configuration files or boot applications
/ProjectData/TMP/	Temporary data is stored in this folder

Tab. 2-5: Folder structure of the OEM partition

IndraContr ol	Available RAM (MB) after CleanUp*	Non-vola- tile memo- ry Motion (kB)	Non-vola- tile memo- ry PLC (kB)	Flag (KB)	Total RAM require- ment per IEC appli- cation	Compact Flash / SD card (MB)/HDD	User parti- tion (MB)	System partition (MB)	OEM parti- tion (MB)
CML L45	~125	~128	~128	64	Dynamic (64KB up to max. available RAM)*	1 GB	665	128	128
		~256							
CML L65	~132	~128	~128	64	Dynamic (64KB up to max. available RAM)*	1 GB	665	128	128
		~256							
CML L75	~251	~128	~128	64	Dynamic (64KB up to max. available RAM)*	1 GB	665	128	128
		~256							
XM21 / XM22	~126	~64	~64	64	Dynamic (64KB up to max. available RAM)*	1 GB	558	127	127
		~128							
XM42	~1192	~2046	~2043	64	dynamic (64KB up to max. available RAM)*	4GB	1732	768	1024
		~4089							
VPB40.4	~370	~1024	~1024	64	Dynamic (64KB up to max. available RAM)*	4 GB on HDD	2000	768	1000
		~2048							

*

Amongst others, the available RAM depends on the Motion configuration

Tab. 2-6: Memory distribution/Memory requirement of the IndraLogic XLC/IndraMotion MLC

Behavior while updating/upgrading	Generally applies: • Update means updating the system firmware in a version • Upgrade means updating the system firmware to a new version • Files stored on the USER partition always remain in case of an update or an upgrade • Files stored in the folder /ProjectDataProtected/ on the OEM partition always remain in case of an update or an upgrade Update: • Only the files on the SYSTEM partition are replaced • All files on the OEM partition and on the USER partition remain Upgrade: • The files of the SYSTEM partition are replaced • The folder /ProjectData/ on the OEM partition is deleted including all its subfolders • Some system-relevant files are deleted in the USER partition (e.g. Diagnostic log, core dumps) • All nvRAM data is deleted
Update options	To update the system firmware, use the IndraWorks firmware download function (refer to chapter 4.4.9 "Firmware management" on page 253).
License information on the firmware	Upon the state of delivery, license information (e.g. on Open Source components) can be retrieved from the control. Therefore, a(n) (anonymous) connection is established to the control either using the IndraWorks file browser or any FTP client. The license information can then be retrieved from the directory /USER/licenses. License information is stored there as .zip archive.

2.3 Software

IndraWorks	The "IndraWorks Engineering" software is used to commission and project the control system. The software consists of the following components: • IndraWorks: Project planning, configuration • IndraLogic: PLC programming • IndraWorks HMI: Visualization and user interface • IndraWorks WinStudio: Project planning tool to create user screens for the IndraWorks HMI
	All components are automatically installed. IndraWorks WinStudio is installed as "Lite" version with 500 variables.
PLC functionality	In addition to the standard IndraLogic libraries, libraries with PLCopen function blocks and technology functions are available: • PLCopen function blocks • The AxisInterface facilitates the access to axes. The AxisInterface provides a structure-based interface (library: ML_TechInterface.library) • The Generic Application Template, GAT, (see GAT), enables the simple and fast development of clearly structured Logic and Motion applications The following variants are provided for the target systems IndraLogic XLC/IndraMotion MLC: – GAT^{compact}: For simple applications with few axes

- GAT with central operation mode SFC: for flexible modular machine concepts and additionally (only IndraMotion MLC)
- GAT with decentral operation mode SFC: For flexible, modular machine concepts (only IndraMotion MLC)
- Technology-based function blocks extend the basic functionality of the target system and provide application-specific functionalities such as cam function blocks, programmable limit switch, PID controller and safe key transmission (library: ML_TechMotionBase.library)
- Technology function blocks extend the basic functionality and provide application-specific functionalities like e.g. FlyingShear, CrossCutter, RegisterController etc. (library: ML_TechMotion.library)
- Functions supporting hydraulic components provide the following tools:
 - Sequential programming for motion sequences
 - Force-controlled traversing and adjustment of several hydraulic cylinders

Additional licenses are provided for:

- IndraWorks CamBuilder to create and edit cams and MotionProfiles (FlexProfile)
- IndraWorks WinStudio with a higher number of usable variables and arrays
- Function for the register control with integrated HMI support



For more information on the IndraLogic XLC/IndraMotion MLC systems, refer to the documentation "IndraLogic XLC IndraMotion MLC 14VRS System Overview" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Free PLC libraries and PLC libraries by third-party providers:

- OSCAT ("Open Source Community for Automation Technology"): This open source library includes several functions in the fields of automation technology und building automation.

For the OSCAT library, refer to www.oscat.com.



Note that these are not Bosch Rexroth products. Therefore, we are not liable for completeness, functionality and operating safety and we do not provide any support for these libraries.

3 Commissioning and operation

3.1 General information

This section describes the commissioning of the hardware, the basic functions of the IndraWorks Engineering environment and general procedures.

For the PLC programming using IndraLogic, refer to the documentation "IndraWorks 14VRS IndraLogic 2G PLC Programming System" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

3.2 IndraLogic XLC/IndraMotion MLC – Basic sequences, general information

Working with IndraWorks and an IndraLogic XLC/IndraMotion MLC requires a functioning hardware with compatible firmware components.

Also refer to the documentation "IndraMotion MLC 14VRS First Steps" and "IndraLogic XLC 14VRS First Steps" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Thus, the following steps are recommended:

- Commissioning as required for the hardware used
 - [chapter 3.3 "IndraLogic XLC/IndraMotion MLC L45/L65/L75 – Commissioning" on page 30](#)
 - [chapter 3.4 "IndraMotion MLC XM – Commissioning" on page 43](#)
 - [chapter 3.5 "IndraMotion MLC VPx – Commissioning" on page 75](#)

Then prepare the IndraWorks interface and perform the project creation steps in offline mode.

First, the offline activities:

- [chapter 3.6 "Installing and starting IndraWorks" on page 103](#)
- [chapter 3.8 "Creating a project" on page 107](#)
- [chapter 3.10 "Creating a control" on page 113](#)
 - and if required
 - [chapter 3.13.1 "Creating Onboard I/Os" on page 124](#)
 - [chapter 3.13.2 "Creating Inline I/Os" on page 127](#)
 - [chapter 3.13.3 "Creating Profibus I/Os" on page 134](#)
 - [chapter 3.13.4 "Creating a Profinet I/O Controller" on page 135](#)
 - [chapter 3.13.5 "Creating Sercos III I/Os" on page 136](#)
 - [chapter 3.16 "Creating a kinematics" on page 153](#)
 - [chapter 3.12 "Creating a function module" on page 121](#)

Omit individual points if they are not necessary in the specific case. There is a subsequent transition to online mode comparing the project parameters with the parameters in the control and in the drives.

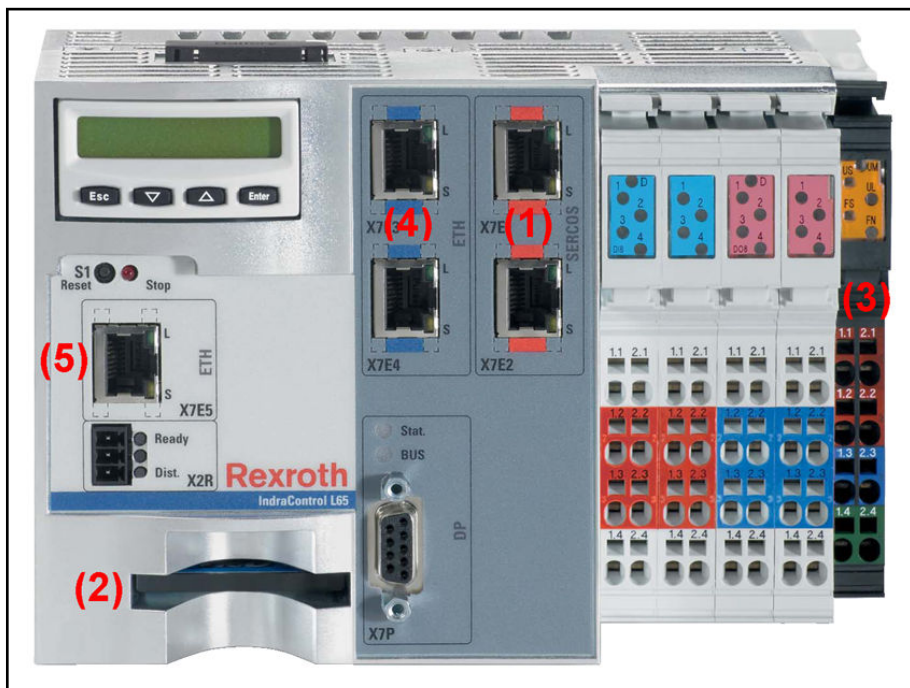
3.3 IndraLogic XLC/IndraMotion MLC L45/L65/L75 – Commissioning

3.3.1 General information

This section describes the preparation of an IndraControl L-based control for the configuration using the project planning and programming software "IndraWorks Engineering".

3.3.2 Connections of the control

Ports



- ① Sercos III ports
- ② CF card
- ③ Voltage supply
- ④ Connections for Ethernet IP, Profinet, Standard Ethernet (only IndraLogic XLC/IndraMotion MLC L45/L65/L75)
- ⑤ Standard Ethernet and Ready contact connection

Fig. 3-1: Example: CML65.1 hardware for IndraLogic XLC/IndraMotion MLC applications

3.3.3 Response of the ready contact

The Ready contact is opened under the following conditions:

- Switching to CP0
- Fatal system error (F9)

The Ready contact is closed under the following conditions:

- Switching to CP4



The Ready contact is also opened in case of special hardware problems (e.g. falling below the thresholds of supply voltage or internal voltages).

For more detailed information, refer to the project planning manual of the respective control.

3.3.4 Control startup

Requirements for the initial startup:

- Bridge the Sercos III ports X7E1 and X7E2 ① with an Ethernet cable (elimination of possible errors in the Sercos bus)
Omit this step for controls without Sercos interface
- Insert the CF card with the IndraLogic XLC/IndraMotion MLC firmware into ②
- Connect network cable with connection to the workstation at ⑤
- Provide supply voltage at ③

After switching on the supply voltage, the control runs up to the diagnostic display **BB STOP**.



The first time the control is switched on or after a Compact Flash replacement, an update of the Sercos FPGA can be required on the control. Switching off the voltage supply during the update can result in damage to the CML control. The operator is should therefore execute the update from version 14V22.

1. The diagnostics **HW-INIT?** is displayed on the CML. Only when pressing the “Enter” key on the display of the control, the FPGA is updated. During the update, the control displays **HW-INIT!**. The message **PWRCYCLE** has to be displayed once the update is completed. After switching the voltage supply of the control on and off again, commissioning of the control can be continued.
2. If the voltage supply of the control is switched off during a pending diagnostics **HW-INIT?**, the error message **F90B0083** is displayed when switching the control on the next time. The diagnostics indicates that an FPGA update has previously been rejected. Please do not switch the control off and on again! Upon the next startup, the **HW-INIT?** diagnostics is generated. Proceed as describe under 1.

WARNING

CML control shows HW-INIT! on the display

As long as this message is displayed, the internal logic is updated.

This process can be required during initial commissioning or during a firm-ware download.

If the voltage supply of the CML control is switched off in this state, the control is damaged.

Wait in this state until **PWRCYCLE** is displayed.

3.3.5 Operating the control display

The control display indicates the control status, the network setting configuration and the single command triggering.

The control status is displayed after startup. If there is no error, the PLC status (STOP or RUN) and Sercos bus status (P0, P2 or BB) are displayed. If an error is pending, the error number is alternately shown with a brief error description. Press <ESC> on the display to acknowledge the error.

Press <Enter> on the display to go to the control menu. The buttons on the control panel have the following functions:

- Enter** Selects the menu item currently shown or goes one level deeper into the menu.
- ESC** Exits a menu item or goes one level up in the menu. Once the uppermost level of the menu is reached, exit the menu system with <Esc> and the status display becomes active again.
- Arrow down** Shows the next entry in the menu level.
- Arrow up** Shows the previous entry of the menu level.

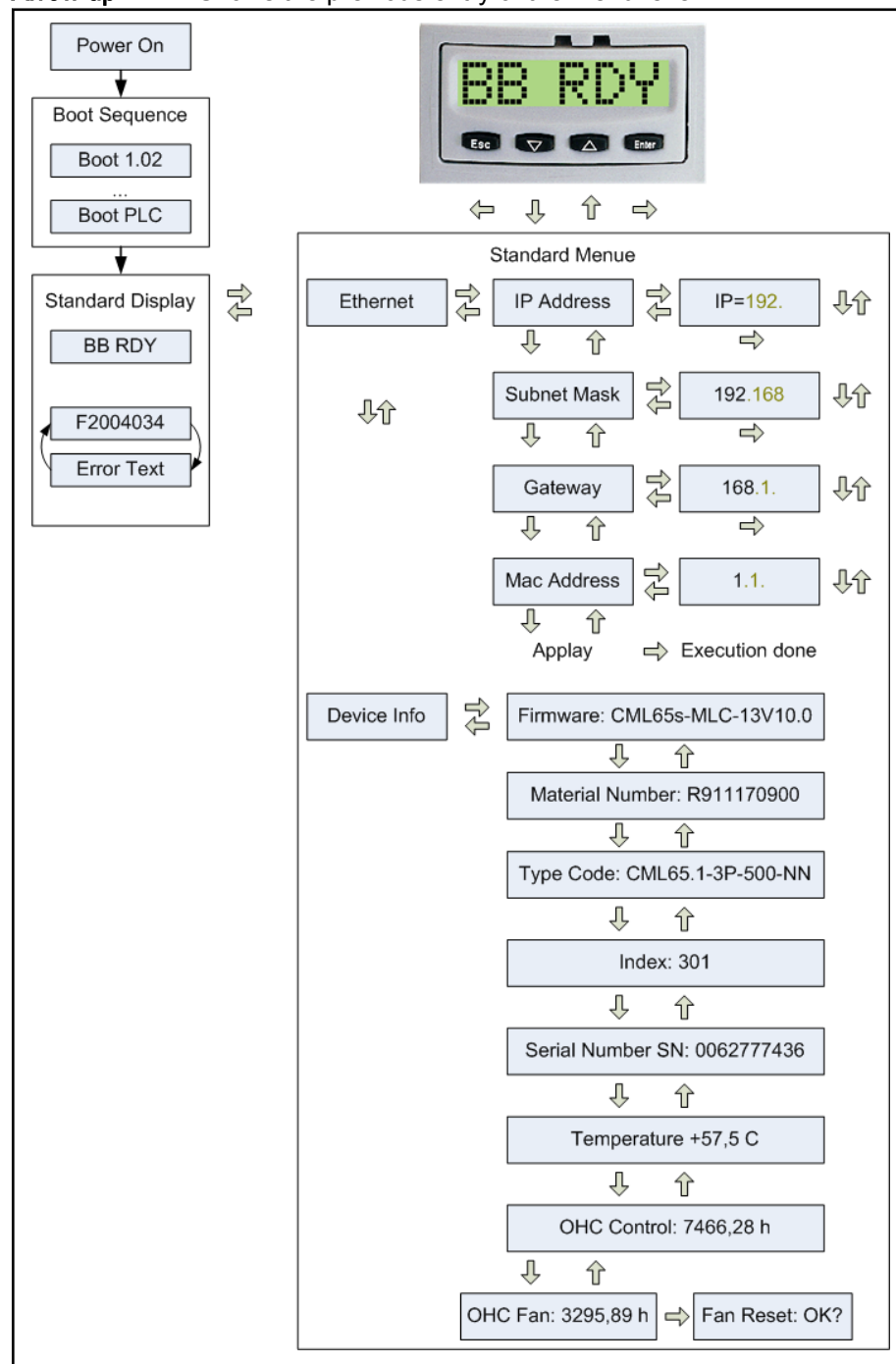


Fig. 3-2: Diagnostics and operation of the IndraLogic XLC/IndraMotion MLC display

Press <Esc> and <Enter> simultaneously on the control panel of the control for eight seconds to switch to the advanced (extended) mode. This shortcut enables the advanced functionality of the control display and is to be used by trained staff only.

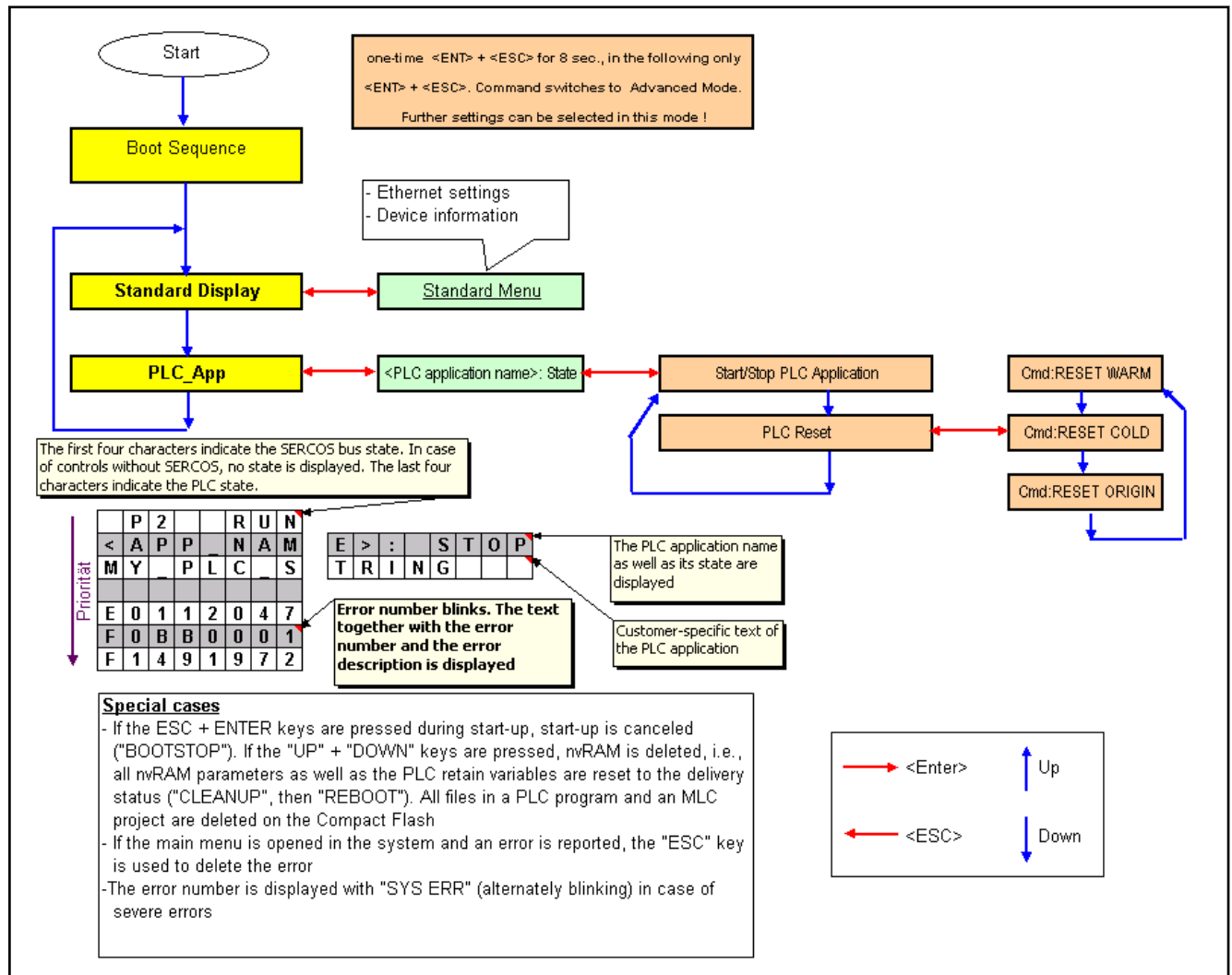


Fig. 3-3: Menu in advanced (extended) mode

3.3.6 Setting the IP address

IP address - Initial setting

Before the control can be connected to the programming device via Ethernet (e.g. notebook), provide the control with an IP address valid for the network.

State upon delivery

The following addresses are set on the control upon delivery:

Address	Initial value
IP address	192.168.001.001
Subnet mask	255.255.255.0
Standard gateway	192.168.001.001

Tab. 3-1: Initial values

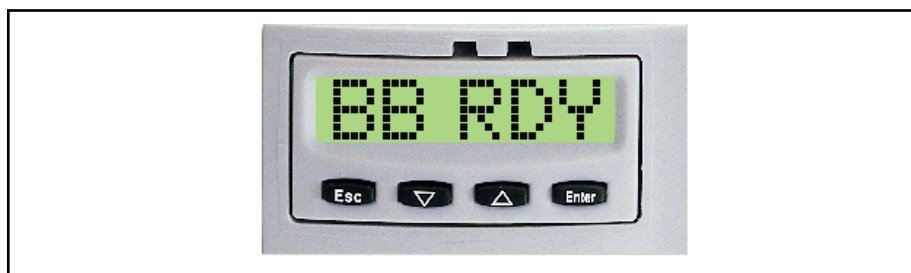
Set the IP address and subnet mask of a control via the four operating keys of the control display (see fig. 3-4 "Display with four operating keys (standard display)" on page 34). Afterwards, connect the control to the PC via the company network or via cross-over cables. The cross-over connection re-

quires no address change in the control. Only the programming device address has to be adjusted.



In order to set up and operate an IT-secure system, the network properties of the components used have to be known. If the control is connected to the company network, observe the instructions of the network administrator. For useful information on the network security with regard to Rexroth controls, refer to "Rexroth IndraControl Security Guideline".

In the **BB STOP** state, retrieve and set the IP address and the subnet address and determine the current firmware release.



- Esc** One level back; discard a change
- v** Downward menu navigation or decrement value
- ^** Upward menu navigation or increment value
- Enter** Open the next menu level or confirm the entry

Fig. 3-4: Display with four operating keys (standard display)

The following figure shows the operating menu of the display based on the standard display:

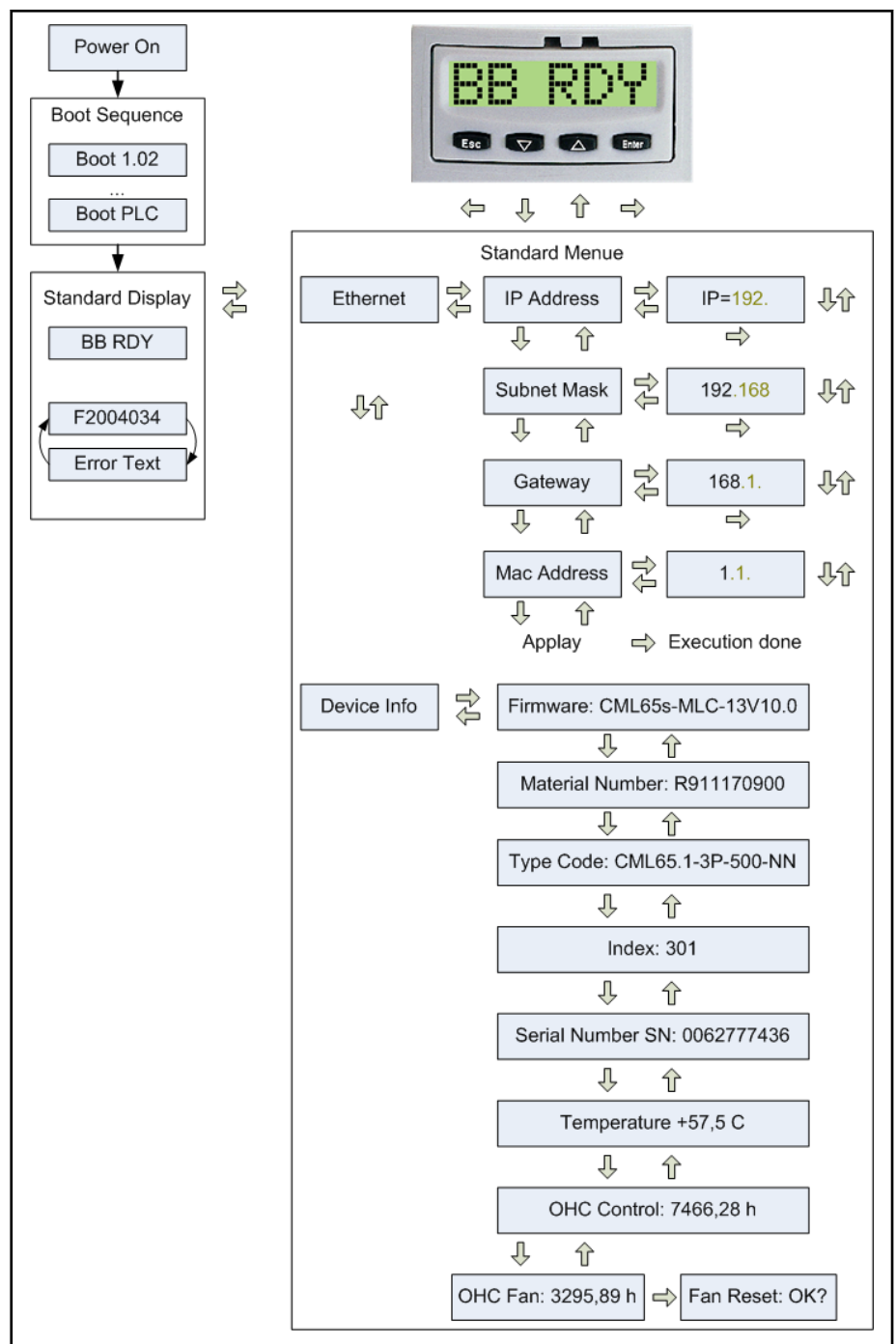


Fig. 3-5: Standard menu overview to operate display and keyboard

1. Move with <Enter> from the standard display **BB STOP** to the **ETHERNET** display.
2. Press <Enter> again to go to the **IP address**.
3. Press <ENTER> again to change the preset address (change the numerical value with <DOWN> or <UP>; continue with <Enter>). The individual blocks flash to visualize the change.
4. After the fourth block, press <Enter> to trigger the query: "OK : ?. Confirm with <Enter>. The change is applied and the **ETHERNET** display opens. If <Esc> is pressed during the change, the change is discarded!

5. Change the subnet mask and, if necessary, the gateway address analogously.

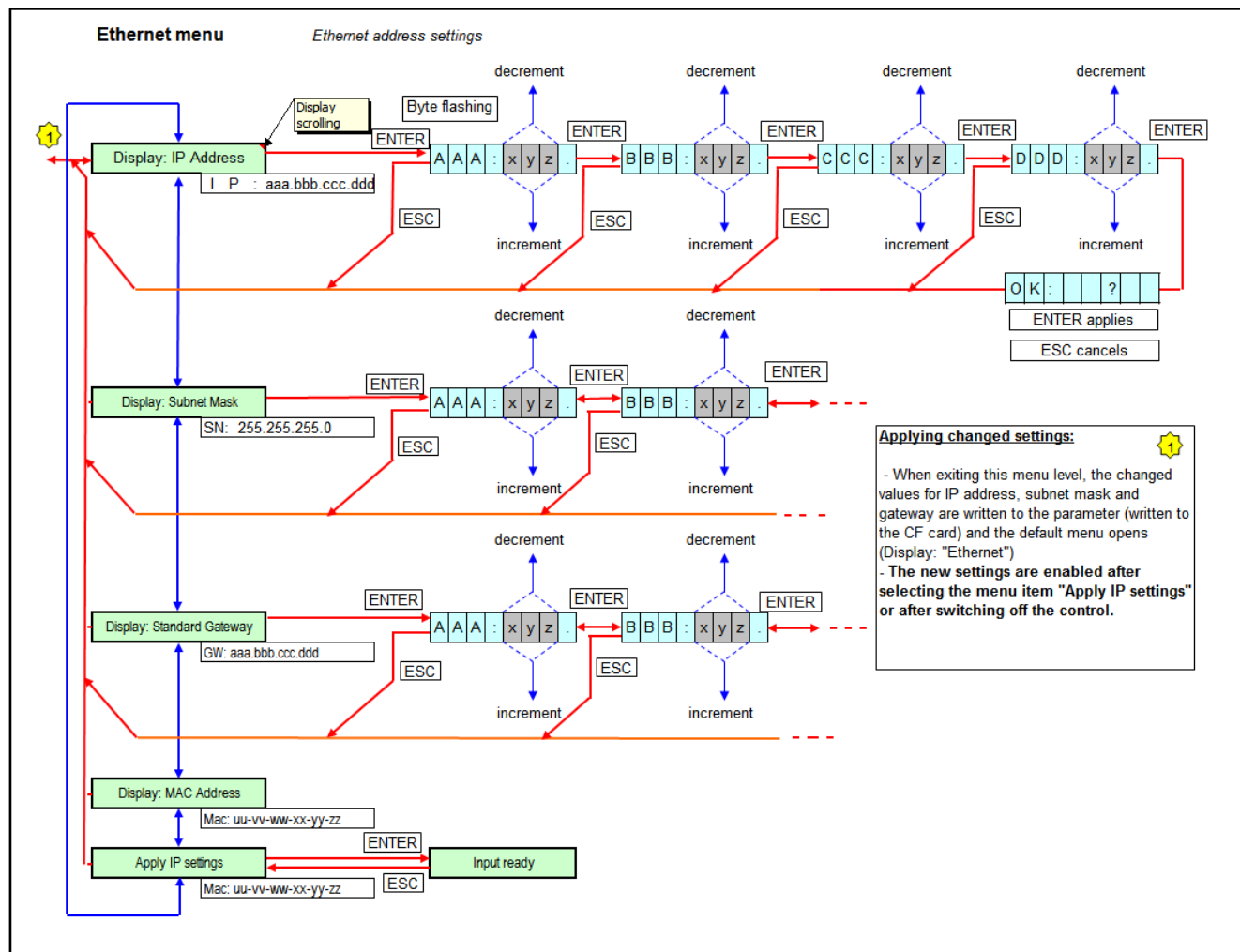


Fig. 3-6: Ethernet menu



An address change is applied only after the "Apply IP Settings" menu item was enabled or the voltage was switched off and back on again (boot). Up to then, the new Ethernet settings are displayed although the previous values are still active.

Identify the MAC address according to the menu overview. Do not modify the MAC address.



After setting the IP address and the subnet mask, they are supposed to correspond to the requirements for future use.

Behavior in case of IP address conflict

The same IP address is not to be provided to two devices in one network. If this is the case, the control responds as follows:

1. If, when booting the control or after reconfiguring the IP address, it is determined that the same IP address is already used, the control stops the communication on the engineering port. A corresponding error message is displayed.

2. If the control detects at runtime that its own IP address is used by another device, it waits for 10 seconds whether the second device stops the communication. A corresponding warning is shown on the display of the control during this period. If the communication is not stopped after 10 seconds, the control stops its communication via the engineering port. A corresponding error message is displayed.

If the control stops the communication via the engineering port, it is not reachable via Ethernet until next restart or until a new IP address is specified via the display. In this case, there is no communication between IndraWorks and the control.

Network settings via the configuration file

Some network settings (IP address of control, subnet mask and standard gateway) can be changed via a configuration file.

The configuration file has to be in ASCII format and the file name has to be "Config.txt".

The "Config.txt" file is located in the USER partition of the Compact Flash card. The Compact Flash card can be accessed with a standard card reader. The configuration file "Config.txt" can be edited with a text editor.

The entries for IP address, subnet mask and standard gateway can be modified. Use the "Config.txt" template and change the desired values in that template.

Do not change the spelling of the keywords! The syntax of the values has to comply with the conventions.

The control applies the changed values after a restart. If the data is syntactically incorrect, the control does not apply the modified values but accesses the latest data saved.

Network parameters upon delivery

```
[ethernet]
ip_address 192.168.0.65
subnet_mask 255.255.255.0
gateway 0.0.0.0
```



The Ethernet settings (ip_address, subnet_mask und gateway) may not contain leading zeroes.

Cross-over connection

A cross-over cable provides a special coupling between an IndraLogic XLC/ IndraMotion MLC and a PC. In this case, adjust the IP address of the PC and its subnet mask to the IndraLogic XLC/IndraMotion MLC according to the operating system of the PC (e.g. for Windows XP: **Start ► Settings ► Network Connections ► LAN Connection ► Properties ► Internet Protocol TCP/IP ► General**).

If the subnet mask is the same, set an (adjacent) IP address on the PC:

Address	Control	Notebook (XP) before	Notebook adapted
IP address	11.105.74.212	IP address	11.105.74.213
Subnet mask	255.255.255.128	Automatically	255.255.255.128
Standard gateway	Neutral	Obtain	Not set

Tab. 3-2: Setting when connecting via cross-over

3.3.7 "BOOTSTOP" menu

When reaching the "BOOTSTOP" menu, the control startup of the IndraLogic XLC/IndraMotion MLC is stopped. Different commands can be executed and the control startup can subsequently be continued without the control being switched off and on.

After the control (CMLx5) is switched on, press the outer buttons (<Esc> and <Enter>) located below the display and when "BOOT 1.02" is displayed, keep them pressed until "BOOTSTOP" is displayed.



If the control was switched on again after a SysError, data is automatically backed up. During this data backup, the control display shows the text "ExcData".

It is possible to go to the "BOOTSTOP" menu before.

Press (at least 3 seconds) individual keys or shortcuts to open the available commands.

Press "Enter" to start a selected command.

Press <Esc> to cancel a selected command. The display returns to the "BOOTSTOP" menu.

If a command is executed, "SUCCESS" or "ERROR" is displayed for three seconds. The display returns to the "BOOTSTOP" menu if the executed command does not cause an automatic control reboot.

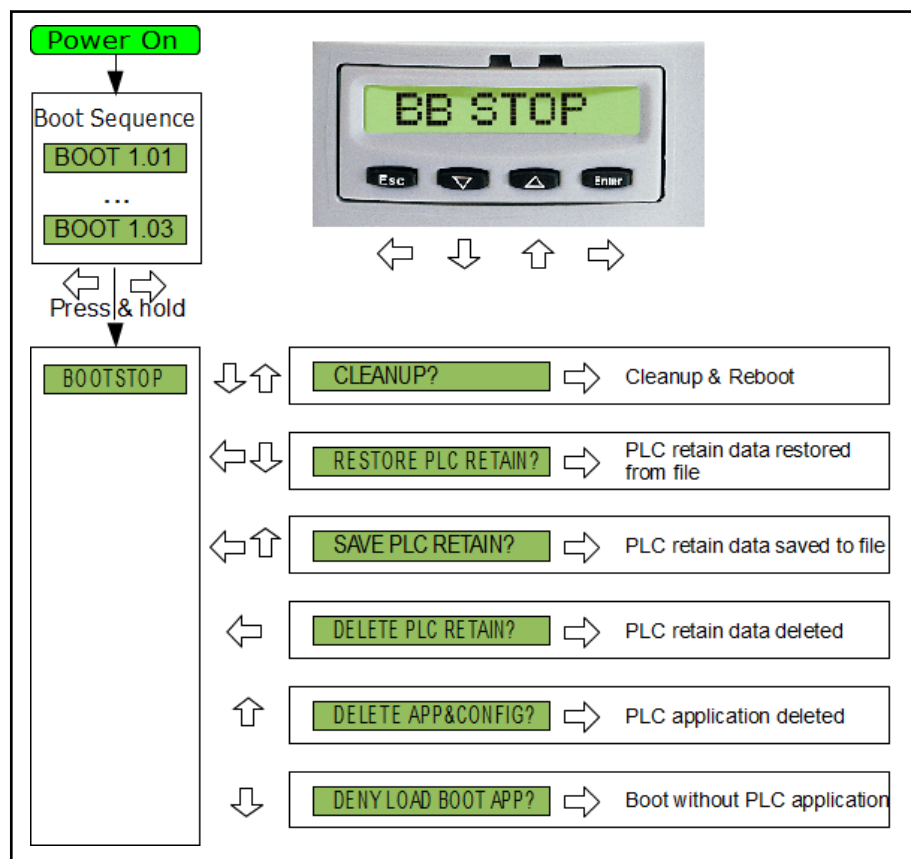


Fig. 3-7: "BOOTSTOP" menu structure

The following commands are available:

- **Continue system startup**
Keys: <Esc>, <Enter>
Command display in the display: "CONTINUE STARTUP?"
The system continues the control boot
- **Reset control**
Keys: <Up>, <Down>

Command display in the display: "CLEANUP?"

The control is reset. Parameterizations, boot project files as well as the complete NV RAM memory of the control are deleted (see [chapter 3.3.9 "Deleting control memory" on page 40](#))

- **Backing up retain and persistent retain memory of the PLC**

Keys: <Esc>, <Up>

Command display in the display: "SAVE PLC RETAIN?"

The complete PLC memory (retain, persistent-retain) is saved in the "PlcRetain.save" file on the storage medium

- **Restoring PLC retain and persistent retain memory**

Keys: <Esc>, <Down>

Command display in the display: "RESTORE PLC RETAIN?"

The complete PLC memory (retain, persistent retain) is restored from the "PlcRetain.save" file



To restore the retain memory, it has to be loaded subsequently with the corresponding boot application. Otherwise, the loaded boot application is switched to the "STOP" state with the exception "Retainmismatch". Execute a "cold reset" or a "reset origin" to force the initialization of the retain or persistent-retain data.

- **Deleting retain and persistent-retain memory of the PLC**

Key: <Esc>

Command display in the display: "DELETE PLC RETAIN?"

The complete PLC memory (retain, persistent-retain) is deleted. When loading a boot application subsequently using a retain or retain-persistent memory, it is switched to the "STOP" state with the exception "Retainmismatch". Execute a "cold reset" or a "reset origin" to force the initialization of retain or persistent-retain data and to allow the application start

- **Deleting the PLC application file and the configuration file**

Key: <Up>

Command display in the display: "DELETE APP& CONFIG?"

When deleting the application file and the PLC configuration file on the data carrier, no PLC application can be loaded at next control reboot. This command can be useful if an exception occurs in the initialization part of a PLC application (e.g. FB_Init) that will cause a SysError (F9 error)

- **Deny loading PLC boot application(s)**

Key: <Down>

Command display in the display: "DENY LOAD BOOTAPP?"

At next control boot, a boot application (application files and valid entry in the PLC configuration file) on the storage medium is not loaded. This command can be useful if a SysError (F9 error) occurs when booting the control. If this error occurs in the PLC initialization task "StartTask", loading the boot application can be denied by this command to check whether the control boot is successful. If a SysError occurs in the "Start-Task", it is not caused in the boot project, but in the PLC initialization. Contact the Bosch Rexroth Support

3.3.8 Response in case of a fatal exception (SysError)

If a SysError (F9 error) occurs, provide troubleshooting information as follows.

If the error display in the control display flashes (e.g. "Sys-Err F9240001 BlkDrvUd"), switch off the control and switch it on again.

After boot phase 1.04, "ExcData" is shown in the control display. All required files are collected during this phase and saved in the "ExcData" folder on the USER partition of the CF card.

Booting the control continues.

If no errors occurred during control startup, the backed up files can be loaded from the "ExcData" folder to the system partition via FTP by the control and provided to the Bosch Rexroth Support for troubleshooting purposes.

The application can be subsequently loaded and started via the advanced display menu.

If the control startup results again in a SysError, go to the "BOOTSTOP" menu after switching off and on and enable the "Deny load boot application(s)" option.

If the startup is now trouble-free, the error cause is in the PLC boot project. For troubleshooting, load the "ExcData" folder to the user partition using the control and forward it together with the IndraWorks project archive to the Bosch Rexroth Support.

If the startup results again in a SysError, delete boot application and PLC configuration via the "BOOTSTOP" menu. After startup, the PLC application is applied to the control. Retain and persistent data are initialized again.

If this is also not successful, reset the control to delivery state. Start "CLEAN-UP" via "BOOTSTOP" menu (see [chapter 3.3.9 "Deleting control memory" on page 40](#)).

Load the control configuration and the PLC application again to the control. Retain and persistent data are initialized again.

3.3.9 Deleting control memory

From previous use, the control can contain old program components, parameterizations and PLC data that are removed in this step by clearing the memory.



Deleting the memory is only mandatory after changing the version of the control firmware. Generally, the control deletes immediately upon the first startup of the changed systems. For a release or patch, the existing user data remains in the new environment.

When using the function module as C2C interface (control link), consider the note on parameter "C-0-0040, sercos local and function module bus, command configuration".

With brand-new controls, this step can be omitted.

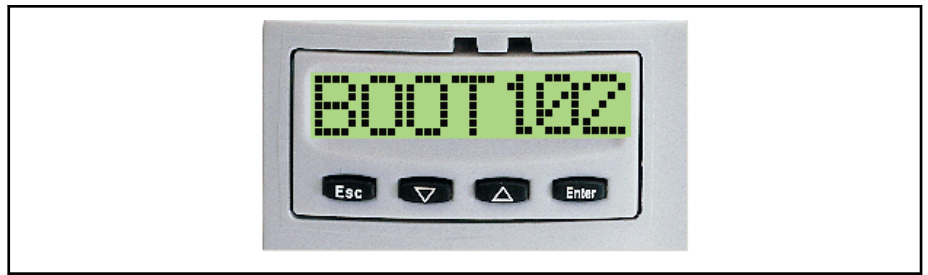


Fig. 3-8: Rebooting the control

1. After switching on the control, press both the outer buttons <ESC> and <Enter> below the display and keep them pressed until **BOOTSTOP** is displayed.
2. Press both the inner buttons.
CLEANUP? is displayed and the buttons can be released.
3. Press <Enter>.

CLEANUP, **SUCCESS**, **REBOOT**, **StartUp** are subsequently shown in the display.

The control runs up to **BB RDP**, the memory is cleared, the Motion components are ready for operation and the PLC components in ready for operation. No valid PLC application is loaded.

3.3.10 Locking display keys

To protect the control, lock the display keys to impede unauthorized operating access.

Thus, set bit 13 to 1 in the parameter "C-0-0036, Control configuration".

The following operating actions using display keys are then locked:

- Entering the BOOTSTOP menu at control startup
- Entering the standard menu
- Entering the "Advanced Mode" for PLC applications
- Error Clear

If a fatal exception (SysError) occurs when operating the control, the following operating actions are temporarily permitted upon next startup:

- Entering the BOOTSTOP menu

Apart from locking the operation mode switch, bit 12 in the parameter C-0-0036 can be set to 1 to lock the default procedure of the control via the parameter "C-0-1019 Command: Restart and reset to default".

For more information, refer to the parameter description of the parameter "C-0-0036, Control configuration".

3.3.11 Generating a core dump

Core dump refers to the backup of the complete RAM on the CF card of the control. This is only required for certain errors and requested by the support.

The control triggered a SysError. The control display shows a "SysError" alternating with the error code.

1. Initiating a core dump.

Press <Up> and <Enter> simultaneously for at least 5 seconds to generate a core dump.

The control reboots automatically after a core dump is initiated.

2. Core dump backup.

The core dump is stored on the CF card on the /ata0b/ partition after reaching the phase "BOOT1.04". Note: Core dumps already stored in the partition /ata0b/ are overwritten without prompt! The archiving progress is shown on the display.

After a successful core dump backup, "COREDUMP FINISHED" is displayed and booting is paused.

If the core dump backup was not successful, "COREDUMP FAILED" is displayed and booting is paused.

3. Control restart.

Irrespective of whether the core dump backup failed or was finished successfully, restart booting with <Esc> to initialize the control again.

The control boots.

4. Core dump reading.

The previously generated core dump can now be retrieved via the IndraWorks File Explorer or an FTP client (**Set FTP transfer to Binary mode**). The file name is "vxcore1" and can be found on the /ata0b/ partition. It is also reasonable to back up the files "ExcLog.dat" and "ExcLog.bak".

3.3.12 Adding the Sercos bus



This section is only relevant for controls with onboard Sercos III port.

The bridge suggested in section "[Ports](#)" on page 30 was used instead of the Sercos bus and is now replaced by the bus.

The following prerequisites are required:

- every single drive in the ring has the same current firmware (MPH/MPB, "Synchronous operation" function package or HNC3x, "Servo package" function package)
- each address is only used once
- the wiring is correct

The individual drives are automatically synchronized with the master baud rate (of the control).

After switching the control off and back on, **BB Stop** should be reached for the control and without power on **BB** for the drives.

3.3.13 Replacing hardware

Target Replacing the IndraLogic XLC/IndraMotion MLC hardware. Transferring project data and firmware from one control hardware to another using a CF card.

Procedure It is assumed that the control runs in **BB RUN** with active axes. The following steps are required:

1. Switch off the control, replace, wire the new control. Apply any present function modules and the Inline bus.
2. Insert the CF card of the old control into the new control.
3. Switch on the control.

After switch-on, the control hardware detects the new CF card.

The display of the control shows "A0200017, Hardware changed; Restoring NVRAM".

The control runs until **BB Run**. That depends on the setting of "C-0-0450, startup target mode of the control".

3.4 IndraMotion MLC XM – Commissioning

3.4.1 Commissioning steps

To commission the device, proceed as follows:

1. Mount the control.

For details, refer to the operating instructions "IndraControl XM21, XM22 controls" (part no. [R911340667](#)) and "IndraControl XM42 Controls" (part no. [911345566](#)).

2. Connect power supply to the XD1 connection of the control.

For details, refer to the operating instructions "IndraControl XM21, XM22 controls" (part no. [R911340667](#)) and "IndraControl XM42 Controls" (part no. [911345566](#)).

3. Switch on control → Initial firmware starts.

Refer to [chapter 3.4.11 "Initial firmware" on page 56](#).

4. Connect the project planning PC to the control via XF5 or XF31.

5. Use the commissioning tool "IndraControl First Touch" to make the respective network settings (IP address, subnet mask, gateway address) for the XF5 connection.

Refer to [chapter 3.4.4 "Setting the IP address for the XF5 port" on page 47](#).

6. Create IndraWorks project with a control on the basis of IndraControl XM.

The project planning and programming software "IndraWorks Engineering" has to be installed in the system variant "IndraWorks ML*" on the project planning PC.

Refer to [chapter 3.8 "Creating a project" on page 107](#) and [chapter 3.10 "Creating a control" on page 113](#).

7. Load the system firmware to the "IndraControl XM" control using the project planning and programming software "IndraWorks Engineering".

NOTICE

Control malfunctions due to control switch-off during initialization

Note that hardware is initialized after the system firmware installation and the subsequent reboot. Wait till completion. Do **not** switch off the control. This procedure has to be completed. Subsequently, continue commissioning.

3.4.2 Notes on the initial/system firmware

General information

Two operating states are available for the IndraControl XM/VPB controls.

Initial firmware

The IndraControl XM/VPB controls are always provided with a system-independent **initial firmware** ([chapter 3.4.11 "Initial firmware" on page 56](#)) upon delivery. This initial firmware provides the basic functions to manage the con-

trol. The operation mode switch SF1, the status LEDs and the integrated browser-based software **IndraControl First Touch** (chapter 3.4.15 "IndraControl First Touch" on page 62) are provided as interface.

Procedure to install the MLC system firmware:

1. Create a project in IndraWorks based on the respective target control.
2. Perform a connection test to the control.
Call: Go to the context menu of the control in the Project Explorer **Properties**, tab "Hardware/communication" Connection test "**Execute**".
3. If the connection test was successful, open the firmware management. To open the firmware management, go to the context menu of the control and load the firmware version to the control.
→ Reboot the control and the system firmware starts.

MLC system firmware

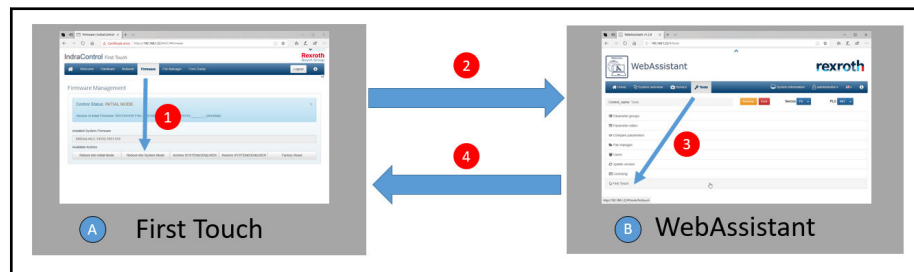
The MLC system firmware includes all functions of the Motion Logic control. The browser-based software "WebAssistant" or its predecessor "IndraMotion Service Tool" is integrated for commissioning and diagnostic purposes. The engineering software IndraWorks is used to program the control.



Up to the IndraMotion MLC 14V20, the integrated browser-based software "IndraControl First Touch" was included with limited functionality.

Toggling between the initial firmware and the MLC system firmware

To toggle from the MLC system firmware to the initial firmware, e.g. to create or restore an archive of the control partitions, go to the WebAssistant and select the command **First Touch** in the **Tools** tab. The system firmware is closed and the initial firmware is started.



A Initial firmware
B MLC system firmware

Fig. 3-9: Toggling between the initial firmware and the MLC system firmware

Toggling between the MLC system firmware and the initial firmware (First Touch)

Prerequisite: The MLC system firmware is installed on the control, refer to "Procedure to install the MLC system firmware:" on page 44

1. Start the commissioning tool "WebAssistant" (B) and open the "Tools" tab.
2. Execute the command "First Touch" ③.
→ The command stops the MLC system firmware and starts the initial firmware ④.

Toggling between the initial firmware and the MLC system firmware (WebAssistant)

Prerequisite: The MLC system firmware is installed on the control, refer to "Procedure to install the MLC system firmware:" on page 44

1. Start the commissioning tool "First Touch" (A) and open the "Firmware" tab.
2. Execute the command "Reboot into System Mode" ①.
→ The command stops the initial firmware and starts the MLC system firmware ②.



No user data is lost when toggling from the initial firmware to the MLC system firmware and vice versa. An exception is the reset to its delivery state using the "Factory reset" command via the IndraControl First Touch or the switches SF2 and SF1.



It can also be toggled directly at the XM control. Press the SF2 switch (ca. 5 s) until the LEDs **DIA3** and **DIA4** flash alternately. The LED **E** is on.

Keep the SF2 switch pressed on the **Clear** for approx. 4 seconds and then switch to the "Run" position. When the LED **E** is green, it can be communicated with the IndraControl First Touch using the set IP address.

3.4.3 Connections of the control

This section describes the ports of the IndraControl XM21 and XM22.

Ports XM21 and XM22



XF1/XF2	Sercos ports
XF5	Standard Ethernet port: Engineering interface
XD1	Voltage supply
XF30	USB host
SF2	Hardware reset/golden image
XF31	USB device: Engineering interface
XG10	SD card slot
SF1	Operation mode switch
LEDs s... E	Status LEDs

Fig. 3-10: Example: XM21 hardware for IndraMotion MLC applications

Ports XM42



XF1/XF2	Sercos ports
XF3/XF4	Realtime Ethernet (Profinet/Ethernet-IP) ports
XF5	Standard Ethernet port: Engineering interface
XD1	Voltage supply
XF30	USB host
SF2	Hardware reset/golden image
XF31	USB device: Engineering interface
XG10	SD card slot
SF1	Operation mode switch
LEDs s... E	Status LEDs

Fig. 3-11: Example: XM42 hardware for IndraMotion MLC applications

3.4.4 Setting the IP address for the XF5 port

IP address - Initial setting

For the initial commissioning and the specification of the network settings, the commissioning tool "IndraControl First Touch" is provided. The address can only be changed via this commissioning tool.

The web-based software tool allows to commission and maintain the controls of the IndraControl XM generation.



For a detailed description on the commissioning tool "IndraControl First Touch", refer to [chapter 3.4.15 "IndraControl First Touch" on page 62](#).

3.4.5 IndraWorks Engineering via the interface Prog (XF31)

Instead of the Ethernet interface XF5, the connection XF31 can be used to commission the control or to use the IndraMotion Service Tool. Connect the USB interface of your computer to the micro USB port XF31 via a common USB data cable/charging cable. Upon the first connection, the corresponding device driver (USB remote NDIS device) is installed on the computer.

It is communicated between computer and control via Ethernet, but it is only implemented as point-to-point implementation. Bridging to other networks or interconnecting switches is not possible.



The IP address of the XF31 port is always **192.168.234.234**. The user may not change the address.



The transmission rate can be limited by the USB host support of the PC and the USB cable used!

Connection problems between the control and the engineering PC can result.

3.4.6 Operating and display elements

LEDs on XD1 plug

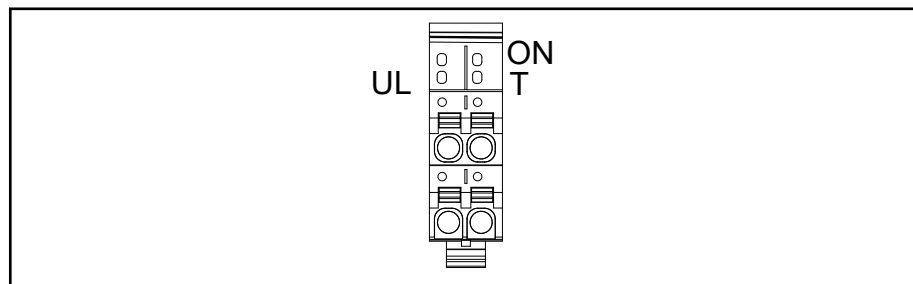


Fig. 3-12: LEDs on XD1 plug

The following functions are assigned to the LEDs on the XD1 plug:

LED	Color	Function
U _L	Green	24 V supply voltage connected and within the permitted range
ON	Green	All FPGAs (Field Programmable Gate Array) in the system are ready for operation. If this LED is not on, an error is present and the user has to trigger a "fallback", refer to chapter 3.4.13 "Fallback mode" on page 59
T	Red	Maximum temperature exceeded. The power supply unit switched off the control

Tab. 3-3: Functions and LEDs on the XD1 plug

Reset button

The "Reset" button is positioned on the higher located area of the control housing.



Fig. 3-13: Position of the reset button

Press the "Reset" button at running control to trigger a voltage cycle (reset).

The "Reset" button has two functions that can be triggered if the "Reset" button is pressed when applying the supply voltage:

- Press "Reset" button < 5 seconds: Triggering fallback mode (see [chapter 3.4.13 "Fallback mode" on page 59](#))
- Press the "Reset" button > 5 seconds until the DIA3 and DIA4 LEDs flash alternately: Triggering initial firmware (see [chapter 3.4.11 "Initial firmware" on page 56](#))



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

Operation mode switches SF1 and LEDs

The LEDs and the operation mode switch SF1 are used for operation and diagnostics.

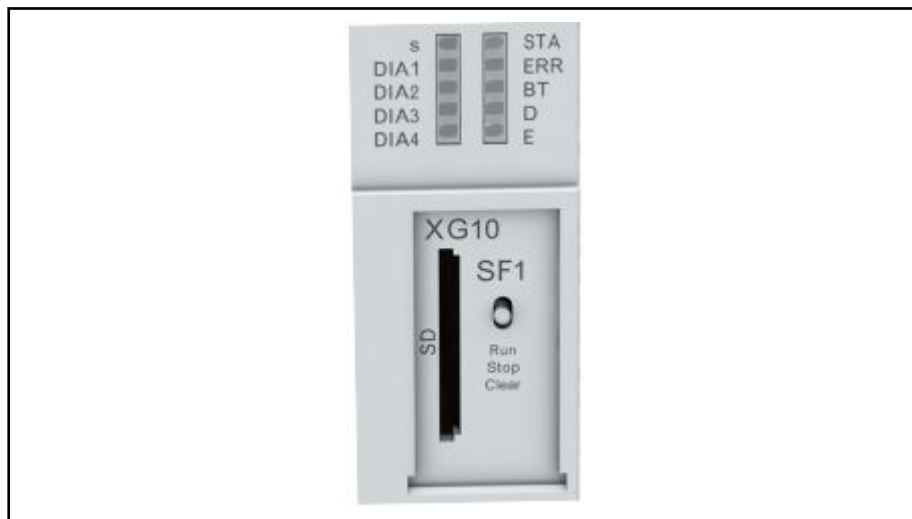


Fig. 3-14: Operation mode switches SF1 and LEDs

The XM controls are operated via the operation mode switch SF1. The user can thus determine the state of the control (Run or Stop) or select and enable specific operational steps via specific menus. To operate these menus, the period the switch is pressed is important:

- To select the subsequent menu items, the operating switch has to be pressed less than 3 seconds in the non-engaging position **Clear**
- To perform the action of the respective menu item, the operating switch has to be pressed more than 3 seconds in the non-engaging position **Clear**
- The control signals that the respective action is accepted indicating a static, green light of the "DIA1" LED
- To enable the selected menu item, release the operation mode switch
- If an error occurs while executing the action or during the operation, the "DIA1" LED is temporarily red

The LEDs have the following significance:

Sercos status	s
Feedback of the operation mode switch	DIA1
Basic diagnostics	DIA2
Boot LED BSP + initial firmware	DIA3 (3.3V)
Boot LED BSP + initial firmware	DIA4 (5V)
PLC status	STA

Error status	ERR
Boot status	BT
Diagnostics: S20 bus	D
Error status: S20 devices	E

Display of the "BT" LED

The control startup is visualized with flashing and color codes via the "BT" LED:

Flashing/color code	Control state	Description
 Off/orange	Control startup	The IndraMotion MLC firmware is started
 Orange	BOOTSTOP	The control startup was stopped by pressing the operation mode switch in "Clear" position. The control is now in the "BOOTSTOP" menu
 Red	Error at startup	Error occurred during control startup. Startup is canceled
 Off	MLC firmware startup completed	Control startup and IndraMotion MLC firmware start were successfully completed

Tab. 3-4: Flashing codes of the "BT" LED

The control startup can be affected via the position of the operation mode switch:

Position of the operation mode switch	Function
Run	PLC boot project is loaded. The control changes to the PLC state configured in the parameter "C-0-0405, PLC, configuration"
Stop	PLC boot project is not loaded. This impedes that the control does not boot anymore if the boot project is defective
Clear	The "BOOTSTOP" menu is enabled. The operation mode switch has to remain in this position when the control is switched on. Otherwise, this switch position functions like the "Stop" switch position

Tab. 3-5: Position of the operation mode switch

After control startup, the PLC status is displayed via the "STA" LED, the error status of the system via the "ERR" LED and the communication phase of the Sercos bus via the "s" LED.

Display of the "STA" LED

Color code	Control state	Description
 Green	RUN	At least one PLC application was started. By switching the operation mode switch to the "Stop" position, all running PLC applications can be stopped
 Orange	READY	No PLC application was loaded. If there is a PLC application on the control, switching this operation mode switch to the "Run" position can load and start the PLC application
 Red	STOP	All loaded PLC applications are stopped. Switching the operation mode switch to the "Run" position, all loaded PLC applications can be started

Tab. 3-6: Color codes of the "STA" LED

Display of the "ERR" LED

Color code	Control state	Description
 Green	No error	No error is present
 Orange	Warning	A warning is active
 Red	Error	Error occurred during control startup. Booting was canceled

Tab. 3-7: Color codes of the "ERR" LED

Display of the "s" LED

Flashing/color code	Sercos state	Description
 Off	NRT mode	No Sercos communication active
 Orange	CP0	Sercos communication phase 0 is active
 Green/orange	CP1	Sercos communication phase 1 is active
 Green/orange	CP2	Sercos communication phase 2 is active
 Green/orange	CP3	Sercos communication phase 3 is active
 Green	CP4	Sercos communication phase 4 is active

Flashing/color code	Sercos state	Description
 Green/red	Sercos class 5 error	An MLC Sercos error of class 5 occurred
 Red	Sercos class 8 error	An MLC Sercos error of class 8 occurred. The control returns to CP0

Tab. 3-8: Color codes of the "s" LED

Display of the "DIA2" LED

Extended diagnostics are visualized via the "DIA2" LED using flashing codes:

Flashing/color code	Control state	Description
 Orange/red	Do not switch off control!	Do not switch off the control in this state in order not to damage important firmware components
 Orange/green	Keys are generated for encrypted connections	Upon the first control boot, the keys are generated for encrypted connections. This can take up to two minutes
 Off/orange	Switch off control!	The control has to be switched off in this state, as there is no automatic reboot

Tab. 3-9: Flashing codes of the "DIA2" LED

After the control startup, the PLC operations on the control can be operated using the operation mode switch of the control:

Transition to Run	If a PLC application is available on the control, it is loaded (if not already loaded) and the application is started (PLC status: Run). In the Run switch position, the operating state of the application can be freely changed via IndraWorks
Transition to Stop	All running PLC applications are stopped (PLC status: Stop). In the Stop switch position, the operating state of the control cannot be changed to "Run" via IndraWorks. If the attempt is still made, the following warning is output in the MLC diagnostics: "E00D0002 - Operation mode switch in STOP: Start not possible"
Transition to Clear	Switching to the Clear position allows to reset the loaded PLC applications to default (PLC status: Ready). The following menu items are visualized with flashing and color codes via the "DIA1" LED:

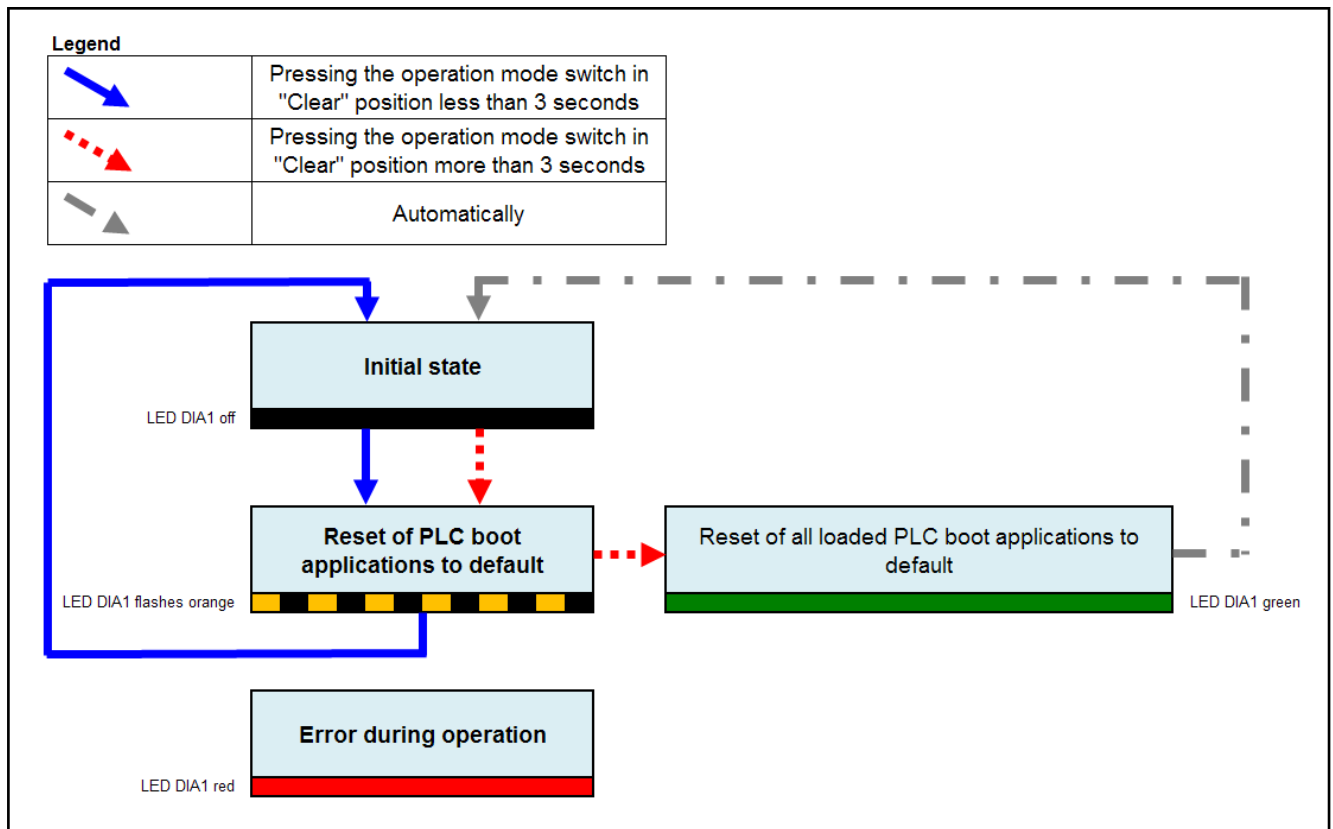


Fig. 3-15: Menu "Clear PLC boot application" and LED DIA1 display

The PLC application can only be started in the initial state via the operation mode switch.

3.4.7 "BOOTSTOP" menu

Control startup is not yet completed in the BOOTSTOP menu. No applications can run in this state. To enable the menu, the operation mode switch has to be in **Clear** position until "BT" LED is yellow.

The following actions can be executed in the "BOOTSTOP" menu:

- Clearing control memory:
From previous use, the control can contain old program components, parameterizations and PLC data that are removed in this step by clearing the memory.



Memory deletion is also mandatory after each firmware version change. Please backup your relevant user data before!

With brand-new controls, this step can be omitted:

- Clearing control memory including network setting reset
- Deleting PLC application files and configuration files
- Deleting PLC retain and retain-persistent memory
- Restoring PLC retain and persistent-retain memory
- Backing up PLC retain and persistent-retain memory
- Continue system startup

The menu is visualized via the "DIA1" LED by flashing and color codes. After activating the menu, observe the following menu sequence:

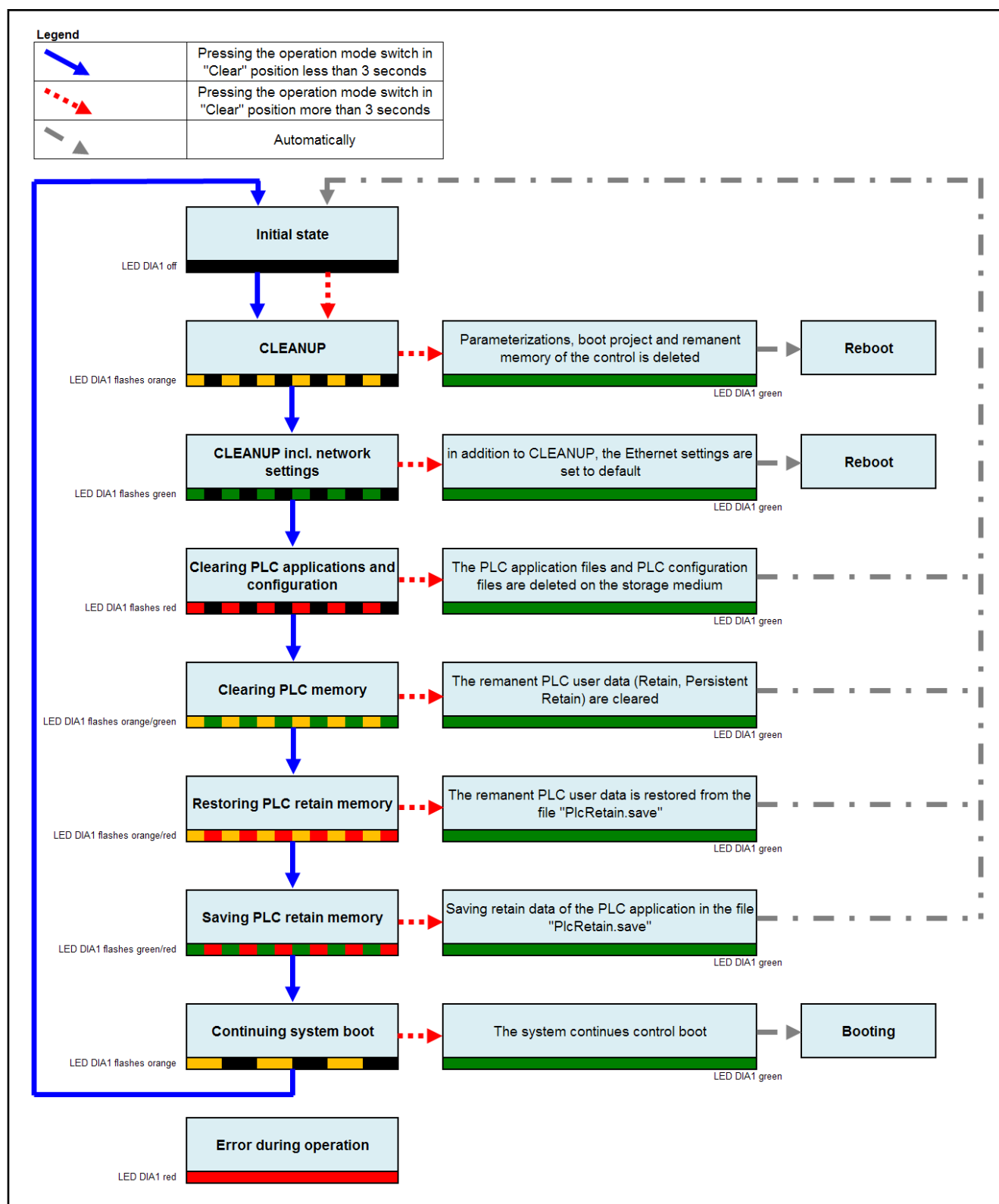


Fig. 3-16: "Boot stop" menu and LED DIA1 display

3.4.8 Behavior in case of fatal exception (SysError)

If there is a fatal exception at the control (in the MLC often referred to as SysError), the following behavior can be observed at the control:

Flashing/color code	Control state	Description
 Orange/red	SysError	A SysError occurred in the IndraMotion MLC firmware. This is a fatal exception

Tab. 3-10: LED behavior in case of SysError

This flashing sequence is simultaneously output at the LEDs "s", "DIA1", "DIA2", "STA", "ERR" and "BT". A SysError can be uniquely identified.

If this state occurs more often at the control, please contact the Bosch Rexroth Service.

There are the following handling options in this state (visualized via LED "DIA1" by flashing and color codes):

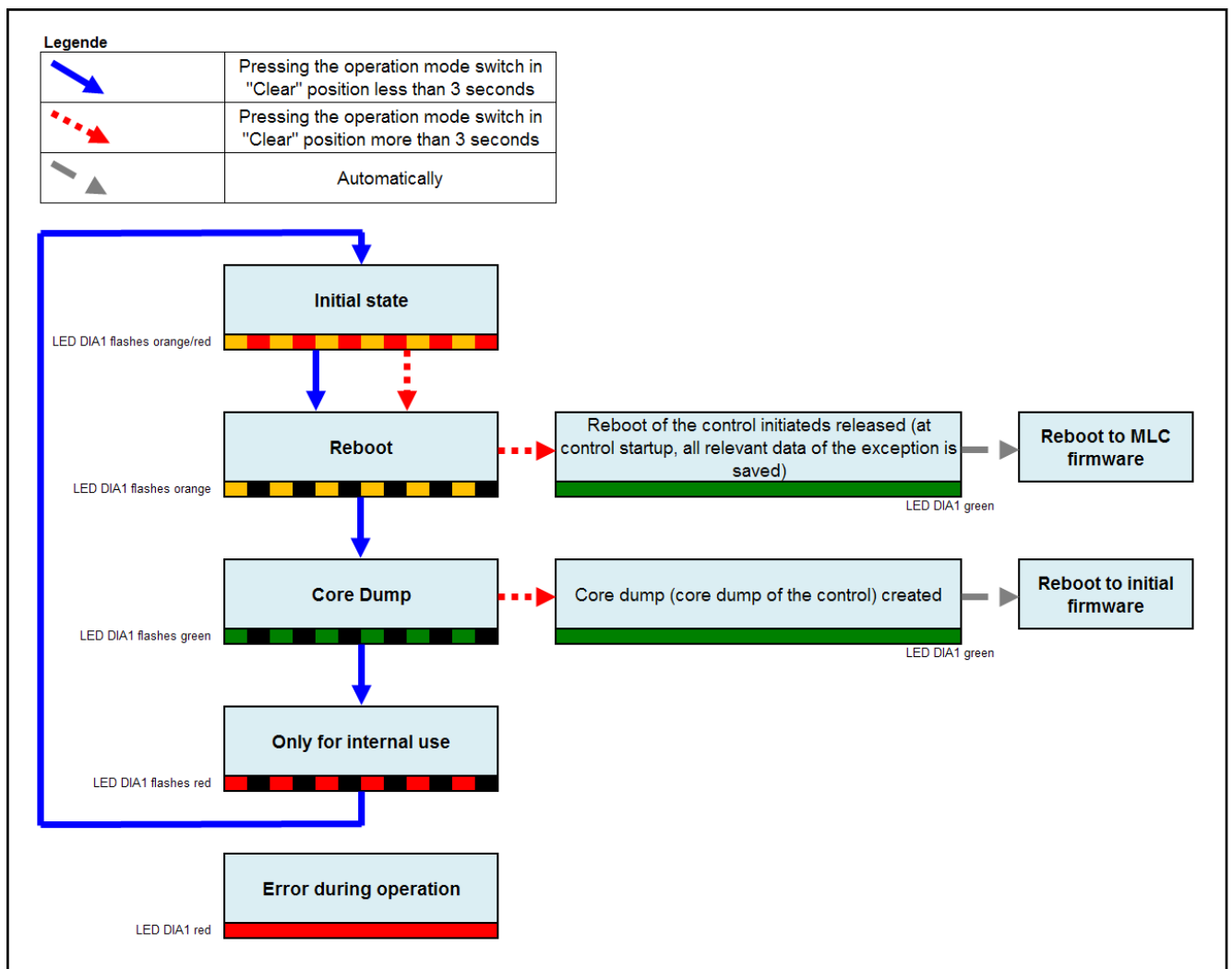


Fig. 3-17: "SysError" menu and LED DIA1 display

3.4.9 Locking the operation mode switch SF1

To protect the control, lock the operation mode switch to impede unauthorized operating access.

Thus, set bit 13 to "1" in the parameter "C-0-0036, Control configuration".

"Run" is assumed as permanent switch position. Thus, boot applications are loaded and applications can be loaded and started via the user interface.

The following operating actions using the operation mode switch are then locked:

- Entering the BOOTSTOP menu at control startup
- Impedes loading the boot application at control startup
- Loading and starting applications
- Stopping applications
- Resetting application origin

If a fatal exception (SysError) occurs when operating the control, the following operating actions are temporarily permitted upon next startup:

- Entering the BOOTSTOP menu
- Impedes loading the boot application

Apart from locking the operation mode switch, bit 12 in the parameter "C-0-0036, Control configuration" can be set to "1" to lock the default procedure of the control via the parameter "C-0-1019 Command: Restart and reset to default".

For more information, refer to the parameter description of the parameter "C-0-0036, Control configuration".

3.4.10 Creating a core dump

The term "Core dump" refers to the backup of the complete RAM on the Compact Flash card of the control. This is only required for certain errors and if requested by the Rexroth support for troubleshooting purposes.

To create a core dump, refer to [fig. 3-17 "SysError menu and LED DIA1 display" on page 55](#)

3.4.11 Initial firmware

General information



The control is not provided without system firmware upon delivery. A system-independent initial firmware is already installed on the control.

The initial firmware provides commissioning and maintenance functions. Basic functions can be activated manually without any additional tools. The controls of the device family IndraControl XM with the operation mode switch SF1 and the LED display panel provide a simple interface.

The commissioning tool "IndraControl First Touch" (see [chapter 3.4.15 "IndraControl First Touch" on page 62](#)) provides comfortable functions. If connected to a PC, it can be opened with a web browser. The comprehensive mechanisms for commissioning using the "IndraWorks Engineering" software are also supported by the IndraControl XM.

LED states

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

LED	Function	Color	Status
DIA2	Save core dump on SD card or USB medium (for diagnostic purposes)	Green/orange flashing	In process
		Green	Done
		Red	Error

LED	Function	Color	Status
DIA3, DIA4	Operating system state	Alternatingly flashing in red	Initial firmware is active
ERR	Reset to delivery state	Red	Function selected/processed
		Red, flashing	Confirm selection
BT	Reset user name/password	Red	Function selected/processed
		Red, flashing	Confirm selection
D	Delete network configuration	Red	Function selected/processed
		Red, flashing	Confirm selection
E	Start First Touch	Red	Function selected/processed
		Red, flashing	Confirm selection
		Green	First Touch running

Tab. 3-11: LED states

Starting and opening the initial firmware

No system firmware is installed on the IndraControl XM upon delivery. Apply the supply voltage and the control starts the initial firmware. After successful system firmware load, the control does not boot the initial firmware anymore. To call the initial firmware again, press the "Reset" button when switching on the 24 V supply voltage until the LEDs DIA3 and DIA4 flash alternately in red. Subsequently, open one of the following functions via a menu structure:

Menu item no.	Function(s)	LED
1	Start First Touch	E
2	Start First Touch, delete network configuration	E, D
3	Start First Touch, delete network configuration, reset user name/password	E, D, BT
4	Start First Touch, delete network configuration, reset user name/password, Delete Files -> Factory Reset	E, D, BT, ERR

Tab. 3-12: Menu items of the initial firmware



If the function was executed successfully, the LED "E" changes from red to green after some seconds.

The operation mode switch SF1 can be used as follows to reach the menu items:

1. Press SF1 < 3 seconds down: Navigation and selection of the menu item.
2. Press SF1 > 3 seconds down: Triggering the menu item function.
3. To confirm the "Factory reset" selection (menu item no. 4), the operation mode switch SF1 has to be set to the "Run" button.



To select menu item 4 "Factory reset", all files installed since commissioning, are deleted on the IndraControl XM. We recommend to create a system firmware backup (see [chapter "Firmware management" on page 64](#)) before using this function. The initial firmware is part of the hardware and it is not deleted.

Creating a backup using IndraControl FirstTouch

To create a backup of the XM control using the commissioning tool "IndraControl First Touch", proceed as follows:

1. Start the commissioning tool "IndraControl FirstTouch", refer to (menu item 1) in chapter [chapter "Starting and opening the initial firmware" on page 57](#).
2. Open the "Firmware" tab and execute the command "Archive SYSTEM/OEM/USER"
Select the storage location from the backup file, e.g. the user partition.
Saving can take up to several minutes.
3. To transfer the backup file to a PC or an archive, open the "File manager" tab.
Open the storage location of the backup file (its location of creation) and transfer the file to the target directory.

Refer to ["Archive SYSTEM/OEM/USER" on page 65](#)

Restoring a backup using IndraControl FirstTouch

To restore a backup of the XM control using the commissioning tool "IndraControl FirstTouch", proceed as follows:

1. Start the commissioning tool "IndraControl FirstTouch", refer to (menu item 1) in chapter [chapter "Starting and opening the initial firmware" on page 57](#).
2. Open the "Firmware" tab and execute the command "Restore SYSTEM/OEM/USER"
3. Go to the backup file and execute the "Restore" command.
The restoration can take up to several minutes.
4. If the backup file of the USER partition was restored, it is recommended to subsequently back it up on a local PC or server and to delete it on the system partition. Otherwise, errors might result during later backup/restore operations.

Refer to ["Restore SYSTEM/OEM/USER" on page 66](#)

Installing backup from external SD card

If the control is as in delivery state, a backup can also be loaded to the control without PC. Proceed as follows:

1. Copy a valid control backup to a Bosch Rexroth SD card XA-SD01 (part no. R911173884) for XM2x or XA-SD02 (part no. R911175017) for XM4x. Use either a PC with SD card reader or the file manager of the "IndraControl First Touch" commissioning tool.
2. Rename the image file to "system.fw".
3. Plug in the SD card to the base of the IndraControl XM labeled with "SD".
4. Switch on 24 V supply voltage.

5. The initial firmware automatically starts loading the backup to the control. While loading, the "ERR" LED is lit in orange. After successful loading, the "ERR" LED is off and the "E" LED is lit in green.
6. Reboot to start the control with system firmware.

Together with the "Backup system firmware" function (see [chapter "Firmware management" on page 64](#)), the installation can be facilitated.

Licenses

The initial software for the IndraControl XM controls was developed under the following license declarations:

- Apache License Version 2.0, January 2004
- The GNU General Public License (GPL) Version 2, June 1991
- The MIT License
- OpenSSL License
- The zlib/libpng License

3.4.12 Booting

The control starts booting after switching on the 24 V voltage supply. Booting can be monitored and checked using different LEDs.

The following boot sequence is defined:

1. U_L LED at the 24 V plug is lit in green if 24 V are connected.
2. ON LED at the 24 V plug is lit in green if the complete programmable logic is properly loaded.
3. DIA3 and DIA4 LED in block of 10 flash alternatingly in red while booting.
4. The LEDs DIA3 and DIA4 LED in a block of 10 go off when booting is complete and the operating system is running.



If it is not booted in this sequence, an error is present (see [chapter 3.4.21 "Error causes and troubleshooting" on page 74](#)).

3.4.13 Fallback mode

The control-internal, programmable function blocks are loaded upon control start and startup. After successful loading, the "ON" LED is green.

If the "ON" LED is not green after control startup, loading failed. In this case, the user has to initiate the "Fallback Mode". Therefore, press the "Reset" button when switching on the 24 V supply voltage until the "ON" LED is lit in green.

3.4.14 Backing up and restoring

Backing up and restoring XM control data with IndraWorks

The following methods are available to back up and restore an XM control.

The context menu of the XM control in the Project Explorer provides the commands **Device data ► Backup** and **Restore**.

The commands allow to back up control data from the control to the IndraWorks project and to restore the project on a control. The backup includes parameters and kinematic data. The control partitions can also be backed up and restored.



Backing up and restoring a device data backup created using IndraWorks can only be restored using IndraWorks.



A device data backup is only available if there is an online connection to the control.

For more information, refer to:

- [chapter "Archiving" on page 259](#)
- [chapter "Restoring" on page 263](#)

Backing up and restoring using IndraControl First Touch and the initial firmware

The commissioning tool "IndraControl First Touch" is available as browser-based software for the XM and VPx controls and provides the following functions to back up and restore the internal non-volatile memory:

- To archive the internal memory medium, see ["Archive SYSTEM/OEM/USER" on page 65](#)
- To restore an archive on the control that was created using "IndraControl First Touch", see ["Restore SYSTEM/OEM/USER" on page 66](#)



This mechanism can be used to back up the partitions SYSTEM, OEM and USER.

The IndraControl XM21/XM22 include the currently remanent data while archiving. The user has to handle them individually if required.

The IndraControl XM42 control includes the currently remanent data while archiving.

Backing up remanent data for XM2 controls

To also include remanent data into the control using "IndraControl First Touch" via the initial firmware of an XM2 control (e.g. RETAIN or PERSISTENT variables and remanent axis and control parameters), add and execute the following steps before executing the backup in the PLC application:

1. Add the library `ML_NVRAMDataHandler` to the library manager.
2. Start the function `MLC_NVRAMSetPrjArchive()` in a slow task with low priority (e.g. cycle time 200 ms, watchdog > 500 ms).

WARNING

When calling this function, it repeats the operation until the "Enable" input is reset again. If the "Enable" input is permanently set to `TRUE`, the file is written in every task cycle. This can destroy the memory, as it is only designed for a definite number of write accesses.

Set the function input `boEnable` to `TRUE` for only one task cycle to save RETAIN data to a file!

Restoring an archive without PC via SD card

If the XM control is reset to its settings upon delivery, an archive can also be restored without a PC, only by using an SD card.



1. The archive to be restored has to be created based on a backup using the "IndraControl First Touch" and should include all partitions of the control.
2. The control has to be in the state upon delivery. A factory reset might be required before.
3. The file name on the SD card has to be `system.fw`.
4. The restoration might require several minutes. Thus, wait until the LEDs **DIA3** and **DIA4** flash alternatingly and until the LED **E** is green.

Please refer to:

- [chapter "Installing backup from external SD card" on page 58](#)
- ["Resetting an XM control to factory settings" on page 61](#)

Resetting an XM control to factory settings

The backup file on the external SD card is only loaded if the XM control runs with its factory settings.

Proceed as follows to reset the XM control to its factory settings:

1. Press the reset button "SF2" when switching on the XM control until the status LED "E" is red and "DIA3" and "DIA4" flash alternatingly in red.
2. Switch the operation mode switch SF1 three times to the "Clear" position.
The status LEDs "E, D, BT, ERR" are red → The "Factory reset" is selected.
3. Switch the operation mode switch SF1 to the "Clear" position for more than 3 seconds to confirm the "Factory reset".
The status LEDs "E, D, BT, ERR" flash in red.
4. Switch the operation mode switch SF1 to the "Run" position to start the "Factory reset".
This might take several minutes and is only completed if the Status LED "E" is green.

Please also refer to [chapter "Starting and opening the initial firmware" on page 57](#)

Updating the backup file after online change

To update an existing local backup file after an online change, proceed as follows:

1. Make the online change and open the user partition of the control using the device data explorer.
Call: IndraWorks Project Explorer, select **Device data ► Explorer** from the context menu of the control.
2. Copy the following files to the local PC:
 - `[*].app`
 - `[*].crc`
 - `DevicePlcAdd.cfg`
3. Select the backup file to be updated (*.fw) on the local PC and open the file with a suitable tool (e.g. 7-Zip).
4. Replace the files in the backup file with the files copied from the control in step 2.

Data on the control and in the backup file is now consistent again.



If changes were made in the declaration of `RETAIN` or `PERSISTENT` variables, the control reports a retain mismatch error after loading the changed PLC application. A "cold reset" is required to reset control data to its initial values.

Use the integrated recipe manager to back up the required PLC variables in a recipe at runtime. This recipe can be loaded after changing the PLC application. The backed up variable values are then restored. Recipes can be loaded and backed up manually or by using function blocks in the PLC application.

3.4.15 IndraControl First Touch

General information

The "IndraControl First Touch" commissioning tool interactively commissions and maintains controls of the IndraMotion MLC XM/IndraMotion VPB generations. For the commissioning tool, go to the IP address (standard IP: 192.168.1.1) of the control. It runs on most of the current web browsers.



The commissioning tool "IndraControl First Touch" is only available in English. The following screenshots are available for the XM2 controls as of the initial firmware version 01V14.

Supported web browsers:

- Chrome 3+
- Firefox 9+
- Internet Explorer 10+

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

After loading the First Touch website, a "Welcome" page is displayed. For all other functions and the navigation to other First Touch sites, a user login is mandatory. To log in, enter user name and password into both the form fields of the navigation bar.

The default user ID is:

- User name: boschrexroth
- Password: boschrexroth

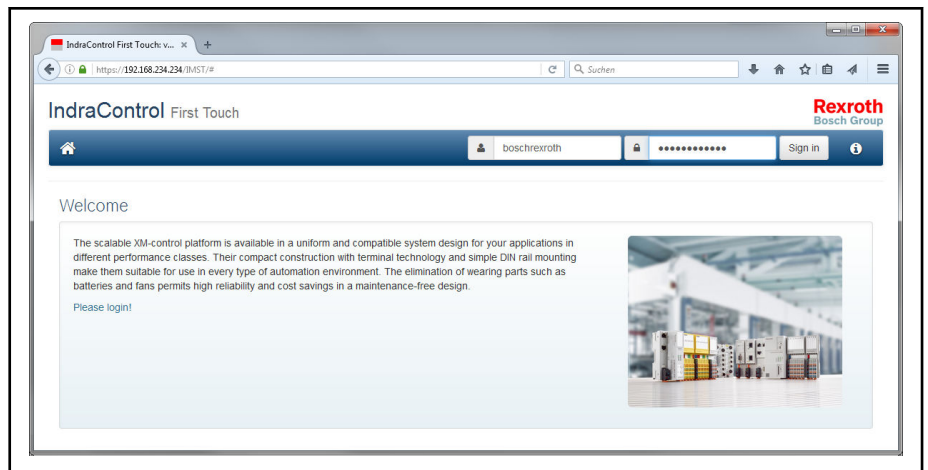


Fig. 3-18: "Welcome" dialog

Hardware data

The "Hardware" site lists all device-specific data of the IndraMotion MLC XM or VPx control as table.

- Material index
- Hardware type plate
- Serial number
- Part number

Network settings

The "Network" site is used to configure the network settings for the XF5 port during the initial commissioning. The currently configured network settings are shown in the following three fields and can also be changed using these fields:

- IP address
- Gateway
- Subnet mask

Enter a valid network setting and write that setting to the control (press the **Write configuration** button). If writing the network settings is completed successfully, a message is displayed in the header area of the site. The **Reboot control** button is additionally displayed. It is used to restart the control and thus applies the network setting.

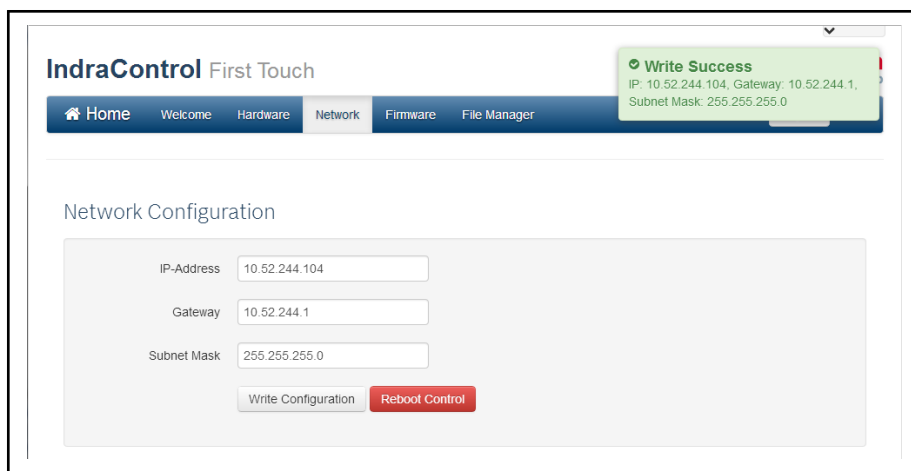


Fig. 3-19: "Network configuration" dialog



The network settings are only applied after a control restart.

Firmware management



The menu items are only available in this dialog if the initial firmware is active.

The firmware management provides a backup and restore functionality of the internal read-only memory of the control. This allows to move the partitions SYSTEM, OEM and USER to an archive that can subsequently be restored via the dialog.



Basically, MLC firmware archives can also be loaded via the "Firmware management" dialog. In this use case, give priority to the IndraWorks firmware dialog (if available) (see [chapter "Firmware download" on page 70](#)).

The "Firmware Management" site provides the following information:

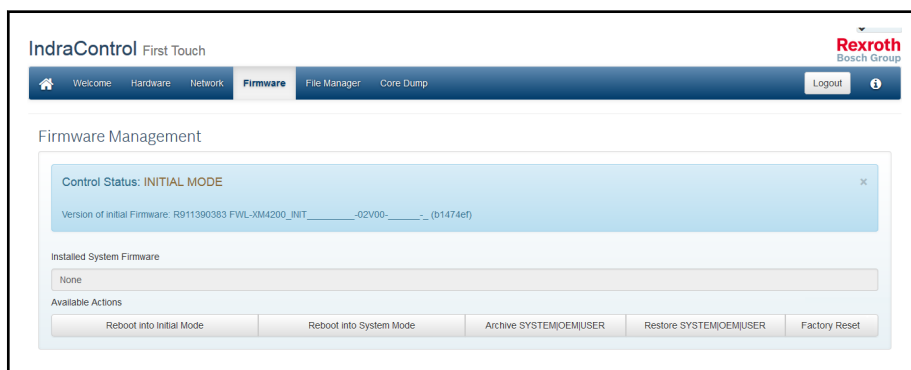


Fig. 3-20: "Firmware management" dialog

- Current control mode:
 - Initial Mode: Initial firmware is loaded or active (initial firmware is shown in the message window)
 - System Mode: Control was started with the previously installed system firmware
- Installed system firmware version ("none" if no system firmware was installed)

Up to the XM2 initial firmware 01V14, the corresponding actions (in brackets) have to be selected via the button **Action**:

- Archive SYSTEM/OEM/USER (backup system firmware): Backs up a complete directory structure to a backup archive (.fw file)
- Restore SYSTEM/OEM/USER (update system firmware): Installation of a previously generated backup from the local file system or the USER partition of the control
- Reboot into System Mode: Boots an installed system firmware
- Factory Reset: Restores the delivery state of the control. The complete directory structure is reset



Note: Loss of data!

An existing system firmware installation is deleted. The network settings are reset to its delivery state.

- Reboot Initial Mode: Reboots the system and restarts the initial mode

Archive SYSTEM/OEM/USER

The function archives the internal storage medium. These include all partitions and their file and directory structures. After the process, an ".fw" file is stored on the USER partition of the control. This file can be loaded to a local PC for archiving at a later point in time (see [chapter "File manager" on page 68](#)).



The file name of a system archive can consist of 4-16 alphanumeric characters and has to have the file extension ".fw".

The backup can only be started if the selected file name of the archive corresponds to the naming rules. During as well as after the backup, a corresponding message is displayed.

Fig. 3-21: Dialog "Archive SYSTEM/OEM/USER"

Fig. 3-22: Dialog "Archive SYSTEM/OEM/USER" – Completed successfully

Restore SYSTEM/OEM/USER

If the action "Restore SYSTEM/OEM/USER" is selected, a modal dialog opens to select an archive file previously generated via "Archive SYSTEM/OEM/USER". The file can either be selected from the local file system or the USER partition of the control. If the file is selected from the local file system, the archive is installed in two steps:

- Transferring file to control
- Installing firmware

Fig. 3-23: Dialog "Restore SYSTEM/OEM/USER" – Upload

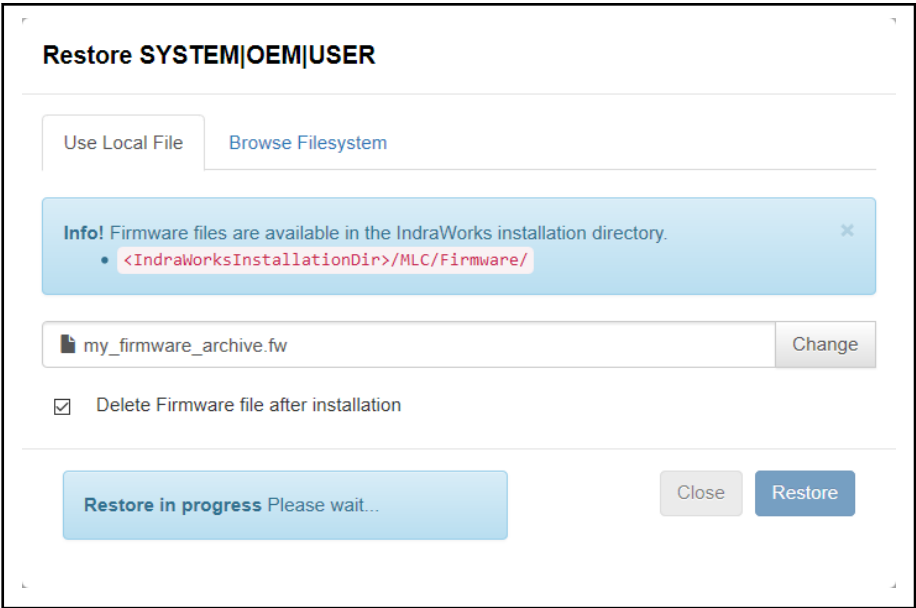


Fig. 3-24: Dialog "Restore SYSTEM/OEM/USER" – Installation running

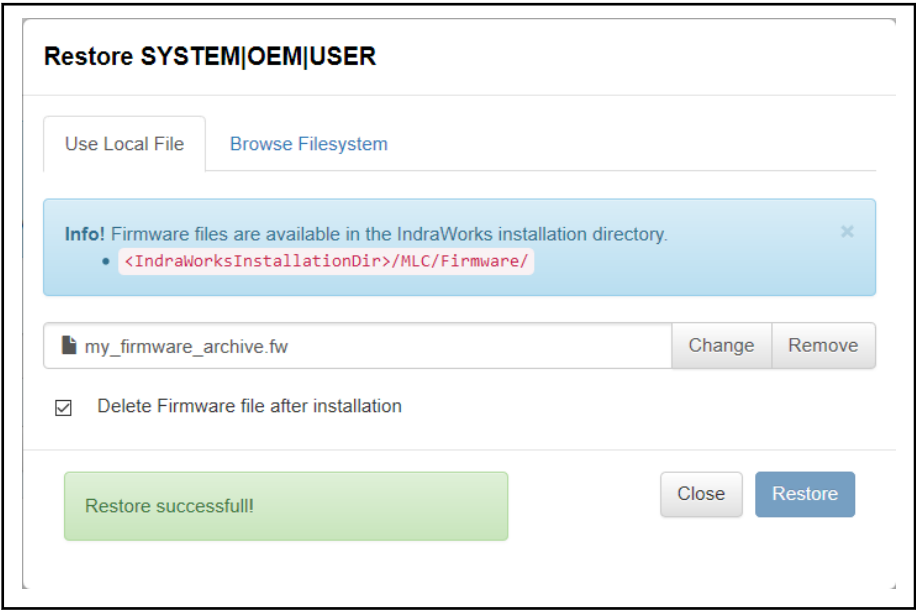


Fig. 3-25: Dialog "Restore SYSTEM/OEM/USER" – Completed successfully

If the archive file is selected from the USER partition, it is directly installed after pressing "Install". The table lists all firmware files found in the root directory of the USER partition. Select the archive file to be installed by selecting the corresponding table row.

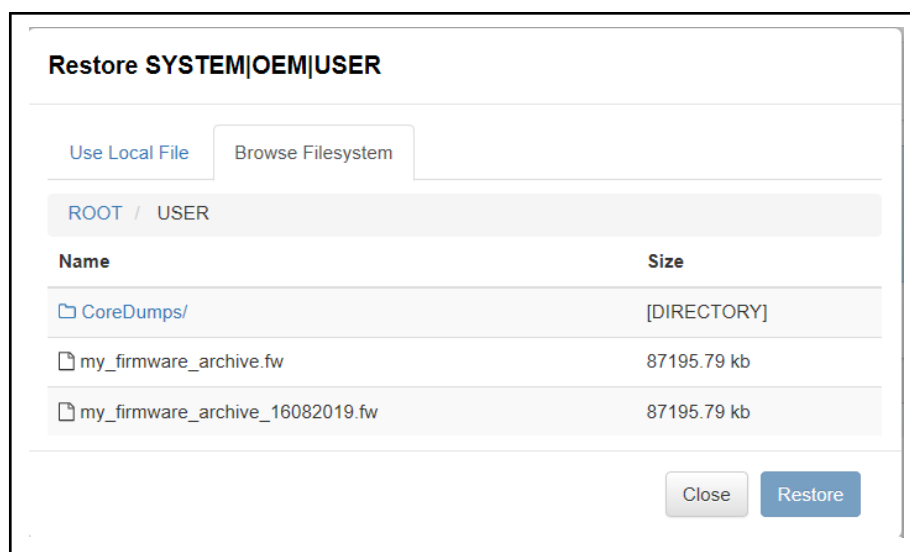


Fig. 3-26: Dialog "Restore SYSTEM/OEM/USER" – From USER partition

File manager

The "File manager" dialog is used to:

- Browse through the directory structure (click on a directory name)
- Transfer files from the control to the client (click on a file name)
- Transfer files from the client to the control (action: Upload file)
- Create directories (action: Create directory)
- Delete (empty) directories (click on the "Delete" icon in the table row)
- Delete files (click on the "Delete" icon in the table row)

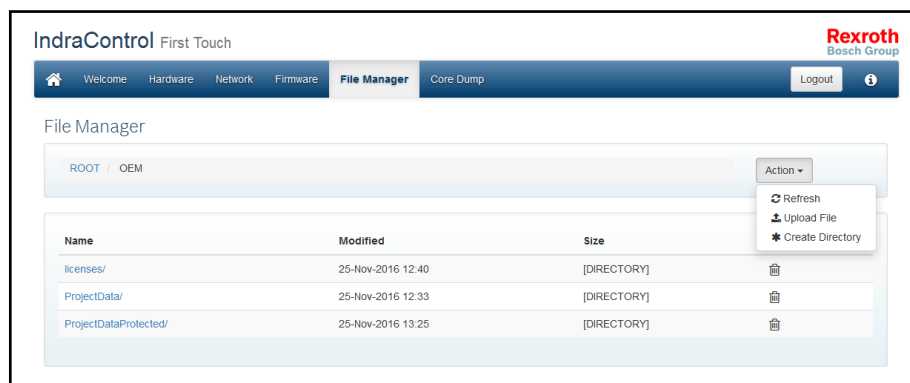


Fig. 3-27: "File manager" dialog

Managing a core dump

In case of a system error, the control can create a complete core dump of the system that can be provided for an error analysis. The IndraControl First Touch supports two use cases with this functionality:

1. Transfer of the active core dump from the control to the PC of the user.

All files assigned to the active core dump are displayed with name and file size in the "Core dump" menu item. Click on the file name to transfer the files to the PC of the user via the browser-specific download dialog.

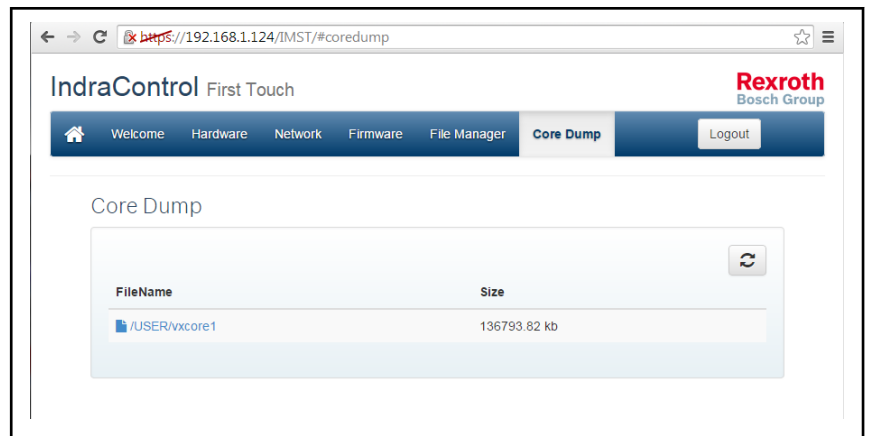


Fig. 3-28: Displaying the active core dump in IndraControl First Touch

- Support of the user if the core dump could not be saved in the file system of the control (e.g. if there is not sufficient free memory space available).

The user can now free up storage space in the default target directory for core dump files (/USER/). Use the "File manager" menu item. An additional data carrier (e.g. USB stick) can also be connected to the control. In both cases, saving the core dump has to be restarted. The IndraControl First Touch provides a dialog in the "Core dump" menu item. This dialog allows to select the target directory if unsaved core dump files are available in the RAM of the control.

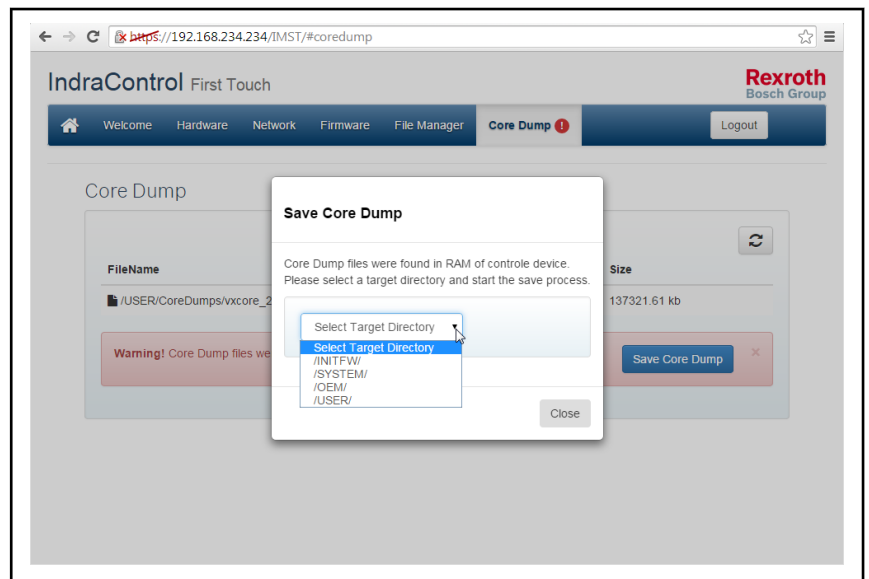


Fig. 3-29: Selecting the target directory to save the core dump

After selecting a valid target directory, press **Save** to save the core dump. If saving was successful, a corresponding message is shown. The dialog can now be closed. After closing the dialog, the core dump is displayed with its respective data.

3.4.16 IndraWorks Engineering

General information

To commission and project the Bosch Rexroth IndraMotion MLC control, the software "IndraWorks Engineering" is provided.

Features:

- PLC and MotionLogic programming based on CoDeSys V3 with object-oriented language extensions
- Comprehensive IEC 61131-3 and PLCopen-compliant software libraries
- Meaningful diagnostics
- Intelligent and wizard-supported operation
- Standardized interfaces such as FDT/DTM, connection of version control systems and Automation Interface

For more detailed information on IndraWorks Engineering, refer to the general IndraMotion MLC system manuals (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Firmware download

1. Select the control

Upon delivery of the device or when using a new MLC release, load the system firmware to the device. Highlight the corresponding device in the project tree and select the item "Firmware management..." from the corresponding context menu (via right-click).

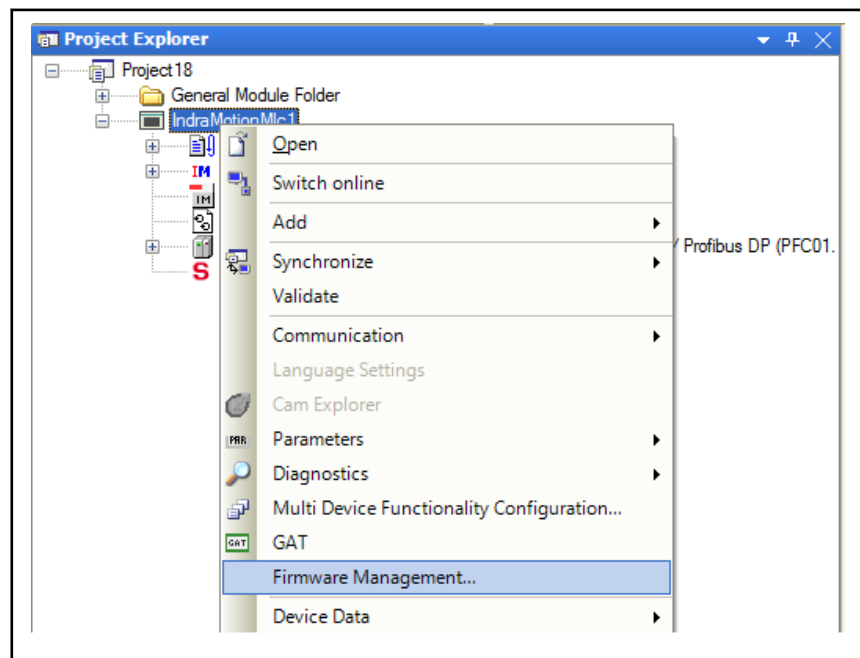


Fig. 3-30: Starting the IndraWorks firmware management

2. Select the system firmware

Select the system firmware for your device. To select the firmware from the IndraWorks installation, go to **Firmware of installation**. Alternatively, a firmware from any memory location on your PC can be selected via **Firmware of file**.



The name of a system firmware file valid for the target IndraMotion MLC XM2 always starts with **XM2sss-MLC-...** and the IndraMotion MLC XM4 target starts with **XM4sss-MLC-...**

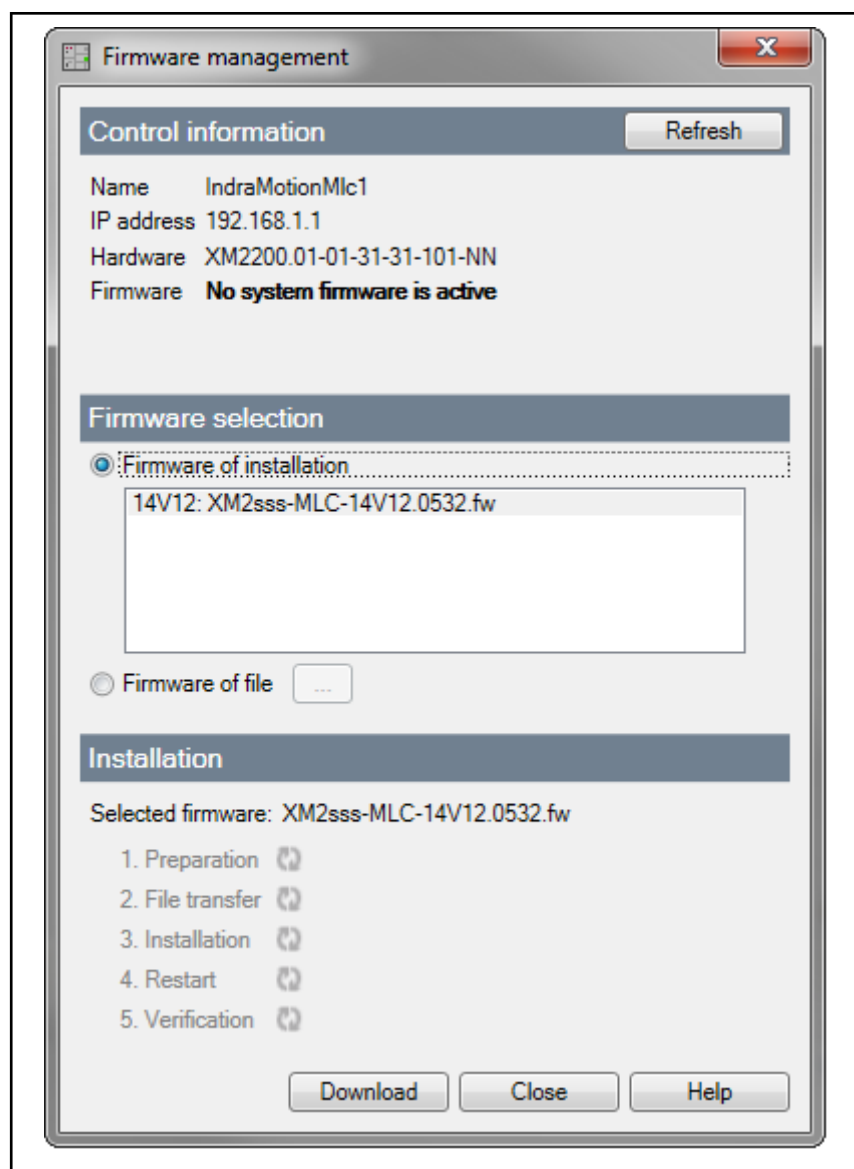


Fig. 3-31: Firmware selection

3. Download firmware

Select the system firmware file and press **Download**. Multiple steps have to be performed. The progress is shown in the dialog window of the firmware management.

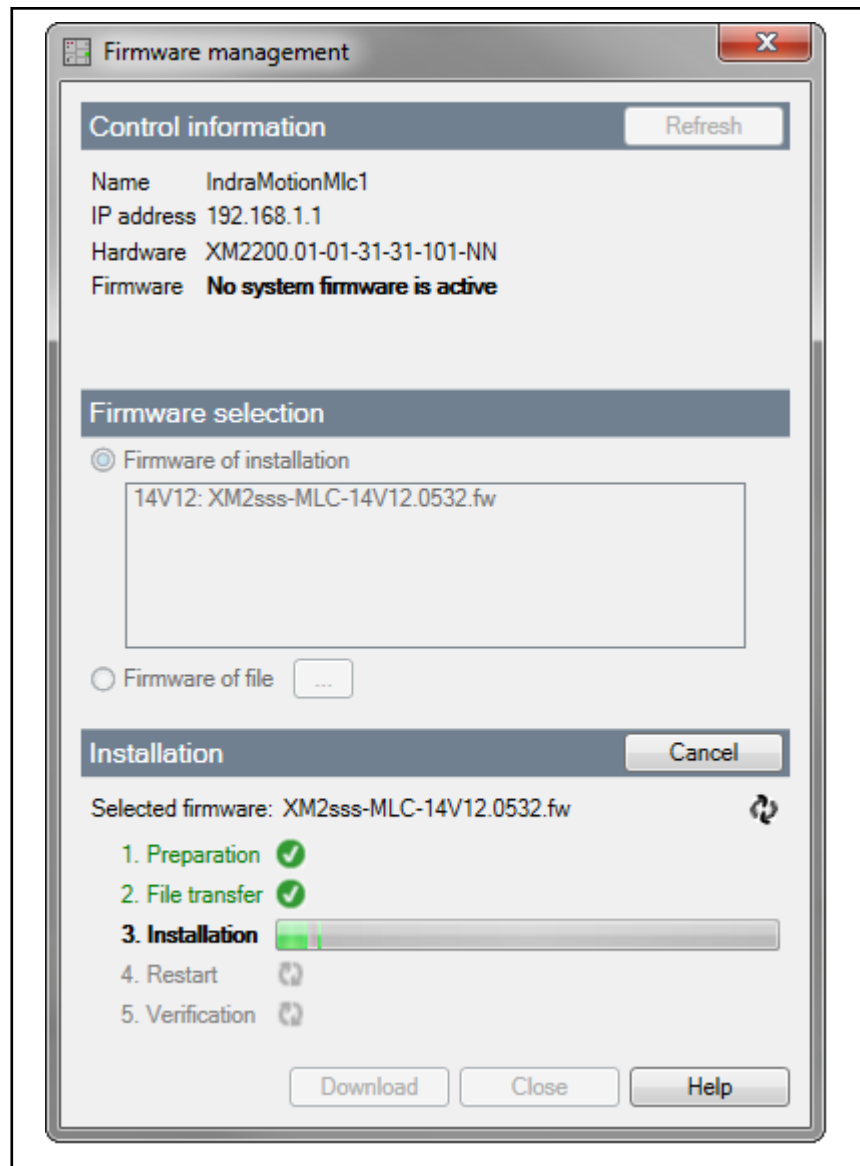


Fig. 3-32: Active firmware download



One the firmware download is started, do not press **Cancel**.

After the download, complete the dialog with **Close**. The system firmware is started.

4. Control restart

After the firmware has been downloaded successfully, the control is automatically restarted.

Under certain circumstances, an FPGA update on the hardware is additionally required. In this case, the following message (PWRCYCLE) is displayed after the firmware download:

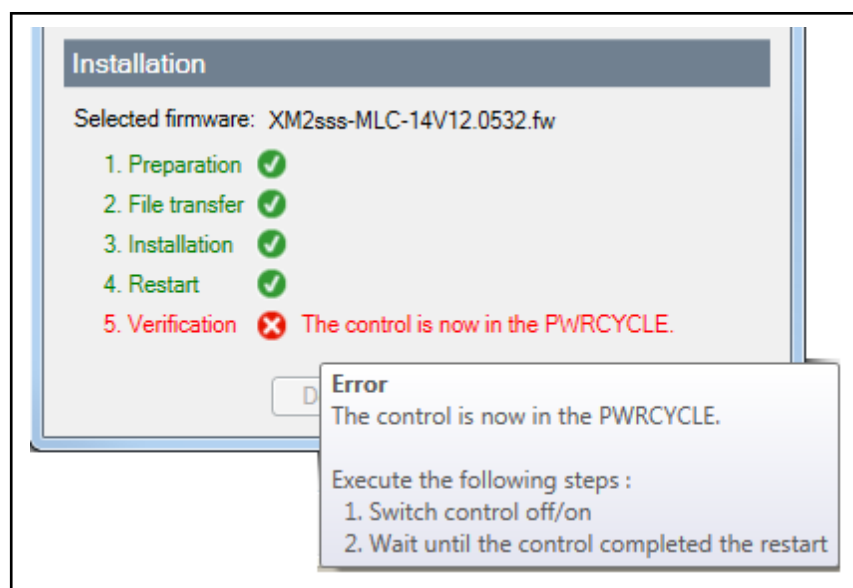


Fig. 3-33: Firmware download: Message "PWRCYCLE"

Shut down the control and restart your system.

The control is then ready.

3.4.17 Backing up remanent data

For the IndraControl XM21 and IndraControl XM22 controls, 128 KB of non-volatile data and for IndraControl XM42 4MB data is automatically backed up in an internal flash memory after a 24 V supply voltage failure and restored during control startup.

3.4.18 Real-time clock

The real-time clock of the control is buffered in switched-off state. The buffer time of the real-time clock depends on the ambient temperature and the operating time of the control.

Operating time of the control	Ambient temperature	Buffer time of the clock
5 years	50 °C	Typ. 10 days
7 years	50 °C	Typ. 7 days
10 years	50 °C	Typ. 4 days
2.5 years	60 °C	Typ. 10 days
3.5 years	60 °C	Typ. 7 days
5 years	60 °C	Typ. 4 days

Tab. 3-13: Buffer time of the real-time clock depends on the ambient temperature and the operating time of the control

It is recommended to set the time via SNTP.

3.4.19 XF30: Using USB memory media

For IndraMotion MLC XM controls, a USB memory medium can be connected via an XF30 port. Only one partition can be reached on the data carrier.

Information on the available drives and the respective drive assignment can be determined via the parameter "C-0-0037, Path names of partitions".

The drive name for a detected USB drive is specified by the system as "REMOVABLE_USB_A".

The read/write access to the plugged-in memory medium can be accessed via the determined identifier "REMOVABLE_USB_A" with IndraLogic file functions or the Oci interface.

Supported USB storage media sizes depending on the selected formatting:

FAT	Up to 4 GB
FAT32	Up to 32 GB

Tab. 3-14: Supported USB storage media sizes



Plugging-in and removing the USB memory medium at runtime is generally possible. However, it can cause a temporarily increased runtime behavior and in motion cycle time exceedances or PLC/hardware watchdogs in case of a high control load. That is why a USB memory medium should only be plugged in or removed in an uncritical machine state (e.g. home position)!

3.4.20 XG10: Using SD card memory media



Only the Rexroth SD card XA-SD01 (part no. R911173884) is approved as memory medium for the XG10 slot of XM2x.

Only the Rexroth SD card XA-SD02 (part no. R911175017) is approved as memory medium for the XG10 slot of XM4x.



The memory medium has to be formatted as FAT file system. Only one partition may be created on the data carrier.

Information on the available drives and the respective drive assignment can be determined via the parameter "C-0-0037, Path names of partitions".

The drive name for a detected SD drive is specified by the system as "REMOVABLE_SD_A".

The read/write access to the plugged-in memory medium can be accessed via the determined identifier "REMOVABLE_SD_A" with IndraLogic file functions or the Oci interface.



Plugging-in and removing the SD card at runtime is generally possible. However, it can cause a temporarily increased runtime behavior and in motion cycle time exceedances or PLC/hardware watchdogs in case of a high control load. That is why an SD card should only be plugged in or removed in an uncritical machine state (e.g. home position)!

3.4.21 Error causes and troubleshooting

Operating and error displays and remedies

The following table describes the LEDs on the voltage power connector.

LED	LED Display	Error causes and troubleshooting
U _L	LED is off	24 V voltage error 24 V supply voltage is not connected 24 V supply voltage is connected with reverse polarity
ON	LED is off	Error when loading programmable logic Initiate fallback mode (see chapter 3.4.13 "Fallback mode" on page 59)
T	LED red	Temperature error Control was switched off due to overheating. - Ensure a lower ambient temperature - Check the control installation - Avoid heat accumulation impeding the natural convection

Tab. 3-15: LEDs in the voltage power connector

Further operating and error displays are located on the individual modules and terminals. For information on the other displays, refer to the manual of the IndraControl S20 component.

3.5 IndraMotion MLC VPx – Commissioning

3.5.1 Commissioning steps

To commission the device, proceed as follows:

1. Mount the industrial PC.
For details, refer to the operating instructions "IndraMotion MLC IndraControl VPB 40.4" (part no. [R911376309](#)).
2. Connect the power supply to the X10 connection of the industrial PC.
For details, refer to the operating instructions "IndraMotion MLC IndraControl VPB 40.4" (part no. [R911376309](#)).
3. Switch on industrial PC → Initial firmware starts.
Refer to [chapter 3.5.8 "Initial firmware" on page 82](#).
4. Use the commissioning tool "IndraControl First Touch" to make the network settings (IP address, subnet mask, gateway address) for the XETH2 connection.
Refer to [chapter 3.5.4 "Setting the IP address for the XETH2 connection" on page 78](#).
5. Connect the project planning PC to the control via XETH2.
The project planning and programming software "IndraWorks Engineering" has to be installed in the system variant "IndraWorks ML*" on the project planning PC.
6. Create an IndraWorks project and a control based on the IndraControl VPx.
Refer to [chapter 3.8 "Creating a project" on page 107](#) and [chapter 3.10 "Creating a control" on page 113](#).
7. Load the system firmware via IndraWorks.
Load the system firmware to the "IndraControl VPx" control using the project planning and programming software "IndraWorks Engineering".

Refer to [chapter "Firmware download" on page 98](#).

NOTICE**Control malfunctions due to control switch-off during initialization**

Note that hardware is initialized after the system firmware installation and the subsequent reboot. Wait till completion. Do **not** switch off the control. This procedure has to be completed. Subsequently, continue commissioning.

3.5.2 Software tools

Standard software tools

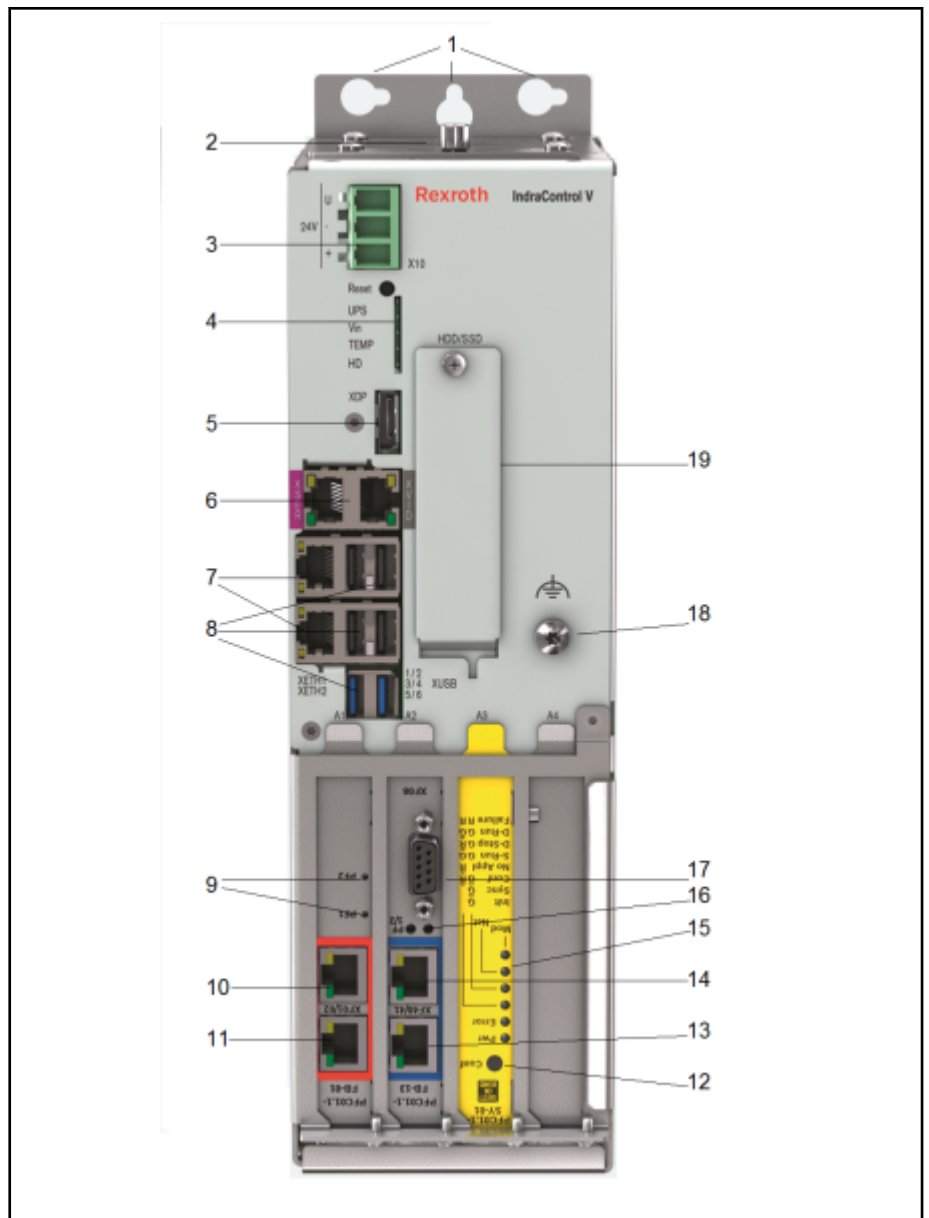
For the descriptions of the standard software tools for the industrial PC IndraControl VPB, refer to the project planning manual "Rexroth IndraControl V-Devices Operating Systems" (part no. [R911343901](#)). The following software tools and functions are for example described in this project planning manual:

- Data backup using the Acronis backup and recovery software
- Software for UPS monitoring "UPS NT Control"
- Maintenance software "IPCMnt"
- IPC service program "IPCSvc"
- Windows 7 Multi-user interface
- Settings for dual monitor operation
- Simulation of the right mouse key
- Auto login
- M-key UpperClass filter for downwards compatibility of the M-key codes
- Enhanced write filter
- File-based write filter
- Intel Rapid Storage Technology

3.5.3 Connections of the control

This section describes the connections of the IndraControl VPx.

Connections, operating elements and LEDs



- 1 Key holes for mounting (also provided at the bottom side)
- 2 Fan
- 3 Plug for voltage supply
- 4 Status LEDs and Reset button
- 5 DisplayPort connection
- 6 CDI interface (data and image interface)
- 7 Network interfaces XETH1, XETH2
- 8 USB interfaces
- 9 LEDs PF1/PF2 (Sercos III)
- 10 XF02 connection with LEDs L/S
- 11 XF01 connection with LEDs L/S
- 12 Acknowledgement button SafeLogic
- 13 XF41 connection with LEDs L/S
- 14 XF40 connection with LEDs L/S
- 14 LEDs PF1/PF2 (RT-Ethernet/Profibus)
- 15 LEDs SafeLogic
- 16 LEDs PF1/PF2 (RT-Ethernet/Profibus)

- 17 XF08 connection (Profibus)
- 18 Grounding screw (hexalobular T25)
- 19 Hard disk(s)

Fig. 3-34: Front view of the IndraMotion MLC based on the IndraControl VPB 40.4 hardware

3.5.4 Setting the IP address for the XETH2 connection

IP address - Initial setting

The default IP address of the communication interface **XETH2** of the control IndraMotion MLC VPB is set to 192.168.1.1. The address can only be changed via the commissioning tool "IndraControl First Touch".

This web-based software tool allows to commission and maintain the IndraMotion MLC based on the IndraControl VPB hardware.



Windows applications directly running on a control computer can communicate via a virtual network adapter. It can be identified as "Real-time hypervisor PCI network adapter" in the Windows Control Panel. The virtual network adapter is used to communicate between Windows and the control firmware. **Please do never change the IP settings made there:**

- IP address: 192168234237
- Subnet mask: 255255255252
- Default gateway: 192168234238

3.5.5 Operating and error displays

There are LEDs on the connector panel and on the extension cards to display the device states and errors. Apply the specified measure if one of the LEDs indicates either an error or a note (see [tab. "LEDs for operating and error display on the connector panel" on page 78](#) and [tab. "LEDs for the operating and error display on the extension cards" on page 79](#)).



Some LEDs, e.g. the CPU temperature monitoring, are only active if the service software has been set accordingly.

LEDs for operating and error display on the connector panel

LED	Display	Meaning	Measure
V _{in}	LED green	Normal operation	-
	LED OFF	No supply voltage (24 V DC)	Check supply voltage at the power supply unit!
TEMP	LED OFF	Normal operation	-
	LED is flashing red (flashing frequency approx. 2 Hz)	Fan is not rotating or is rotating too slowly	Check the fan at the industrial PC!
	LED red	Overtemperature	Reduce ambient temperature!

LED	Display	Meaning	Measure
UPS	LED OFF	Normal operation	-
	LED red	The industrial PC is currently operating in battery mode, i. e. no power supply is available!	Restore the power supply and initiate a controlled restart!
HDD	LED flashing green	Hard disk access	-
	LED is flashing green (with a flashing frequency of approx. 2 Hz) ¹⁾	Warning: SMART analysis identifies errors	Exchange hard disk
Reset	LED red	Monitoring LED for the reset button. The LED is on as long as the "Reset" button is pressed	-

LEDs for the operating and error display on the extension cards

LED	Display	Meaning	Measure
Extension card PFC01.1-FB-01 (Sercos III)			
Ethernet L	LED green	LED constantly on: Connection present	-
	LED OFF	No Ethernet connection	Check cables and connections
Ethernet S	LED orange	LED cyclically on: Data is transmitted	-
	LED OFF	No Ethernet data traffic	Check cables and connections
PF1	LED OFF	Currently not used	-
PF2	LED OFF	Currently not used	-
Extension card PFC01.1-FB-13 (RT-Ethernet and Profibus)			
Ethernet L	LED green	Ethernet connection detected	-
	LED OFF	No Ethernet connection	Check cables and connections
Ethernet S	LED orange	LED cyclically on: Data is transmitted	-
	LED OFF	No Ethernet data traffic	Check cables and connections

¹⁾ Provided that the IPC Service program (IPCSvc) is installed

LED	Display	Meaning	Measure
RT-Ethernet PF1	LED red	LED constantly on: No connection	Check cables and connections
		LED flashes: Slave diagnostics	Check the project planning of the extension card
		LED off: No bus error	-
Profibus PF2	LED green	LED constantly on: Communication present	-
		LED cyclically on: Module configured	-
		LED is acyclically on: Module not configured	Check the project planning of the extension card

3.5.6 Hypervisor

The system solution IndraMotion MLC based on the IndraControl VPB hardware combines the functionality of a Windows HMI PC with the one of a control. Therefore, the Windows operating system and the VxWorks operating system of the IndraMotion MLC control have to be parallelly operated on the IndraControl VPB hardware.

This task is performed by the integrated hypervisor. The hypervisor splits the hardware resources and assigns them exclusively to the Windows or the control operating system. Windows and running Windows application thus cannot directly access the resources of the integrated control. This architecture ensures a transparent and safe communication between the control functionality and the running Windows applications. To exchange data between the Windows applications and the control system, a "shared memory" and a virtual network adapter are provided by the system.



The virtual network adapter can be identified as "Real-time hypervisor PCI network adapter" in the Windows control panel. The virtual network adapter is used to communicate between Windows and the control firmware. Please do never change the IP settings made there:

- IP address: 192168234237
- Subnet mask: 255255255252
- Default gateway: 192168234238

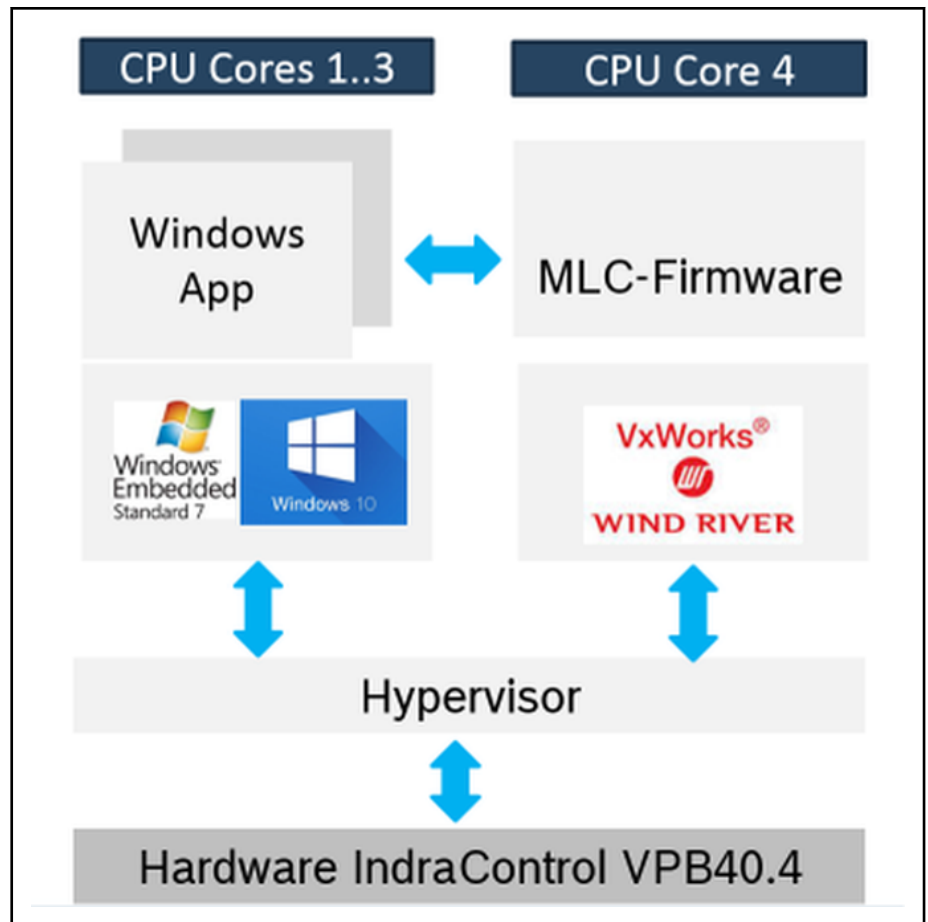


Fig. 3-35: Hypervisor – Architecture IndraLogic XLC/IndraMotion MLC

The distribution of the hardware resources to the respective operating system is defined as follows:

Resource	Function	Assignment
CPU core 1 to 3	Processor	Windows
CPU core 4	Processor	VxWorks (Control)
Ethernet connection XETH1	Communication interface	Windows
Ethernet connection XETH2	Communication interface of the control IndraMotion MLC VPB (default 192.168.1.1). The address can only be changed via IndraControl First Touch	VxWorks (Control)
XUSB 1-6	USB host	Windows
XDVI/XVID	Graphic	Windows
HDD	Bulk memory: Hard disk/SSD	Windows
PFC01.1-FB-01	Sercos III interface	VxWorks (Control)
PFC01.1-FB-13	RT-Ethernet/Profibus DP	VxWorks (Control)

PFC01.1-SY-01	SafeLogic control	VxWorks (Control)
RAM (16 GB)	Distribution on Windows (15 GB/ VxWorks) (1 GB)	Windows/VxWorks (control)

Tab. 3-16: Overview: Distributing the hardware resources to different operating systems

3.5.7 Network File System (NFS)

The internal mass memory (HDD/SSD) is exclusively assigned to the Windows operating system. There is no exclusive mass memory for the control. Thus, the file system of the control is mapped to the internal mass memory. It is mapped via a network file system. The control cannot continue operating if Windows is not running anymore. Thus, it responds with a SYSERROR in this case

File access is not transferred as in case of FTP for example. For the control system, the file system acts like an exclusively available memory medium.

3.5.8 Initial firmware

General information

State upon delivery



The control is not provided without system firmware upon delivery. A system-independent initial firmware is already installed on the control.

The initial firmware provides commissioning and maintenance functions of the control functionality of the IndraMotion MLC based on the IndraControl VPB hardware. The commissioning tool "IndraControl First Touch" is provided as comfortable user interface (see [chapter "Firmware download" on page 98](#)).

The initial firmware provides the following functions:

- Reading out the electronic type plate
- Network setting of the network connection XETH2
- Reset to delivery state
- Create and restore control image
- File manager for the control partitions SYSTEM, OEM and USER

Starting and opening the initial firmware

The IndraMotion MLC based on the IndraControl VPB hardware does not include any MLC system firmware upon delivery. If the MLC system firmware has not yet been installed on the device, the initial firmware is enabled upon each industrial PC startup. After loading the system firmware (refer to [chapter "Firmware download" on page 98](#)), the control boots with the loaded MLC system firmware.



If service is required, the initial firmware can be enabled again via the software tool "IndraControl Systray".

Licenses

The initial software for the IndraMotion MLC based on the hardware of the IndraControl VPB controls was developed under the following license declarations:

- Apache License Version 2.0, January 2004
- The GNU General Public License (GPL) Version 2, June 1991
- The MIT License
- OpenSSL License
- The zlib/libpng License

3.5.9 IndraControl First Touch

General information

The "IndraControl First Touch" commissioning tool interactively commissions and maintains controls of the IndraControl XM and IndraControl VPB generation. The "IndraControl First Touch" can run on most of the modern web browsers.



The commissioning tool "IndraControl First Touch" is only available in English!

Supported web browsers:

- Chrome 3+
- Firefox 9+
- Internet Explorer 10+

The standard URL of the IndraControl First Touch website for the remote access to the control via XETH2 is <https://192.168.1.1/> (default). The IndraControl First Touch can also be directly executed on the control PC via the link in the IndraControl SysTray context menu. In this case, it is communicated via a virtual network adapter.

After loading the First Touch website, a "Welcome" page is displayed. For all other functions and the navigation to other First Touch sites, a user login is mandatory. To log in, enter user name and password into both the form fields of the navigation bar.

The default user ID is:

- User name: boschrexroth
- Password: boschrexroth

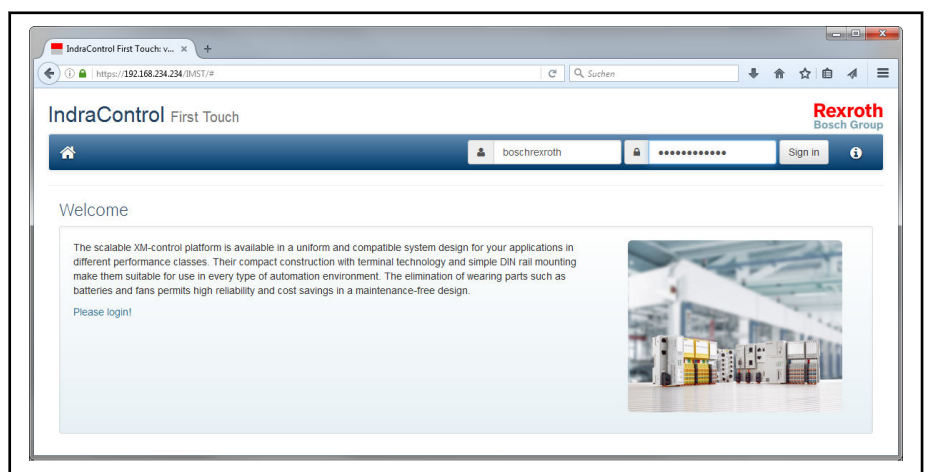


Fig. 3-36: "Welcome" dialog

Hardware data

The "Hardware" site lists all device-specific data of the IndraMotion MLC based on the hardware of the IndraControl VPB in a table.

- Material index
- Hardware type plate
- Serial number
- Part number

Network settings

The "Network" site is used to configure the network settings for the XETH2 connection. The currently configured network settings are shown in the following three form fields and can also be changed using these fields:

- IP address
- Gateway
- Subnet mask

Enter a valid network setting and write that setting to the control (press the **Write configuration** button). If writing the network settings is completed successfully, a message is displayed in the header area of the site. The **Reboot control** button is additionally displayed. It is used to restart the control and thus applies the network setting.

Fig. 3-37: "Network configuration" dialog



The network settings are only applied after a control restart.

Firmware management



The menu items are only available in this dialog if the initial firmware is active.

The firmware management provides a backup and restore functionality of the internal read-only memory of the control. This allows to move the partitions SYSTEM, OEM and USER to an archive that can subsequently be restored via the dialog.



Basically, MLC firmware archives can also be loaded via the "Firmware management" dialog. In this use case, give priority to the IndraWorks firmware dialog (if available) (see [chapter "Firmware download" on page 98](#)).

The "Firmware management" site provides the following information:

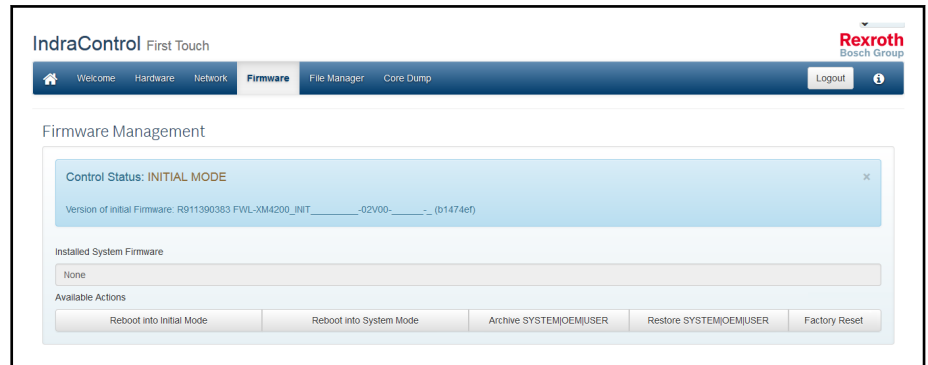


Fig. 3-38: "Firmware management" dialog

- Current control mode:
 - Initial Mode: Initial firmware is loaded or active (initial firmware is shown in the message window)
 - System Mode: The control was started with the previously installed MLC system firmware
- Installed system firmware version ("none" if no MLC system firmware was installed)

Press the following function buttons for the following actions:

- Archive SYSTEM/OEM/USER: Backs up the complete directory structure (partitions SYSTEM/OEM/USER) in an archive file. The generated format corresponds to a firmware archive (.fw file)
- Restore SYSTEM/OEM/USER: Archive file installation from the local file system or the USER partition of the control
- Reboot into System Mode: Boots an installed MLC system firmware
- Factory Reset: Restores the delivery state of the control. The complete directory structure is reset



Note: Loss of data!

An existing IndraMotion MLC system firmware installation is deleted including project and user data. The network settings are reset to its delivery state!

- Reboot Initial Mode: Reboots the system and restarts the initial mode

Archive SYSTEM/OEM/USER

The function archives the internal storage medium. These include all partitions and their file and directory structure. After the process, an ".fw" file is stored on the USER partition of the control. This file can be loaded to a local PC at a later point in time (see [chapter "File manager" on page 88](#)).



The file name of a system archive can consist of 4-16 alphanumeric characters and has to have the file extension ".fw".

The archiving can only be started if the selected file name corresponds to the archive rules. During as well as after the backup, a corresponding message is displayed.

Fig. 3-39: Dialog "Archive SYSTEM/OEM/USER" to create an archive file

Fig. 3-40: Dialog "Archive SYSTEM/OEM/USER:" – Archive file was created successfully

Restore SYSTEM/OEM/USER

If the action "Restore SYSTEM/OEM/USER" is selected, a modal dialog opens to select a previously generated archive file. The source file can either be selected from the local file system or the USER partition of the control. If the file is selected from the local file system, the archive is installed in two steps:

- Transferring file to control
- Installing the archive file (e.g. firmware archive file)

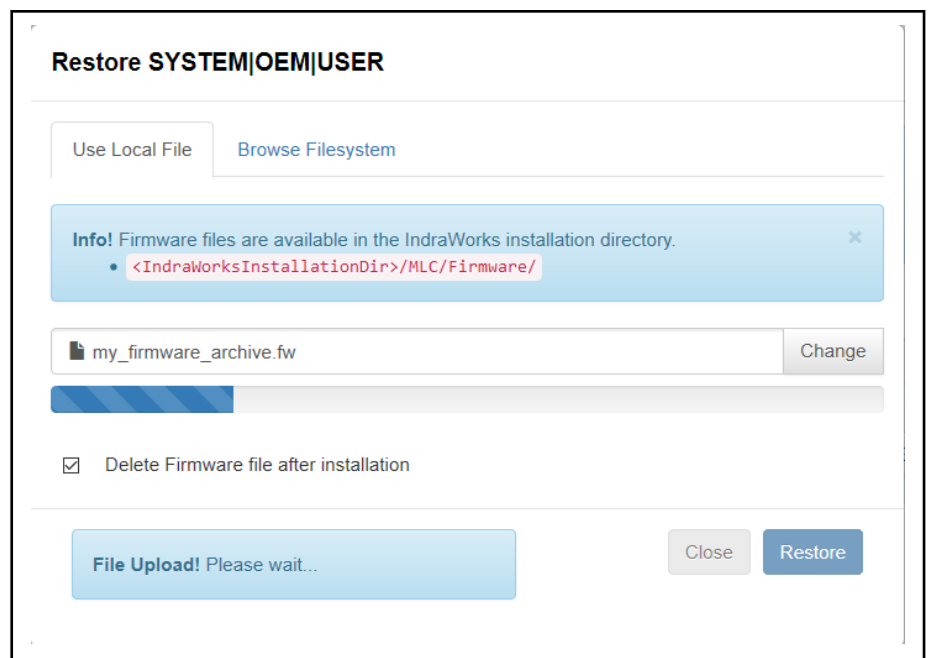


Fig. 3-41: Dialog "Restore SYSTEM/OEM/USER" – Uploading an archive file

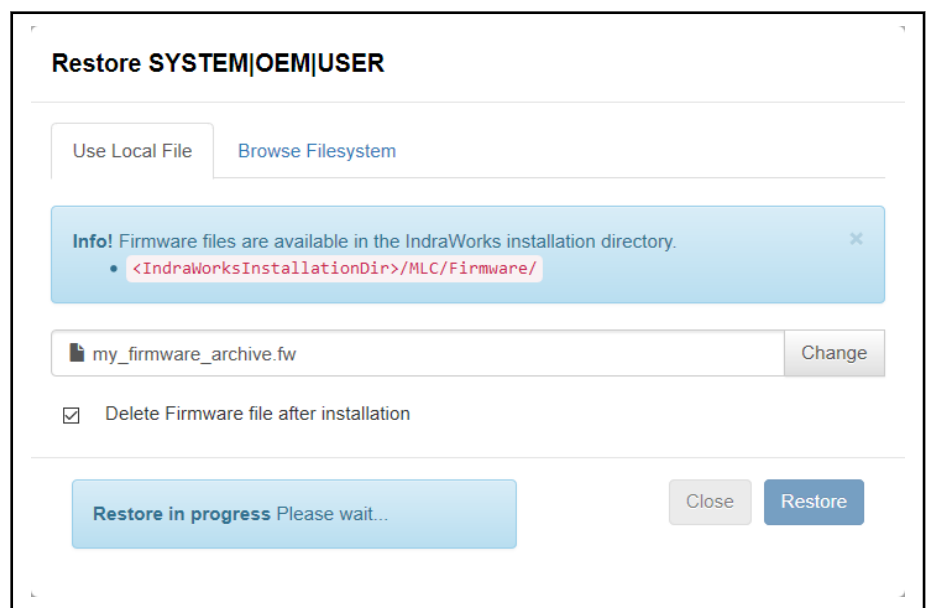


Fig. 3-42: Dialog "Restore SYSTEM/OEM/USER" – Archive is restored

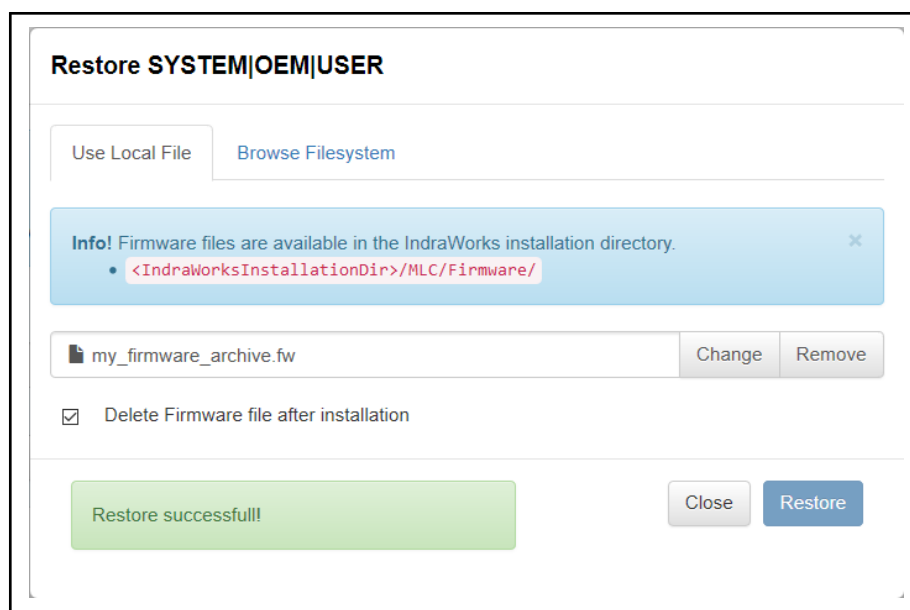


Fig. 3-43: Dialog "Restore SYSTEM/OEM/USER" – Archive was restored successfully

If the archive file is selected from the USER partition, it is directly installed after pressing "Install". The table lists all firmware files found in the root directory of the USER partition. Select the firmware file to be installed by selecting the corresponding table row.

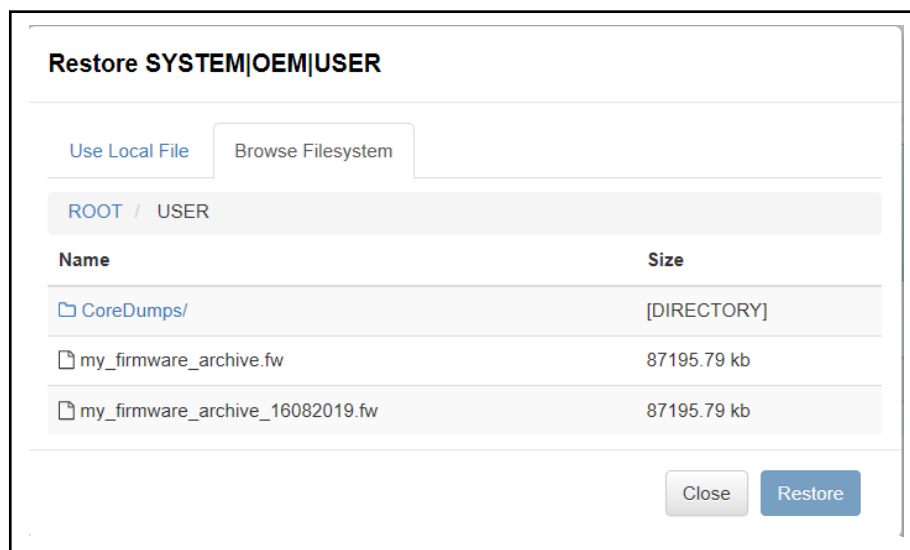


Fig. 3-44: Dialog "Restore SYSTEM/OEM/USER" – From USER partition

File manager

The "File manager" dialog is used to:

- Browse through the directory structure (click on a directory name)
- Transfer files from the control to the client (click on a file name)
- Transfer files from the client to the control (action: Upload file)
- Create directories (action: Create directory)
- Delete (empty) directories (click on the "Delete" icon in the table row)
- Delete files (click on the "Delete" icon in the table row)

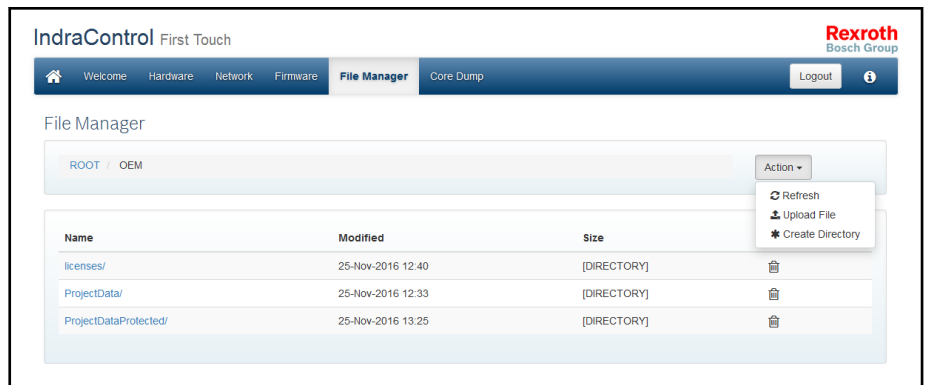


Fig. 3-45: "File manager" dialog

Managing a core dump

In case of a system error, the control can create a complete core dump of the system that can be provided for an error analysis. The IndraControl First Touch supports two uses cases with this functionality:

1. Transfer of the active core dump from the control to the PC of the user.

All files assigned to the active core dump are displayed with name and file size in the "Core dump" menu item. Click on the file name to transfer the files to the PC of the user via the browser-specific download dialog.

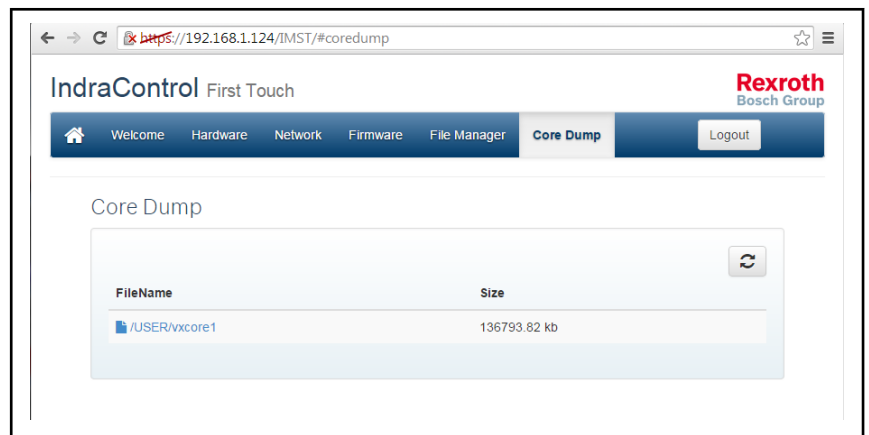


Fig. 3-46: Displaying the active core dump in IndraControl First Touch

2. Support of the user if the core dump could not be saved in the file system of the control (e.g. if there is not sufficient free memory space available).

The user can now free up storage space in the default target directory for core dump files (/USER/). Use the "File manager" menu item. An additional data carrier (e.g. USB stick) can also be connected to the control. In both cases, saving the core dump has to be restarted. The IndraControl First Touch provides a dialog in the "Core dump" menu item. This dialog allows to select the target directory if unsaved core dump files are available in the RAM of the control.

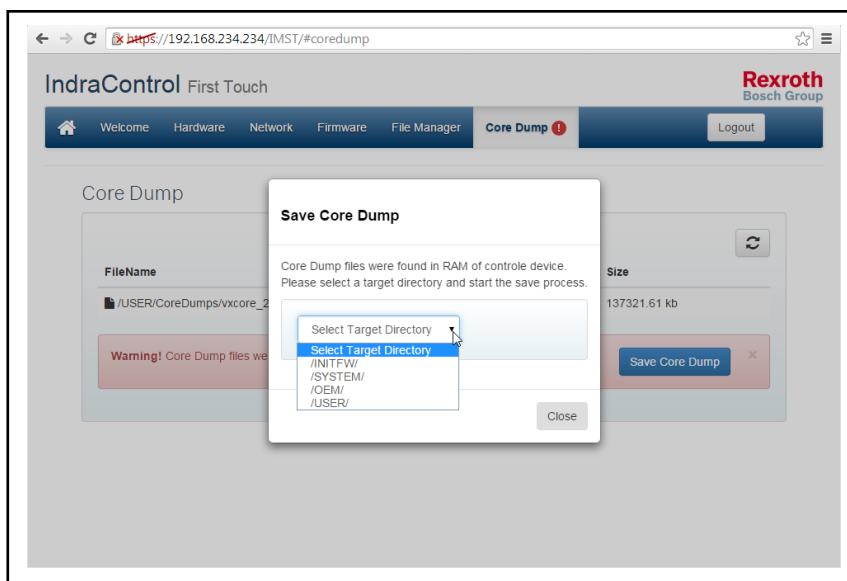


Fig. 3-47: Selecting the target directory to save the core dump

After selecting a valid target directory, press **Save** to save the core dump. If saving was successful, a corresponding message is shown. The dialog can now be closed. After closing the dialog, the core dump is displayed with its respective data.

3.5.10 Operating and display elements of the IndraControl SysTray

The "IndraControl Systray" application is provided as Windows application. This application is automatically started via the Windows Startup. After the start, the application integrates itself within the Windows System Tray. Exiting via the context menu of the application is not intended.

IndraControl Systray supplements the control functionality by the following functions:

- Provision of the operating elements of the comfort operating device
- Retain data backup of the control to the Windows file system
- Emergency power supply connection for the automatic system shut-down

Use the context menu for operational steps. Status information is given via display change of the application icon, via a status and diagnostic dialog as well as information as tooltip.

Context menu Right-click on the icon of the application to display the context menu. Items in the menu are displayed depending on the status "active" (black) or "inactive" (grey).

Main menu

Menu	Subfunction	Description
System firmware	Yes	Active if the MLC system firmware is loaded
Initial firmware	Yes	Active if the initial firmware is loaded
Diagnostics and settings	No	Operating elements and status information (LED display and message text)

Menu	Subfunction	Description
Activate boot stop	No	Set the control to the "BOOTSTOP" mode. Use the "Diagnostics and settings" dialog to display and enable the boot stop functions. For an exemplary description of the individual "BOOTSTOP" functions, refer to the commissioning chapter of the IndraMotion MLC XM2 control (refer to chapter 3.4.7 "BOOTSTOP menu" on page 53)
About...	No	Displays general application information

Tab. 3-17: Main menu

"System firmware" menu

Menu	Subfunction	Description
Reboot	No	Reboot of the system firmware
IndraMotion Service Tool	No	Open an external browser and transfer the "IndraMotion Service Tool" web interface address
Activate initial firmware	No	Initial firmware is enabled

Tab. 3-18: System firmware

"Initial firmware"

Menu	Subfunction	Description
First Touch web interface...	No	Open an external browser and transfer the "First Touch" web interface address
Windows Event Viewer...	No	Start the external application "Windows Event Display"
Activate system firmware	No	System firmware is enabled

Tab. 3-19: Initial firmware

Status display

The states of the control and the application are displayed as icon in the Windows System Tray. This display is supplemented by the respective information as tooltip.

Status display

State/tooltip	Icon	Description
Run		System firmware is loaded and ready. At least one PLC application was started
Stop		System firmware is loaded and not ready. All loaded PLC applications are stopped
Boot stop		The control startup was paused

State/tooltip	Icon	Description
Initial firmware is active		Initial firmware is active
Error		The following errors are signaled: - Version conflict: Version error between IndraControl Systray and firmware - Windows reboot or shutdown - System firmware or initial firmware is not started Context menu is disabled If the error occurs again after the reboot, contact the Bosch Rexroth service
General information		General icon display, e.g. start of the SysTray application, the control is in "System Error" mode, etc.

Tab. 3-20: Application icons

Dialogs

The "Diagnostics and settings" dialog is used as operating and display element of the control. It can be operated via the switches "Run" and "Stop" in the lower section (modes of operations).

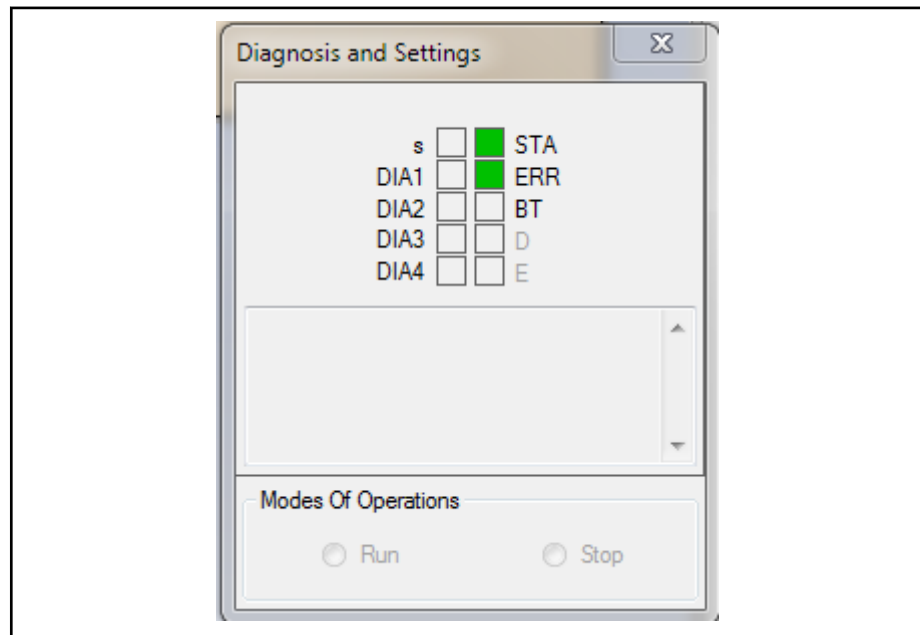


Fig. 3-48: Diagnostics and settings

Status display: Coloring and naming of the LEDs depend on the system.

Message display: Multiple outputs of device messages.

"Run" and "Stop": Control the device via these switches.

In case of a "BOOTSTOP" or system error, the display is supplemented by a function selection switch. Otherwise, the switch is hidden.

An example: Boot stop was enabled.

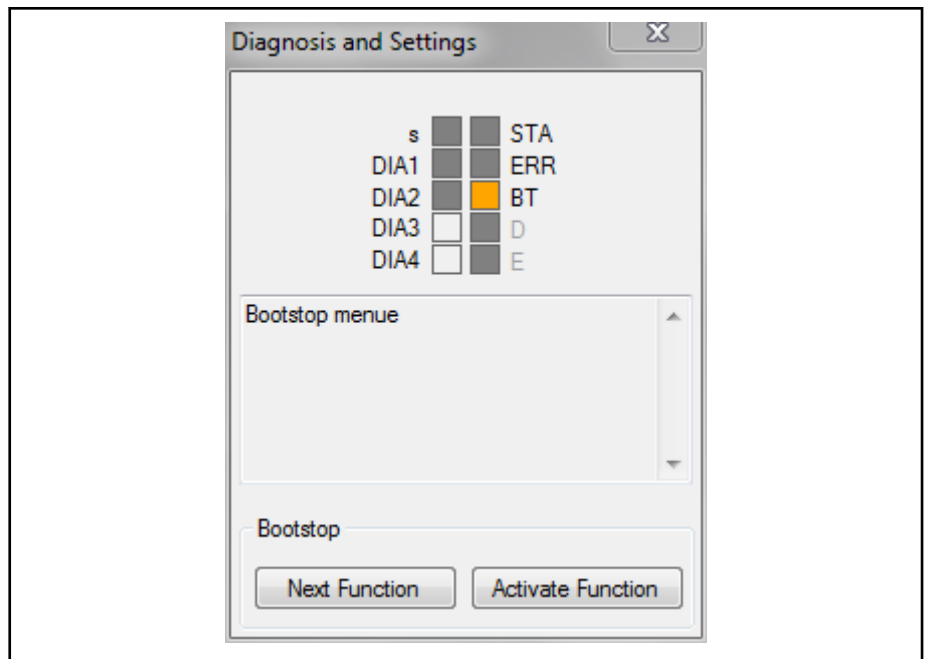


Fig. 3-49: Diagnostics and settings – Boot stop enabled

Next function: Call the next function.

Activate function: Enable the selected function.

For an exemplary description of the individual "BOOTSTOP" functions, refer to the commissioning chapter of the IndraMotion MLC XM2 control (refer to [chapter 3.4.7 "BOOTSTOP menu " on page 53](#)).

The "About" dialog displays general application information. It is called via the context menu of the application.

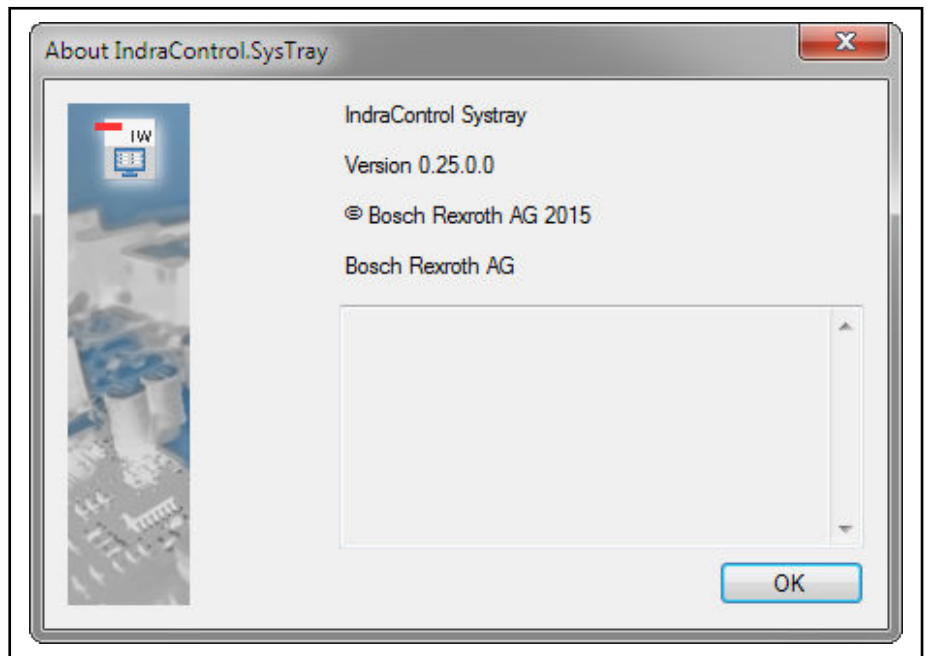


Fig. 3-50: "About" dialog

3.5.11 "BOOTSTOP" menu

Control startup is not yet completed in the BOOTSTOP menu. No applications can run in this state.

For an exemplary description of the individual "BOOTSTOP" functions, refer to the commissioning chapter of the IndraMotion MLC XM2 control (refer to [chapter 3.4.7 "BOOTSTOP menu " on page 53](#)).

3.5.12 Generating a core dump

Core dump refers to the backup of the complete RAM on the Compact Flash card of the control. This is only required for certain errors and requested by the support.

The control triggered a SysError. The "SysError" is displayed with error code under SysTray-> Diagnosis and Settings.

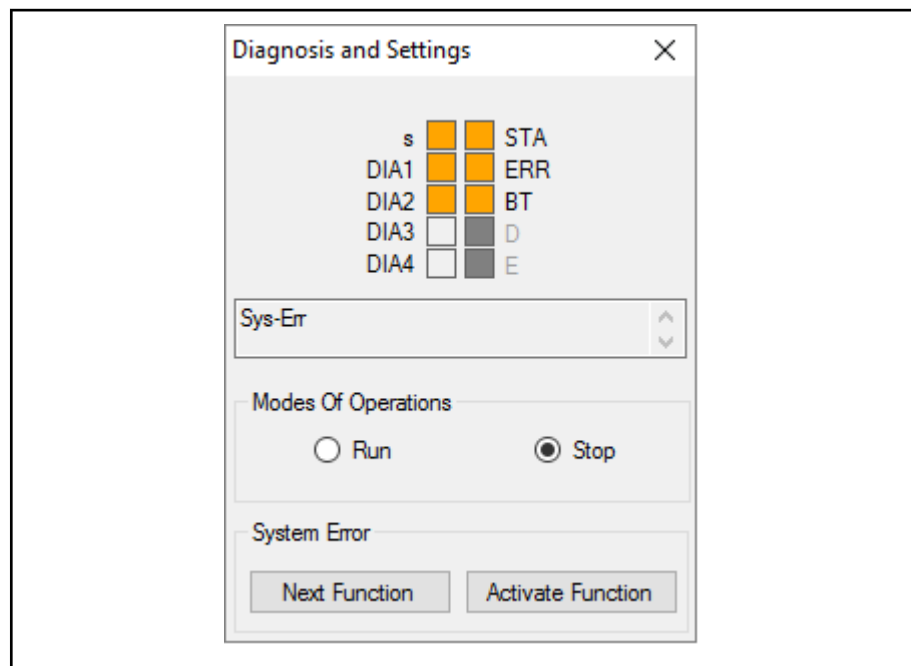


Fig. 3-51: IndraMotion MLC VPx: Display that SysError occurred

1. Select core dump, step 1
Press the button "Next function". It is changed to "Reboot control".

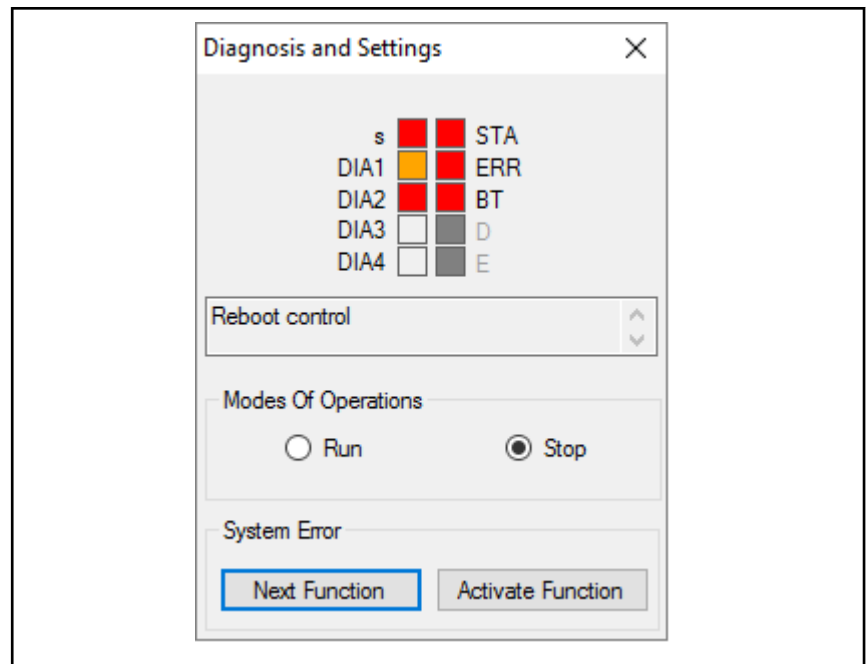


Fig. 3-52: IndraMotion MLC VPx: Core dump step 1
It is changed to "Reboot control".

2. Select core dump, step 2
Press the button "Next function" again.

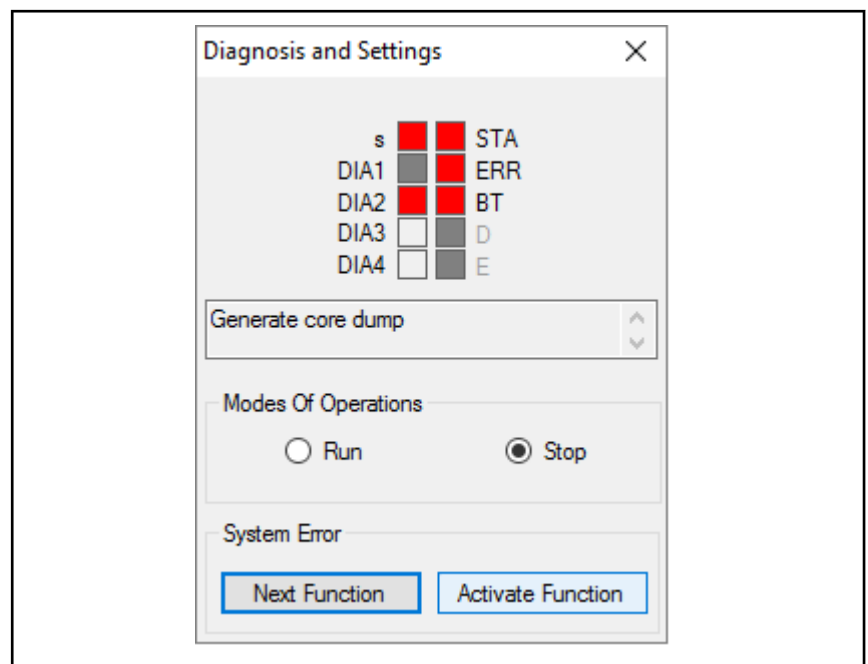


Fig. 3-53: IndraMotion MLC VPx: Core dump step 2
It is then changed to "Generate core dump".

3. Core dump backup.
Press the button "Activate function" to start the generation of the core dump.
The LED display becomes grey at first. The core dump is generated.

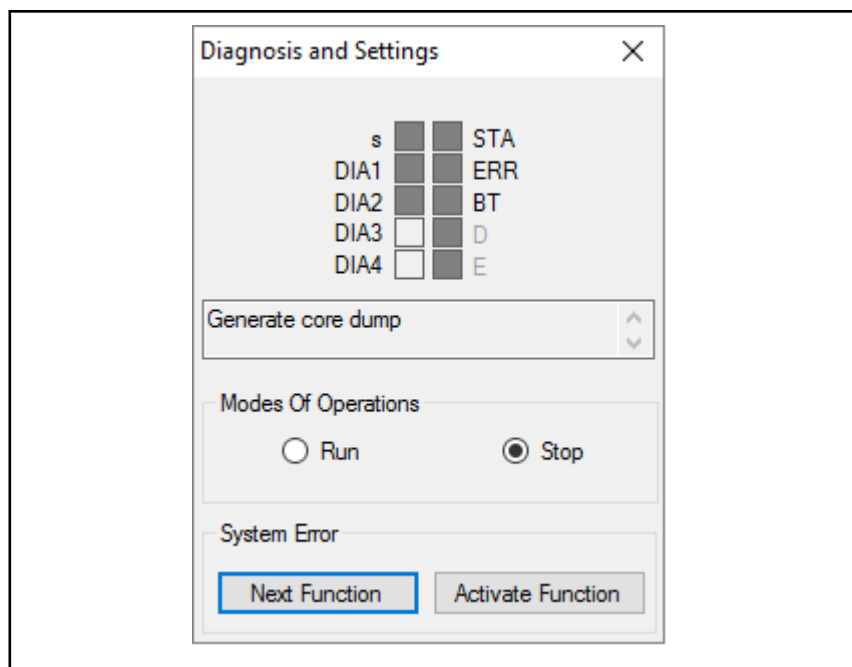


Fig. 3-54: IndraMotion MLC VPx: Core dump started

Right after process completion, the message "CoreDump generation succeeded" is displayed. In case of error, the message "CoreDump generation failed" is issued.

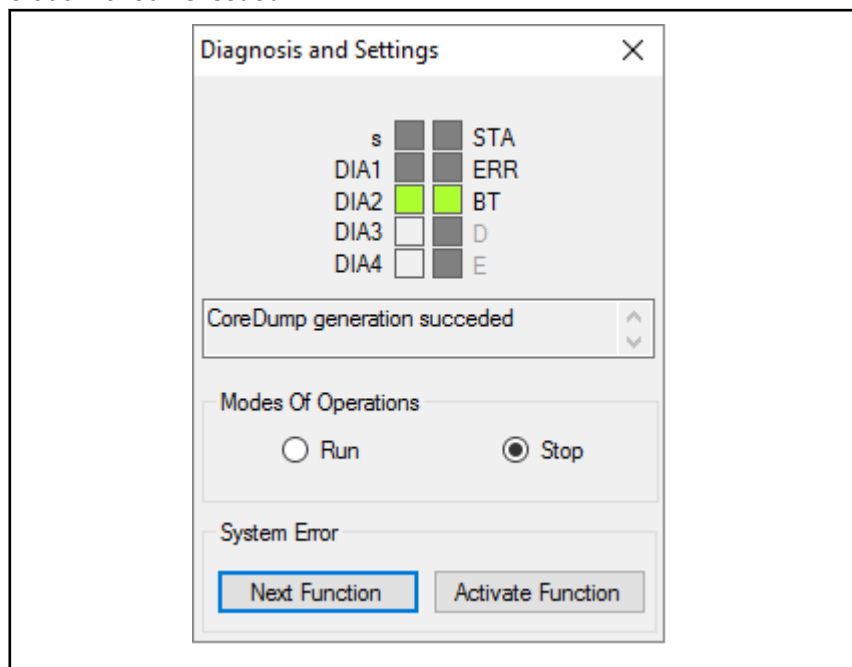


Fig. 3-55: IndraMotion MLC VPx: Core dump started

4. Control restart.

Due to the core dump backup, booting the control was interrupted. Use "Next Function" to select the "Reboot control" function. Confirm the restart with "Activate function". The control is restart.

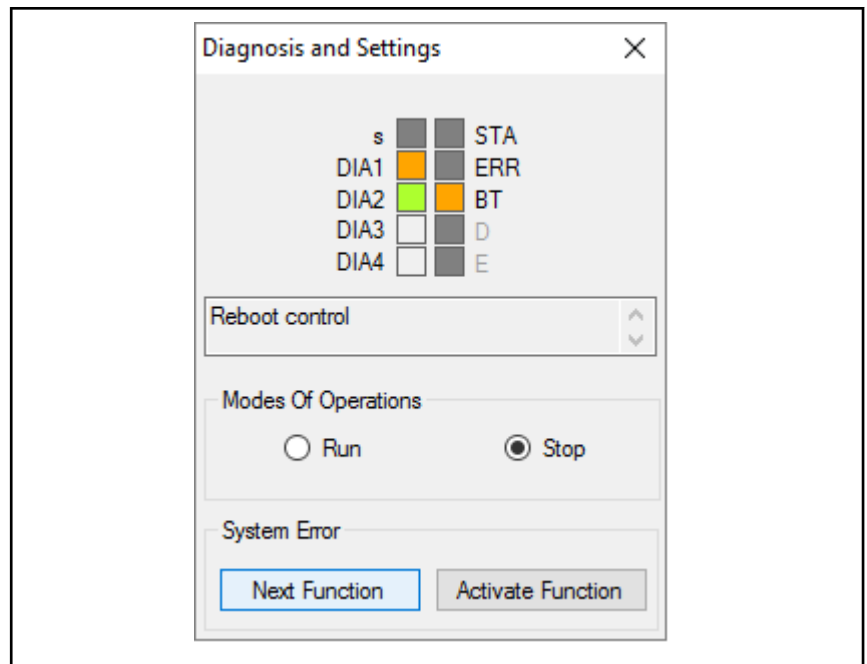


Fig. 3-56: IndraMotion MLC VPx: Continuing booting

The control boots.

After a successful core dump backup, "COREDUMP FINISHED" is displayed and booting is paused.

5. Core dump reading.

The previously generated core dump can now be retrieved via the IndraWorks File Explorer or an FTP client (**Set FTP transfer to Binary mode**). The file name is "vxcore1" and can be found on the /ata0b/ partition. It is also reasonable to back up the files "ExcLog.dat" and "ExcLog.bak".

3.5.13 IndraWorks Engineering

General information

To commission and project the Bosch Rexroth IndraMotion MLC control, the software "IndraWorks Engineering" is provided.

Features:

- PLC and MotionLogic programming based on CoDeSys V3 with object-oriented language extensions
- Comprehensive IEC 61131-3 and PLCopen-compliant software libraries
- Meaningful diagnostics
- Intelligent and wizard-supported operation
- Standardized interfaces such as FDT/DTM, connection of version control systems and Automation Interface

For more detailed information on IndraWorks Engineering, refer to the general IndraMotion MLC system manuals (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Firmware download

1. Select the control

Upon delivery of the device or when using a new MLC release, load the system firmware to the device. Highlight the corresponding device in the project tree and select the item "Firmware management..." from the corresponding context menu (via right-click).

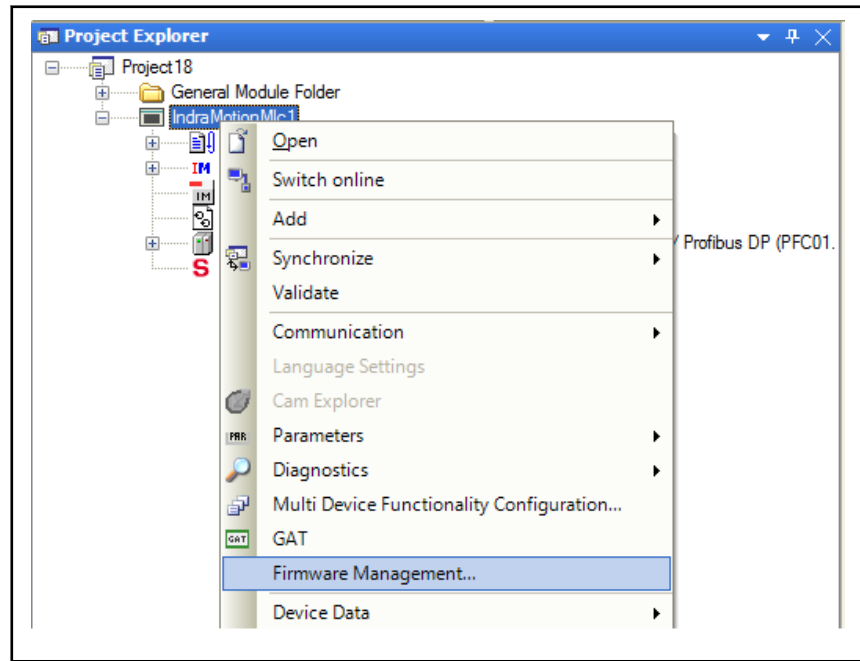


Fig. 3-57: Starting the IndraWorks firmware management

2. Select the system firmware

Select the system firmware for your device. To select the firmware from the IndraWorks installation, go to **Firmware of installation**. Alternatively, a firmware from any memory location on your PC can be selected via **Firmware of file**.



The name of a system firmware file valid for the target IndraMotion MLC VPx (based on IndraControl VPB 40.4) always starts with **IPC02s-MLC-...**

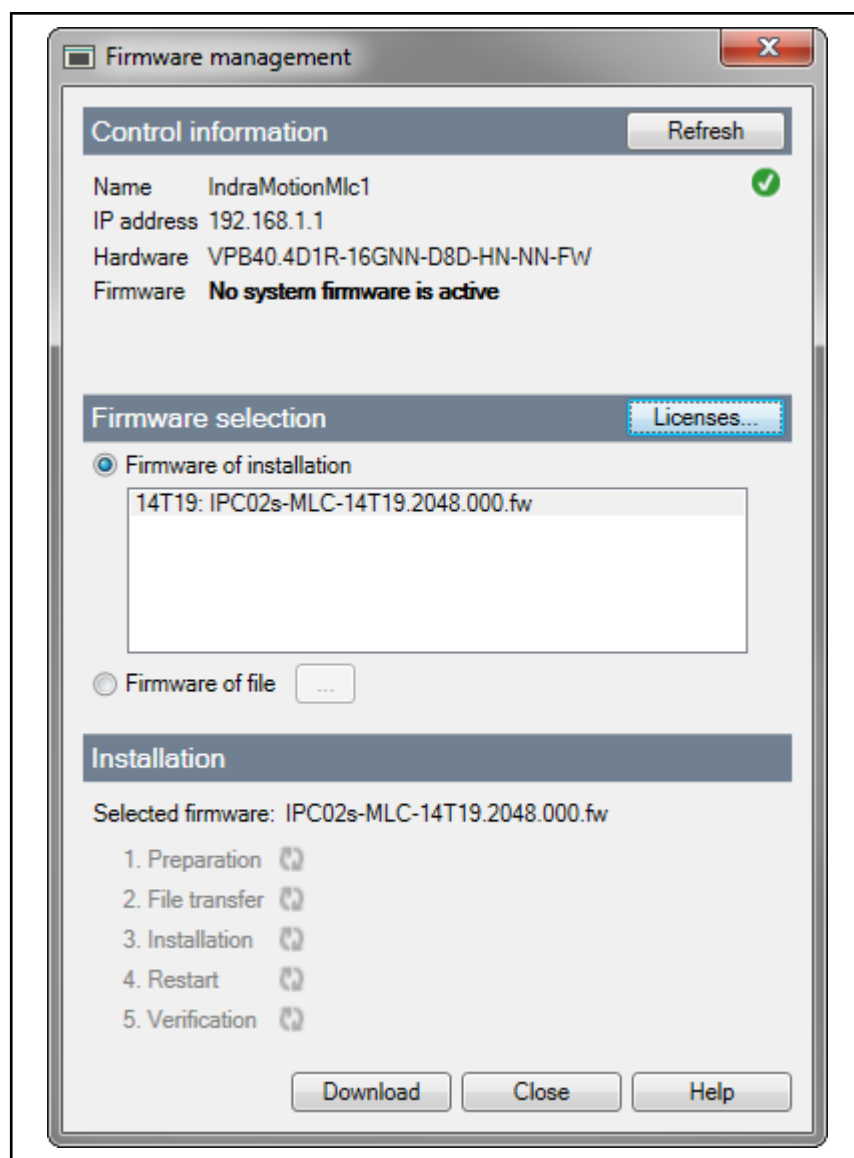


Fig. 3-58: Firmware selection

3. Download firmware

Select the system firmware file and press **Download**. Multiple steps have to be performed. The progress is shown in the dialog window of the firmware management.

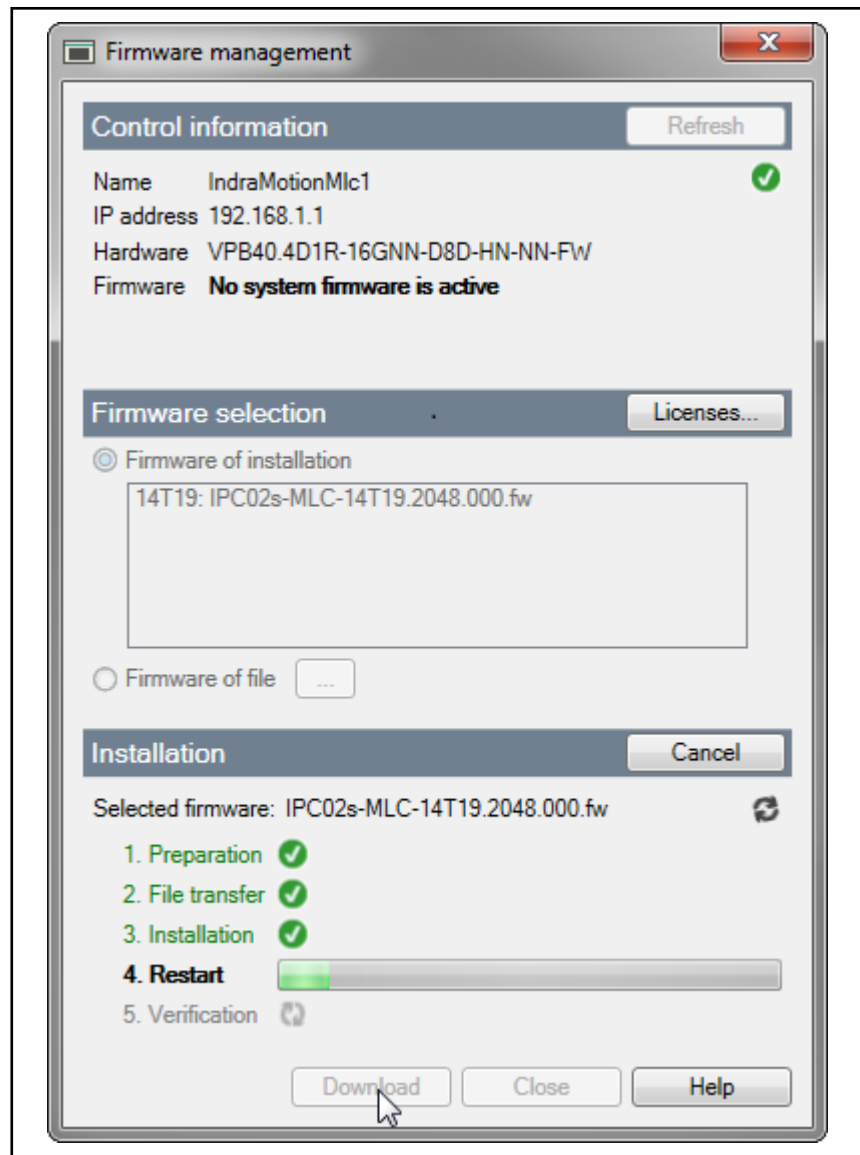


Fig. 3-59: Active firmware download



One the firmware download is started, do not press **Cancel**.

After the download, complete the dialog with **Close**. The system firmware is started.

4. Control restart

After the firmware has been downloaded successfully, the control is automatically restarted.

Under certain circumstances, an FPGA update on the hardware is additionally required. In this case, the following message (PWRCYCLE) is displayed after the firmware download:

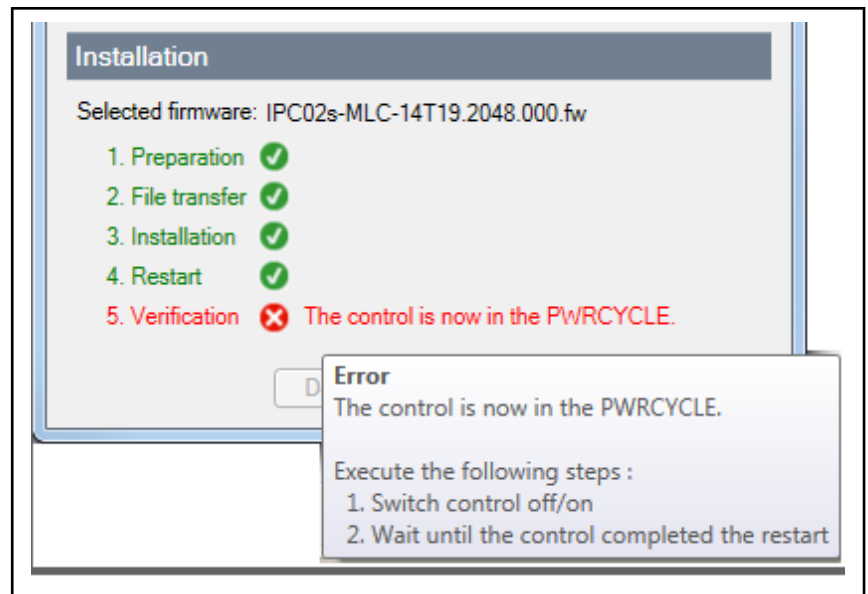


Fig. 3-60: Firmware download: Message "PWRCYCLE"

In this case, shut down the industrial PC. Separate the power supply from the UPS for a short period and wait until the UPS is switched off. Then, restart your system.

The control is then ready.

3.5.14 Backing up remanent data

An additional UPS is required for the controls IndraMotion MLC VPB 40.4 to back up remanent data. When the 24 V supply voltage fails, the UPS signals the control firmware to back up the remanent data on the hard disk. These are restored upon the next control startup.

3.5.15 Behavior in case of fatal exception (SysError)

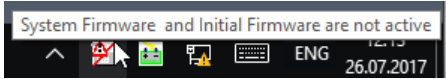
If there is a fatal exception at the control (in the MLC often referred to as SysError), the following behavior can be observed at the control:

3.5.16 Error causes and troubleshooting

For LED error displays on the housing front, refer to [chapter 3.5.5 "Operating and error displays" on page 78](#).



The operating and error displays of the Safety extension card PFC01.1-SY-01 are separately described in the operating instructions "IndraControl PFC01.1-SY-01 Safety Extension Card" (part no. [R911373152](#)).

Error	Troubleshooting
Control does not yet boot ("Wait on service" or "System and initial FW are not active") 	Cause: The NFS server might be blocked via a firewall Solution: Check whether the NFS server is shared in the firewall and share "C:\Program Files (x86)\Rexroth\VPx RT-Ext MLC-xxVRS\bnfsserv.exe" manually in the firewall if required
Firmware download already ends with timeout under "1. Preparation" 	Cause: The FirstTouch server might be blocked via a firewall Solution: Check if the FirstTouch server is activated in the firewall and if required, activate "E:\bin\firsttouch.exe" manually in the firewall
The icon  is now displayed in the Windows Systray	The control reports a system error
Wrong display resolution	- Set the correct display resolution in the graphics driver - Restart the industrial PC
The device switches off unintendedly	Check the max. current consumption of the connected USB devices
No image output	- Check that both CDI cables (XSER and XVID) are connected - Check that the CDI cables (XSER and XVID) are not interchanged
No or incorrect network data transmission if the data transmission rate is set manually	The network card of the remote station has to be able to process the same data transmission rate as the industrial PC. If necessary, change the data transmission rate in Control Panel ► Network Card
No Sercos connection	- Check cables and connections at XF01 and XF02 - Check the project planning of the extension card PFC01.1-FB-01 - Check messages in IndraWorks or in the IndraMotion Service Tool (IMST)

Error	Troubleshooting
No Profibus connection	• Check cables and connections at XF08 • Check the project planning of the extension card PFC01.1-FB-13 • Check messages in IndraWorks or in the IndraMotion Service Tool (IMST)
No Profinet connection	• Check cables and connections at XF40 and XF41 • Check the project planning of the extension card PFC01.1-FB-13 • Check messages in IndraWorks or in the IndraMotion Service Tool (IMST)

Tab. 3-21: Error causes and troubleshooting

3.6 Installing and starting IndraWorks

Installing "IndraWorks Engineering"

Before the initial use, install the project planning and programming software "IndraWorks Engineering".

For more information on the installation, refer to the documentation "IndraWorks 14VRS Software Installation" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

In order to ensure executability, the following conditions have to be met:

- Pentium 3 PC, 1 GB RAM (4 GB RAM recommended), 5 GB hard disk capacity
- Operating systems:
 - Windows XP Professional Service Pack 3
 - Windows Server 2003 Service Pack 2
 - Windows 7 Professional 32/64 bits
 - Windows 10 32/64 bits

Windows 7 or Windows 10 with 64 bits are recommended for big projects. With these operating systems, up to 4 GB application memory are provided for IndraWorks.



On the installation CD or when installing from the network drive, there is an installation manual with information on possible service packages.

IndraWorks - Startup

After , the initial start of IndraWorks Engineering (or after **View ▶ Startup**), the following screen is displayed:

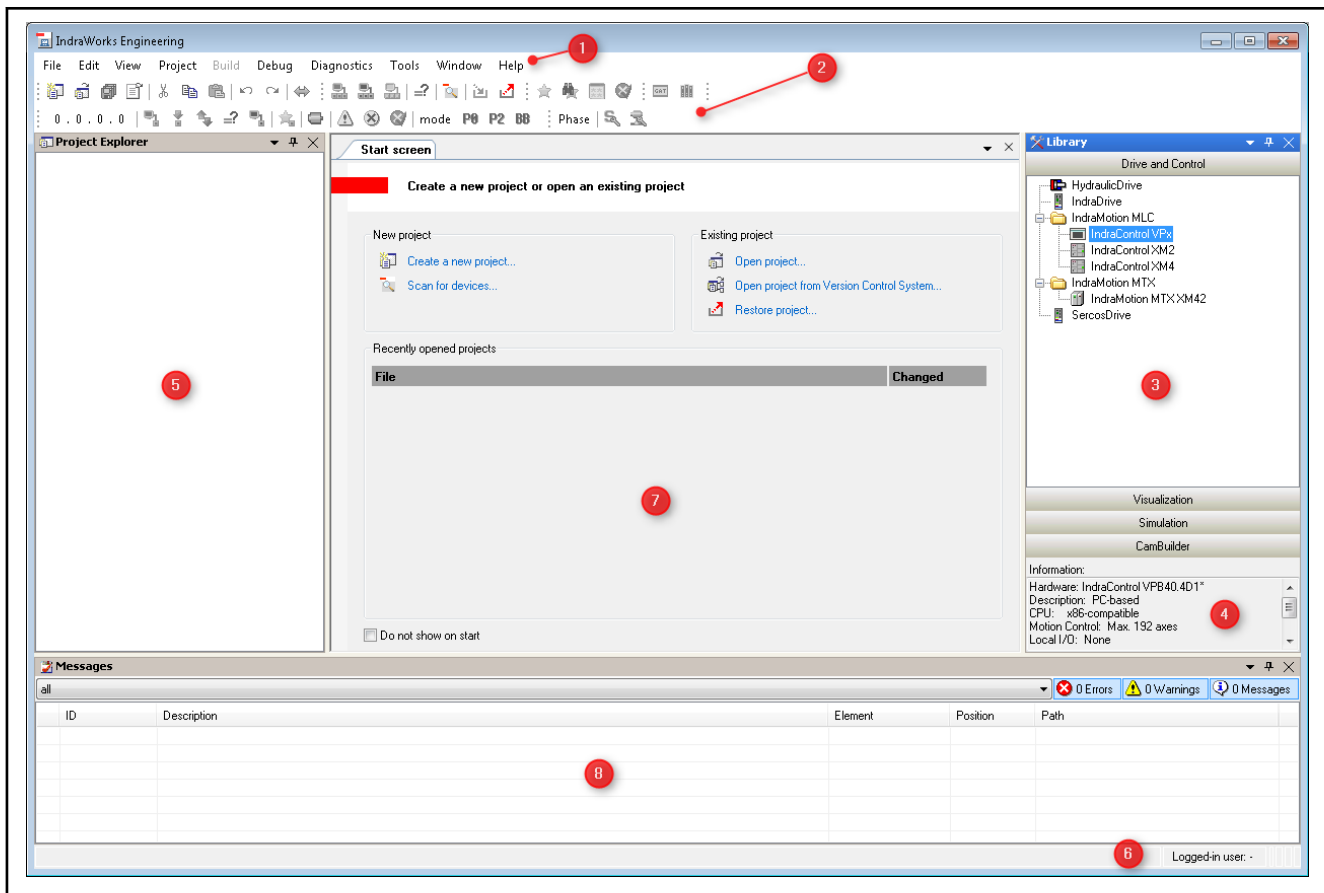


Fig. 3-61: Engineering Suite – Start screen after initial start

The figure illustrates the menu ① of the Engineering Suite. The menu items can be supplemented or changed while working in the Suite. Menus that cannot be used are grayed out.

Display/hide ("View" menu item) and configure the toolbars ② below the menu.

The library ③ contains the elements which can be used for the configuration in the Engineering Suite. These elements are stored in the following folders:

- **Drive and Control:**
 - EcoDrive Cs (PackProfile)
 - FDT Container
 - HydraulicDrive
 - IndraDrive
 - IndraLogic XLC
 - IndraControl L75
 - IndraControl L65
 - IndraControl L45
 - IndraMotion MLC
 - IndraControl VPx
 - IndraControl XM2
 - IndraControl XM4

- IndraControl L75
 - IndraControl L65
 - IndraControl L45
- SercosDrive
- etc.
- **Visualization:**
 - OEM data
 - VCP/VCH
 - VEH/VEP
 - VH21/VR21
 - VPx/VSx
 - VR3x/PR3x
 - VR4x/PR4x
 - WebComposer commissioning visualization
- **Simulation**
- **CamBuilder:**
 - Cam Pool
 - Cam
 - Preview
 - Preview of the superimposed cams (X/Y)

Right-click on the element for the help on each element.

If an MLC control is created, the library is extended by the following groups:

- **Periphery**
- **Function modules**
- **PLC objects**

The current library element is described in more detail in Information ④.

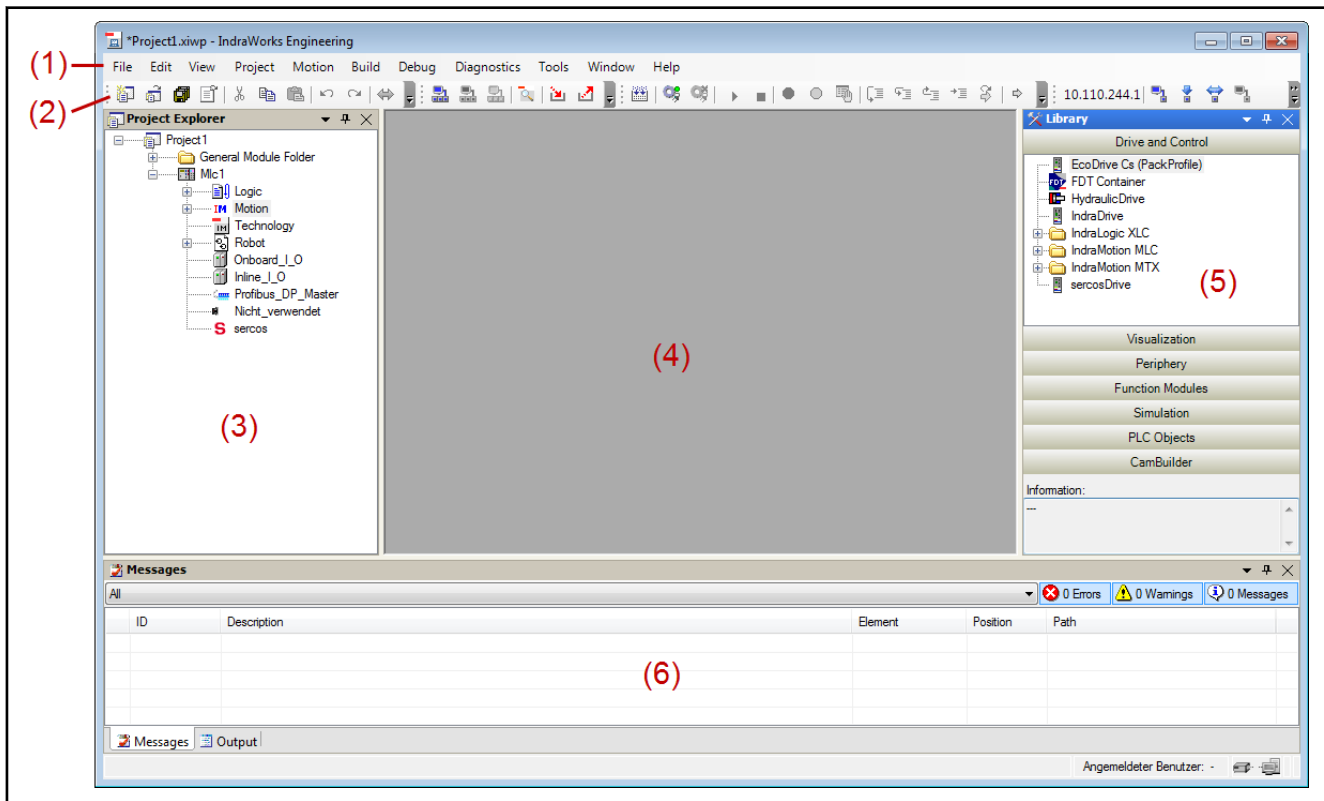
Area ⑤ is reserved for the Project Explorer. In the Project Explorer, the library elements are arranged according to the preferences of the user. Working with the Project Explorer is described in the following chapters.

The status bar ⑥ contains information on the current project (online/offline).

As an alternative to the start screen, the central area ⑦ provides space for the parameterization and configuration dialogs opened by the user.

Messages about the current project are displayed in the "Messages" ⑧ window.

3.7 Overview on the IndraWorks interface



- ① Menu bar
- ② Toolbar
- ③ Project Explorer
- ④ Workspace and document window
- ⑤ Device libraries
- ⑥ Message window

Fig. 3-62: IndraWorks interface with default settings

Menu bar ① The menu bar ① and menu items are freely configurable. Move, delete, add and rename complete menus or menu items. To edit the menu items, select **Tools ► Customize...** (or <Alt> + <x> and <a>). All menu items are stored in the "Commands" tab of the "Customize" dialog. Keep the mouse button pressed to store the individual menu items in any menu of the menu bar. When the "Customize" dialog is open, right-click to open a context menu for each menu and menu item in the menu bar. Rename or delete (among other functions) entries using the context menu.

Toolbar ② The toolbar is ② freely configurable. Move, delete or add icons. To edit the icons, select **Tools ► Customize...** (or <Alt> + <x> and <a>). In the "Customize" dialog, select and deselect predefined and self-created toolbars. In the "Commands" tab of the same dialog, all menu items are also stored as icons. Keep the mouse button pressed to store the individual icons in any toolbar. When the "Customize" dialog is open, right-click to open a context menu for each icon in the toolbar. Rename or delete (among other functions) entries using the context menu.

Move the individual toolbars with . If the toolbar is drawn over a defined area, it becomes a separate window. In order to dock the toolbar again to the IndraWorks interface, move the window with the toolbar to the required position in the IndraWorks interface.

Project Explorer ③	The Project Explorer is preset on the left of the workspace. The Project Explorer is a structured representation of projects and their components. Right-click on a context menu for each item in the Project Explorer.
Workspace and document window ④	The workspace shows document and tool windows to edit different objects of the IndraWorks project.
Device libraries ⑤	The devices available for an IndraWorks project are stored in the device libraries. The devices are classified into different groups: • Drive and Control • Visualization • Periphery • Function modules etc.
Output window ⑥	Status and diagnostic information on the current project are output in the output window.
Windows	Freely move and dock the individual windows, such as the "Workspace" or "Library", in IndraWorks. Arrows show possible positions while moving. Drag a window directly to the arrow with the mouse button pressed (refer to the following figure).

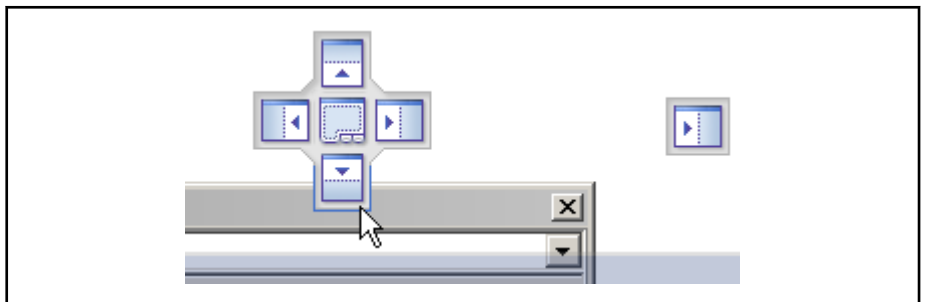


Fig. 3-63: Docking arrows

Each window can also be positioned outside the IndraWorks interface. There are further settings in the context menu of the window. Go to the context menu of a window via the title bar.

Resetting interface layout	The standard user interface can be reset via the Window ► Reset window layout menu.



For more information on the user interface and handling of IndraWorks, refer to the "IndraWorks 14VRS Engineering manual for " (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

3.8 Creating a project

A new project is created via the "IndraWorks - Startup" on [page 103](#) or via the menu items **File ► New ► Project**.

When IndraWorks projects are created, an ID is given in 13VRS and higher. This version ID indicates the minimum IndraWorks installation before editing the project. For more information, refer to the manual "Rexroth IndraWorks 14VRS Engineering", chapter "Working with IndraWorks ⇒ Compatibility mode" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Via the following dialog box, determine project name, project type and compatibility mode.

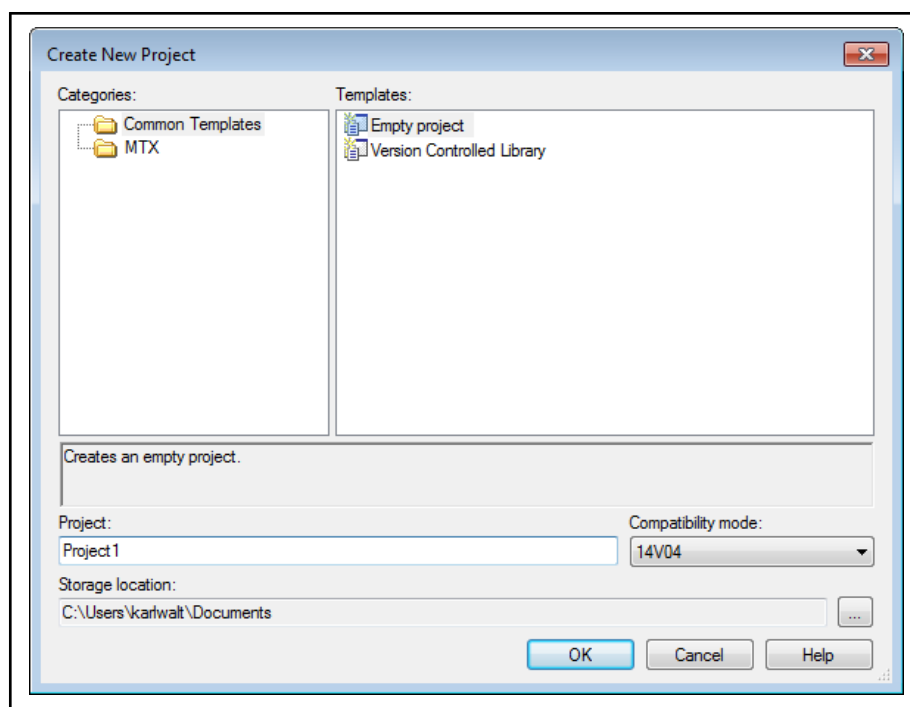


Fig. 3-64: Creating a new project – Specifying the name



The suggested default name can be changed by the user.

Context menu of the project

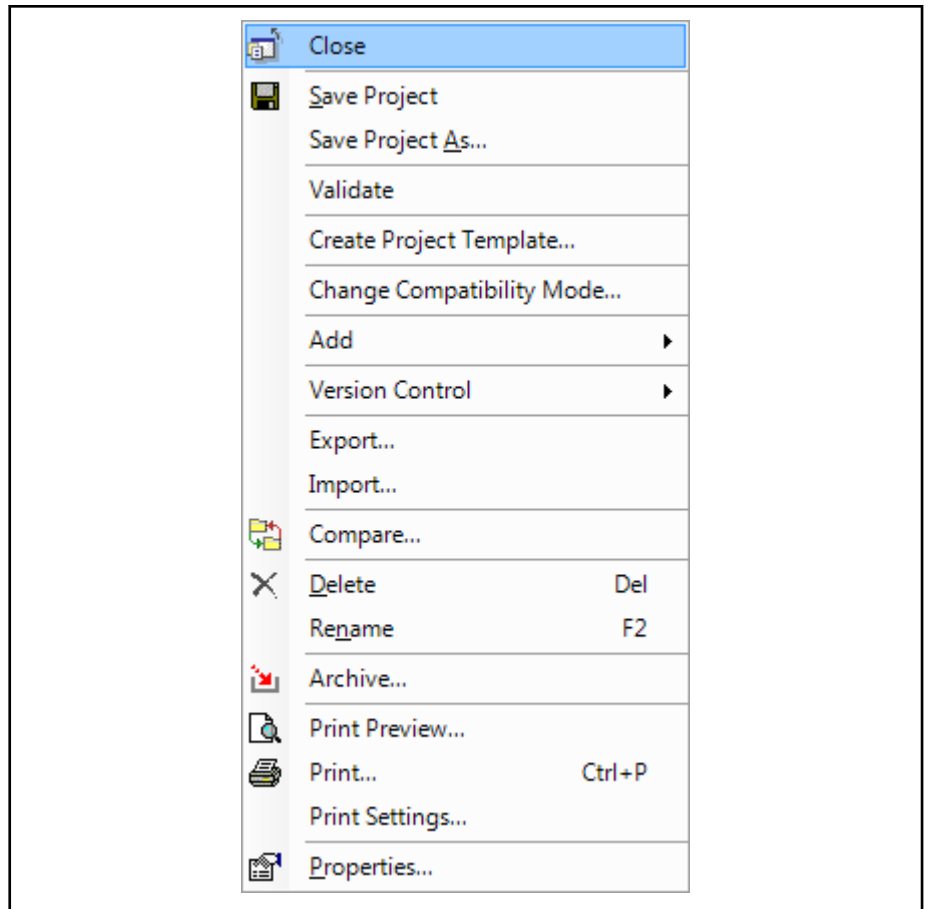


Fig. 3-65: Context menu of an empty project

Right-click on the project to open the context menu (or press <Shift> + <F10> on the project).

The context menu of an empty project contains the following menu items:

- **Close** - The current project is closed and saved
- **Save Project** - The current project state is manually saved
- **Save Project As** - Current project state is stored manually with the same content, but under a different name and in a different folder
- **Validate** - IndraWorks checks for configuration errors in the Motion configuration, see [chapter 7.12 "Validating Motion configuration" on page 560](#)
- **Create Project Template...** - Selects a project template as template when creating an IndraWorks project
- **Change Compatibility Mode...** - Allows to specify the project version to a selected IndraWorks version. For more information on the compatibility mode, refer to the manual "Rexroth IndraWorks 14VRS Engineering" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#))
- **Add** - Allows to add a new folder, new file or new element to the project
- **Version Control** - Allows to record changes in documents or files, see [chapter 4.6 "Version control of the control" on page 308](#)
- **Export...** - Saves elements from the current project to a file [chapter 4.4.14 "Exporting" on page 268](#)

- **Import...** - Imports elements from a file into the current project, see [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the created project
- **Rename** - Allows to rename the project
- **Archive** - Current project state is stored in the file system or on the device as a password-protected data record (optional), see [chapter 4.7 "Complete data backup" on page 309](#)
- **Print Preview...** - Provides a preview of project and device data to be printed
- **Print...** - Printing project and device data
- **Print Settings** - Selects font and size for printing
- **Properties** - displays project name and path



By creating controls and axes, etc., the context menu is supplemented with further menu items (e.g. **Switch Devices Online**).



The changes are saved automatically controlled by the Suite. However, the user can trigger the saving process themselves at this place.

If the user has a "CamBuilder" license, a "Cam Pool" folder can be created to store cam data via the library ("CamBuilder" tab).

Also refer to the documentation "Rexroth IndraWorks 12VRS CamBuilder" [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#).

Operating strategy

There are the following fundamental options to operate the Engineering Suite:

- Drag elements from the library and drop them in the Project Explorer at the desired position (this option is used with physically existing elements (e.g. control or real axis), see also ["Creating control via drag&drop" on page 114](#))
- Right-click to define the element in the Project Explorer at the desired position (this option is used with logic elements, e.g. virtual axis, see also [chapter 6.4.2 "Creating a virtual axis \(virtual master axis\)" on page 391](#))

3.9 Offline parameterization

Support offline parameterization for drives (S-/P-parameters)

From version 14VRS, IndraWorks provides the option of offline parameterization for MLC/XLC controls and drives. The offline parameterization uses offline parameter data that are saved in the IndraWorks project. Thus, controls and drives can be parameterized without hardware in offline mode.



The "offline parameterization" control option is disabled in the default project settings!

Benefits:

- Lower project data volume
- Shorter operating times as for e.g. during parameter adjustment or archiving

Enabling the option, see ["Enabling the offline parameterization" on page 111](#)

Use cases

Subsequently, potential use cases for offline parameterization are described.

If the offline parameterization is not required, it is recommended to disable the option to benefit from a smaller project data volume and shorter runtimes.

- **Advance Engineering/prototypes**

Machine projects are often configured at an early stage at which no machine prototype is available yet.

In this phase of the development, the offline parameterization facilitates configuration and parameterization of axes without hardware. The axis configuration can thus be configured and parameterized prior to the initial commissioning.

→ Reduction of commissioning times

- **Support case**

During the machine operation, it can sporadically be required to correct the axis parameters (e.g. by the OEM²⁾ support).

The offline parameterization allows to correct axis parameters in the project without having to access the real hardware. The OEM support can thus edit the system project and prepare the project for the transfer to the system or the drives.

→ Access to S/P-parameters without real hardware

- **Retrofitting**

During a machine life cycle, retrofit can be required.

The offline parameterization allows to adjust the original machine project without access to the hardware prior to retrofitting. Thus, machine down-times during retrofitting can be reduced.

→ Preparation of project adjustments without real hardware

Enabling the offline parameterization

The control option "Offline parameterization" can be enabled:

1. When creating a new control in step 3: "Extended settings" by enabling the option "Support offline parameterization for drives (S-/P-parameters)".

Refer to ["Step 3: Extended settings" on page 117](#)

2. At a later point, in case of existing controls in the extended settings of the control.

Use the context menu of the control node:

→ **Properties... ► Extended settings**

Enable the checkbox "Support offline parameterization for drives (S-/P-parameters)" to enable the offline parameterization.

²⁾



The offline parameterization can cause a higher project data volume and longer runtimes, e.g. during parameter adjustment or archiving.

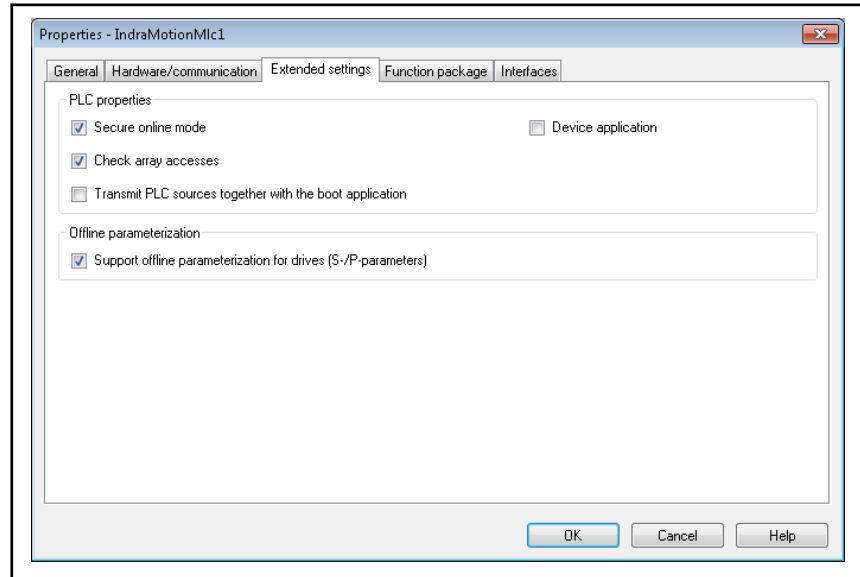


Fig. 3-66: Control properties dialog "Extended settings"

Offline parameterization settings

The following settings can be selected in case of an enabled "Offline parameterization":

1. **Configuring a real axis in offline mode** (entering power section and control unit, motor and firmware).

An offline parameter file is automatically generated for the new axis and is saved in the project. To configure drive-specific dialogs of the axis node, the drive server is started automatically. The parameters of the offline parameter file are visible in the relevant axis dialogs.

The option "Subsequently start wizard to configure the drive" is provided in the axis wizard "Step 2: Configuration".

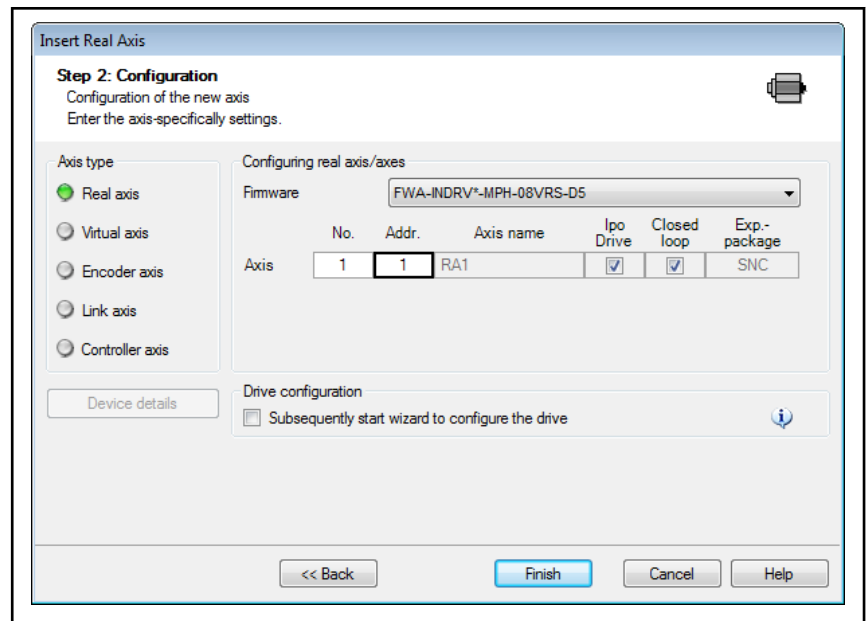


Fig. 3-67: Creating a real axis (IndraDrive) - Configuration

2. During the parameter adjustment, the adjustment of S-/P-parameters is available in case of active offline parameterization, see [chapter "Parameter adjustment" on page 226](#)

Offline parameterization via parameter file

To use the offline parameterization for S/P-parameters of the drives, the offline data has to be generated. The data can be generated as follows:

- by configuring the drive during the creation (power section, control unit, motor) with the offline configurator via **Real axes ► Add ► Real axis... ► Subsequently start wizard to configure the drive**
- by adding a real axis/drive from a parameter file via **Real axes ► Add ► Real axis... ► Select template...**
- by importing a parameter file (requirement: all parameters have been backed up - not only the parameters required to restore data) via **Real axes ► Drive x ► Import...**
- by adjusting the parameters of the control -> project (only possible online) **Real axes ► Parameters ► Execute parameter adjustment...** Parameters can be adjusted completely, device-specifically or only individual parameters can be adjusted from offline (project) to online (device) and vice versa.



Not all dialogs are available offline! In particular the communication dialogs (e.g. cyclic Sercos data, signal control word, signal status word) cannot be parameterized offline



A parameter that has been changed offline does not automatically influence the offline parameterization and vice versa.

The parameter change on the device (IndraDrive or MLC) has to be triggered by a parameter adjustment/download.

3.10 Creating a control

There are two options to create a control in the project:

Creating control via drag&drop Create a control in a project by dragging the library element from the respective subfolder (IndraLogic XLC, IndraMotion MLC) of the "Drive and Control" library folder to the project folder. The properties of the element are shown in the information window.

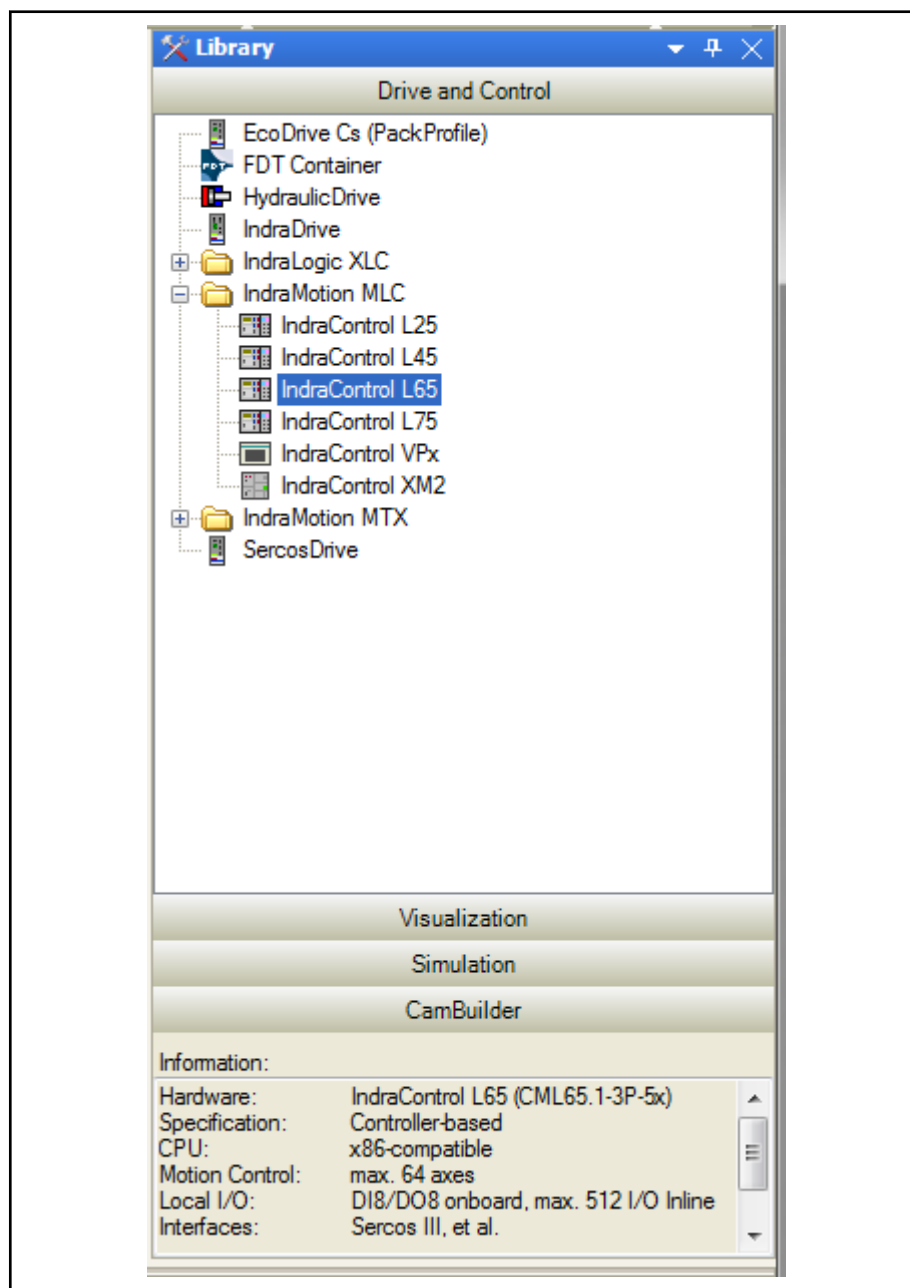


Fig. 3-68: Creating a control (as shown for the IndraMotion MLC L65) - Dragging from the library

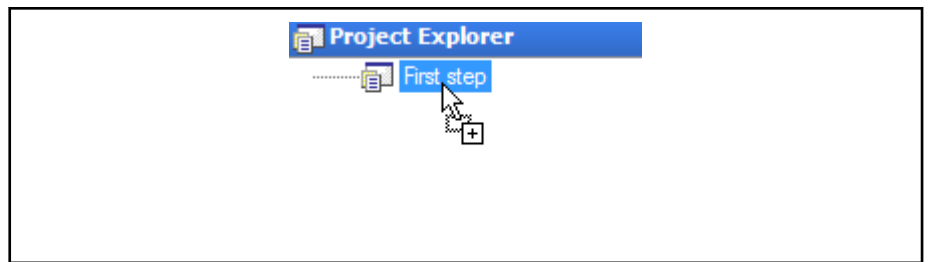


Fig. 3-69: Creating a control - Dropping it in the Project Explorer

Creating a control via the context menu

Right-click on the project node to open the context menu of the project. Select the control via the menu item "Add".

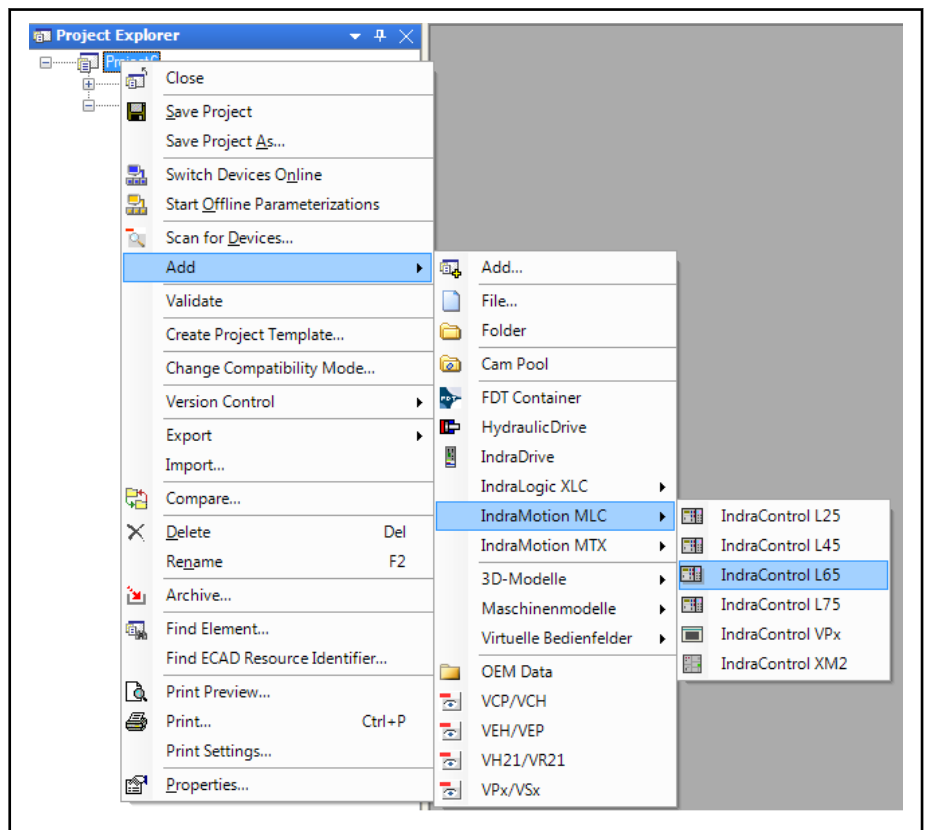


Fig. 3-70: Example: Creating an IndraMotion MLC based on the IndraControl L65 hardware in the project

Creating a control by copying

A control can also be added via "copy and paste". A control that already exists in the project is copied and pasted at the project node.

Dialog to create a control

Creating a control is supported by a wizard in four to five steps.

Step 1: "General settings"

In this step, the **device name**, **comment** on this device and **author** are entered. The preset values can be applied or changed. A comment is optional. A comment is subsequently displayed as tooltip in the Project Explorer.

The suggested **name of the author** is derived from the current Windows login data.

Select a template for the following settings via **Select Template....** Either an already existing control in the project or the parameter backup of a control can be selected as template (see [chapter 3.11 "Creation based on templates" on page 119](#)).

Step 2: "Hardware/communication"

Device configuration

- **Device type**

The "Device Type" shows the system and the hardware of the control to be created. If there are several hardware variants for one system, select the hardware variant. The control hardware is written on the type plate of the control.

The following hardware types are available for the IndraMotion MLC:

Type code	IndraControl	Sercos III	Profibus/Profinet/ Ethernet IP onboard
CML45.1-3P	L45	•	•/•/•
CML65.1-3P	L65	•	•/•/•
CML75.1-3P	L75	•	•/•/•
XM2100.01-.../ XM2200.01-...	XM2	•	-/-/-
XM4203.21-...	XM4	•	-/•/•
MLC VP SET	VPx	•	•/○/○

- Default
- Option
- Not available

Tab. 3-22: IndraMotion MLC hardware variants

The following hardware types are available for the IndraLogic XLC:

Type code	IndraControl	Sercos III	Profibus/Profinet/ Ethernet IP onboard
CML45.1-3P	L45	•	•/•/•
CML45.1-NP	L45	-	•/•/•
CML65.1-3P	L65	•	•/•/•
CML65.1-NP	L65	-	•/•/•
CML75.1-3P	L75	•	•/•/•
CML75.1-NP	L75	-	•/•/•

- Default
- Not available

Tab. 3-23: IndraLogic XLC hardware variants

- **Firmware version**

Generally corresponds to the IndraWorks Suite version

- **Firmware release**

Indicates the firmware release in the version.

This firmware release can be subsequently updated. If the project was loaded in the compatibility mode, this compatibility mode has to be set to the current IndraWorks version before if necessary. For more information, refer to the manual "Rexroth IndraWorks 14VRS Engineering", chapter "Working with IndraWorks ⇒ Compatibility mode" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Ethernet communication

- **Engineering**

For the IndraControl XMx control, the communication can also be established via the micro USB port of the hardware instead of the Standard Ethernet Engineering port.

If the "Micro USB" option is selected, the IP address to set to "192.168.234.234"

- **IP address**

The entered control address has to be valid. Otherwise, there is no communication to the control

The IP address corresponds to the IP address set in section [chapter 3.3.6 "Setting the IP address" on page 33](#)

- **PLC gateway**

Use "localhost" if the PLC gateway is on the computer IndraWorks is installed on. Otherwise, enter the IP address of the computer and of the gateway

- **PLC communication**

In version 14VRS and higher, it can be chosen between two PLC communication types

- **TCP** is recommended due to a better firewall handling and no required broadcast (no broadcast towers). Due to the protocol, it is slower than UDP
- Due to compatibility reasons, **UDP** is provided for controls of the 13VRS

- **Connection test**

Start the connection test via **Execute**. First, the connection test checks whether a control with this IP address (ping) exists and responds with the device name of the control and the current user name (author). Both can differ from the device name and the author. The PLC communication is checked in the second step

Step 3: "Extended settings"

PLC properties

- **Secure online mode**

The "Secure Online Mode" switch enables additional requests to start and stop the PLC and to force values in the PLC monitoring. Due to security reasons, the "Secure Online Mode" is enabled by default

- **Checking array access**

If this switch is enabled, the check function "CheckBounds" from the template database is automatically inserted below the PLC application node.

If this switch is disabled again in case of an already existing control, the check function "CheckBounds" is only automatically removed if the following comment block is still present in the implementation section of the check function:

```
(*****
** This function was generated by the 'check array
access' option of the "Properties" dialog of the con-
troller. If you delete this comment, this function
will not be removed by disabling the 'check array ac-
cess' option.
```

*)

To ensure that customized adaptations are not deleted in the implementation section of the check function when the switch is disabled, remove the comment block.



As the automatically inserted check function is not removed anymore when deleting the comment block, the "CheckBounds" function has to be deleted manually from the application to disable the monitoring of the array limits.

A disabled switch does not mean that no CheckBounds functionality is active.

If the check function is inserted or deleted, login via online change is not possible. A download is required.

The checkbox is only selected if the PLC application type "Standard" or "GAT Wizard" is enabled and if there is no user-defined CheckBounds function

• Transferring PLC sources together with the boot application

When transferring the boot application, PLC program sources (POUs, tasks, etc.) are transferred to the control in addition to the compilation. Use this function to additionally display a detailed comparison for the PLC elements during the online comparison

PLC programming templates

Select between the following variants for the PLC application to be created:

- **Default:** The empty default programs "MotionProg" and "PlcProg" are automatically created in the selected programming language. For other PLC objects, the programming language is selected when creating the object
- **GAT wizard:** In an additional dialog, example projects or programming templates can be selected. GAT is a programming frame ready for operation with predefined locations for the application code. Professional and well-structured application programs with prepared elements using the dialog-based code generation of the GAT Wizard are automatically created
- **Empty:** Creates an empty, non-executable PLC application without programs and tasks

Offline parameterization

The offline parameterization for drives allows to edit drive parameters in offline state without being connected to a real drive, see [chapter 3.9 "Offline parameterization"](#) on page 110.

Drive parameters are provided to the Engineering PC via local drive servers and saved in the project (simulation of the drive firmware).

Prerequisites:

- Control with Sercos interface
- Control firmware 14VRS and above
- At least one real axis/drive is configured in the project

Parameters edited via offline parameterization can be transferred to the real drive via parameter adjustment. The adjustment can either be complete, de-

vice-specific or parameter-selective in both directions, i.e. from the project to the drive or from the drive to the project.

Refer to [chapter "Parameter adjustment" on page 226](#)

Option: "Support offline parameterization for drives (S-/P-parameters)"

- : The offline parameterization is disabled (default settings).
The option can be enabled or disabled subsequently in the control properties.
Refer to ["Tab Extended settings" on page 280](#)
- : The offline parameterization is enabled.
S-/P-drive parameters can be saved in the project and can be edited without online connection to the drive.



The offline parameterization can cause a higher project data volume and longer runtimes, e.g. during parameter adjustment or archiving.

Step 4: "Function packages"

Select the function packages required for the control in the third dialog of the wizard. The selected function packages define the functional scope of the runtime.



Function packages are subject to license and have to be ordered for each hardware.

For IndraControl L controls, the function packages are fixedly predefined and do not have to be ordered separately.

Step 5: "Interfaces"

In this step of the wizard, the use of Onboard interfaces, Profibus DP and Ethernet-IP Slave has to be defined. Preset the actual order of the required function modules.



A function module can also be entered into the IndraLogic XLC/IndraMotion MLC Lxx even if the function module is not yet connected to the control.

While going online, the absence is acknowledged by an error message.

A subsequently connected module is detected at next control startup.

Press **Finish** and in the following waiting time, the PLC program belonging to the project is automatically created in the background.

The device is thus added to the current project.

Overview in the Project Explorer

The project structure is explained in [chapter 4.1 "Project structure" on page 161](#).

Context menu

The context menu items are described in [chapter 4.4 "Control – Context menu" on page 206](#).

3.11 Creation based on templates

The "Select Template" dialog can be started on the first site of the creation wizard when creating controls, axes and kinematics.

Enter the template used to create the drive. All template properties are applied.

Click in the lower right on **Select Template...** in the "General Settings" dialog.

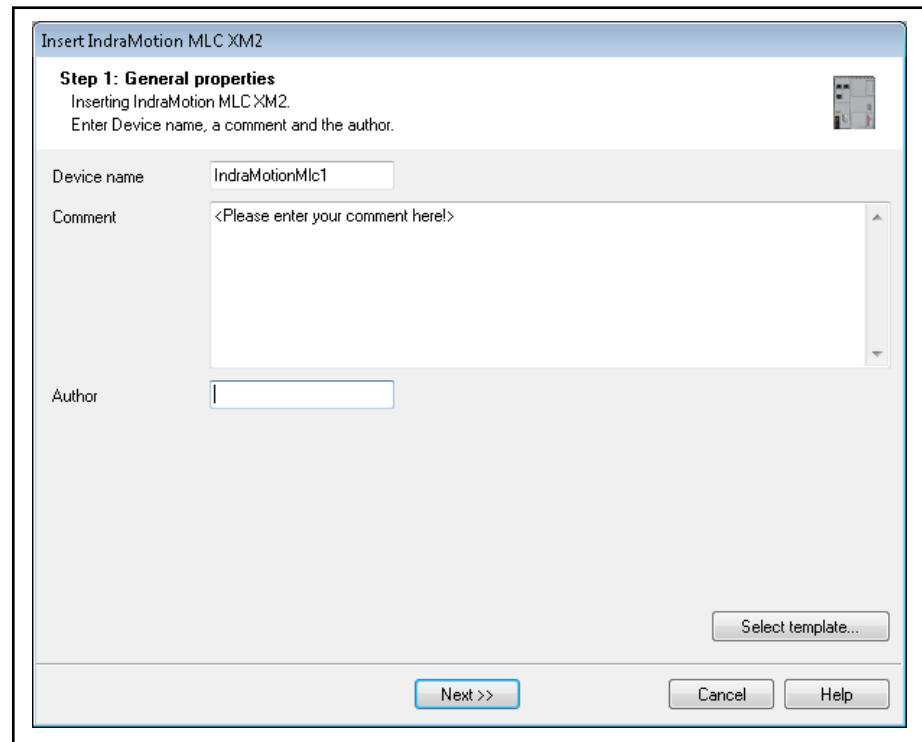


Fig. 3-71: Example: Creating an XM2 control

Creating a control based on an already existing control in the project

To create a control based on a template in the project, select "From project" and then select a control from the list.

Only controls matching the previously selected device are provided in the list, i.e. if an XM2 control is created, only controls of the type MLC XM2 are displayed.

After selecting a device, click on **OK**. The template values are entered in the wizard. These values can now be changed. To create the device, click on **Finish** on the last site.

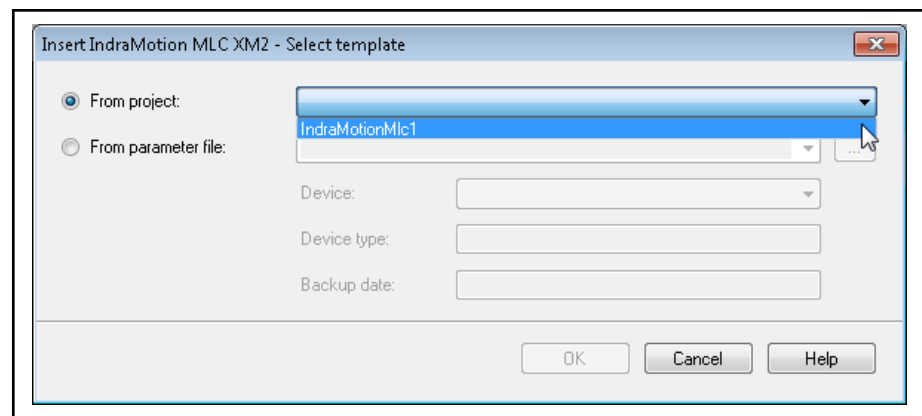


Fig. 3-72: Creation based on a project

Creation based on a template from a parameter file

To create a device based on a parameter file, select "From parameter file". Subsequently, specify the parameter file used to create the device. Either select a file from the list of the latest selected files or select a new file via **...**. The file is then analyzed and all devices matching the previously selected de-

vice are displayed in "Device". A matching device has to have the same type, i.e. if an XM2 control is created, only controls of the type XM2 are displayed.

After selecting a device, click on **OK**. The template values are entered in the wizard. These values can now be changed. To create the device, click on **Finish** on the last site.



To create a device based on a parameter file, the parameter file had to be previously exported from the context menu of the control "Parameter⇒ Export..." in the mode "All parameters".

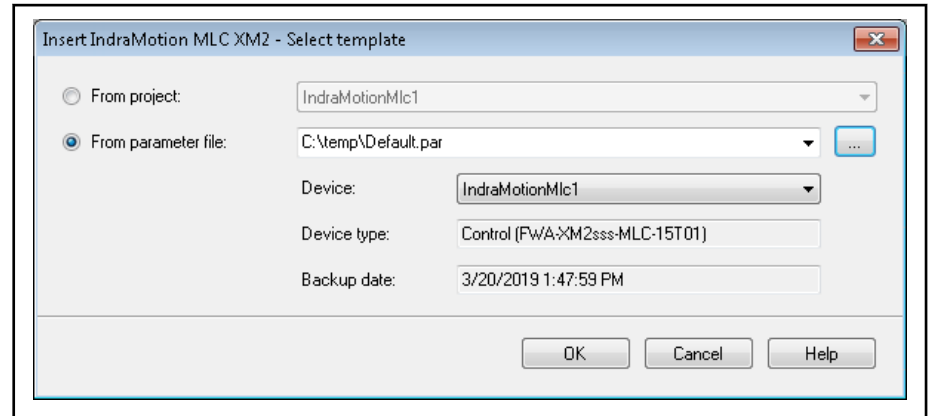


Fig. 3-73: Creating a control based on a parameter file

3.12 Creating a function module



For IndraLogic XLC controls, function modules are only available for IndraControl Lxx variants.

To extend the functionality of the control, connect up to four function modules at the left of the control.

Specifying function module when configuring the control

It is possible to specify a function module when configuring the control (see following figure), even if it is not yet connected to the control.

The module is already added to the right location in the Project Explorer.

While going online, the absence is acknowledged by an error message.

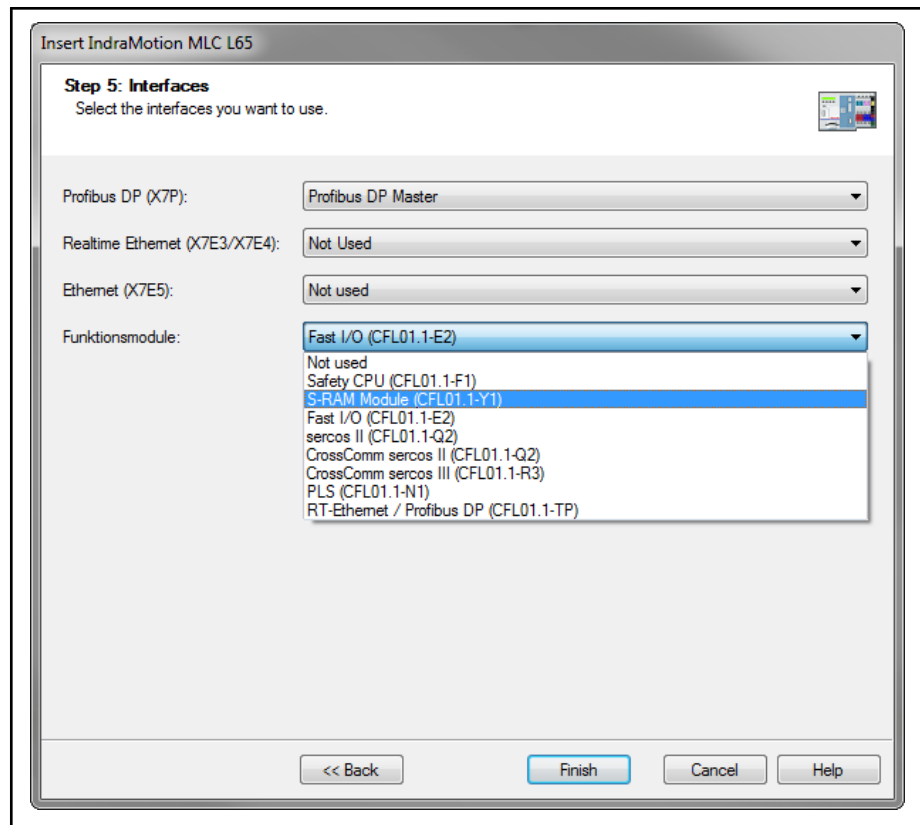


Fig. 3-74: Inserting a Fast I/O function module using a wizard (for an IndraMotion MLC for example)

Inserting a module subsequently to an already configured control

Function modules to be subsequently connected can be selected via the "Properties" dialog of the control, via the context menu item **Add** of the control or via drag&drop from the library and stored in the Project Explorer on the control.

Drag&drop from the device library:

Drag the function module from the "Function modules" group of the library to the control

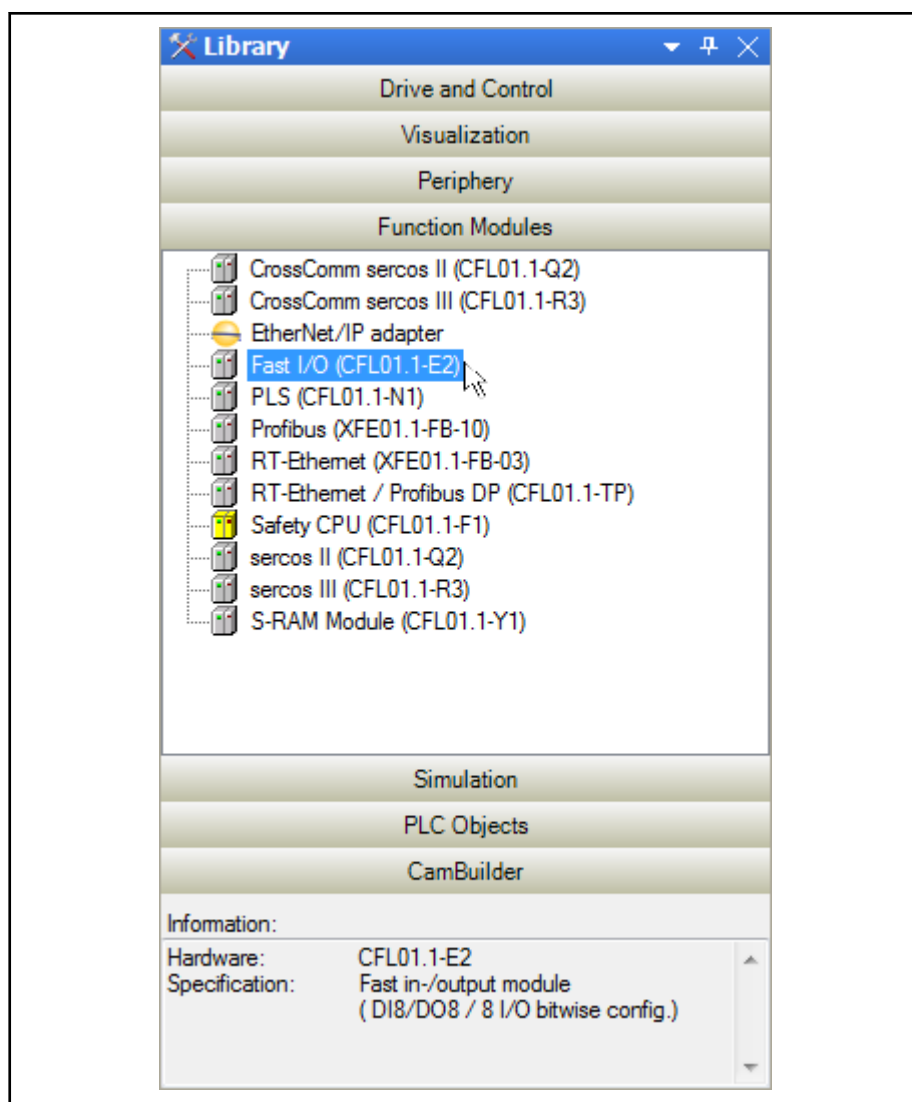


Fig. 3-75: Dragging a module from the library
.... and "drop" it on the control or above the Sercos folder.

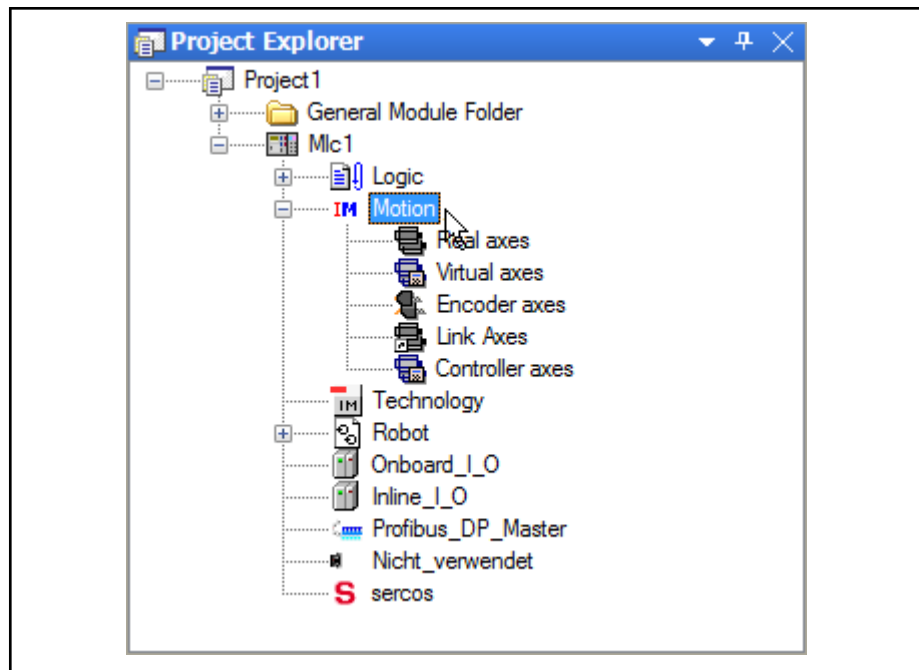


Fig. 3-76: Inserting a module



A subsequently connected module is only detected upon the next control startup.

Configuring the module

Each module, except for the S-RAM module (CFL01.1-Y1) in an IndraMotion MLC, has to be subsequently configured via corresponding dialogs.

The function modules currently available for the IndraLogic XLC/IndraMotion MLC, as well as their function and configuration, are described in "Rexroth IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

3.13 I/Os and field buses

3.13.1 Creating Onboard I/Os

The controls based on the IndraLogic XLC/IndraMotion MLC L45, L65 and L75 provide the user with 1 byte (fast) of inputs/outputs. There are no On-board I/Os available on IndraMotion MLC XM21, IndraMotion MLC XM22, IndraMotion MLC XM4 and IndraMotion VPx.

The connections can be used byte by byte or bit by bit.



The response time (turnaround time) of the bus from writing to the output to reading the modified input value is:

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

Double-click to open the window on the "Onboard_IO" folder in the Project Explorer.

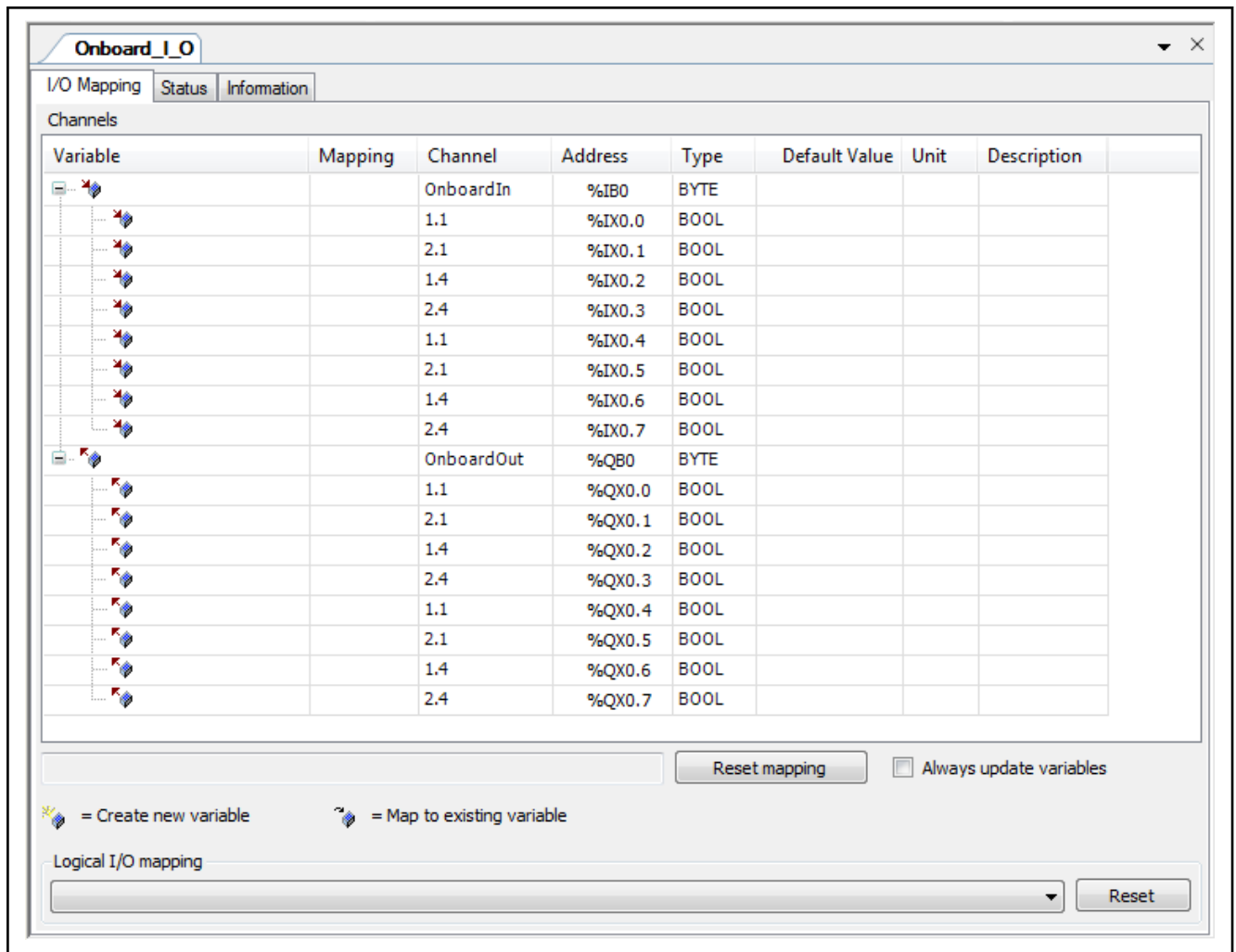


Fig. 3-77: Creating local I/O – Declaring inputs and outputs

The starting addresses for the input and output bytes are assigned automatically, but can be changed subsequently (see [fig. 3-85 "Labeling fixedly specified address" on page 131](#)).



Keep the starting addresses %IB0 or %QB0 for Onboard I/Os.

The starting addresses of the Inline I/Os can be set to %IB2 or %QB2 and for Profibus I/O e.g. to %IB500 or %QB500.

"I/O mapping" tab

Assign the I/O ranges of the Onboard I/Os to the physical control addresses (I/O addresses of the PLC).

- Variable:** This column shows input and output modules. Click on the plus or minus symbol to switch between byte view and bit view.
 Also assign a symbolic address to each absolute address (double-click on the respective field). After it has been entered, the symbolic address is automatically created as global variable in the PLC project
- Mapping:** If a **new variable is defined**, only one variable name has to be entered in the "Variable" column, for example: "bVar1". In this case, the symbol  is inserted into the **Mapping** column. Click on the icon and the variable is automatically **declared internally as global variable** and

the icon changes to . After this point in time, the variable is globally available in the application

- **Channel:** Symbolic channel name
- **Address:** I/O address. Enter the I/O address as byte address (e.g. %IB10). Entries in italics are for display purposes only and cannot be edited
- **Type:** Byte addresses are labeled with "BYTE" and bit addresses with "BOOL"
- **Current value:** Physical state of the input/output. The state is only displayed in diagnostic mode during communication between IndraWorks and the control
- **Default value:** Preassignment of the variable (TRUE or FALSE)
- **Unit:** Unit for the parameter value, e.g. "ms" for milliseconds
- **Description:** Enter any comment on an address
- **Reset Mapping:** Delete all variable assignments
- **Always update variable:**
 - Checkmark not set:
Only the variables used in the PLC program are updated
 - Checkmark set:
All variables are updated

"Status" tab Click on the "Status" tab to display the list.

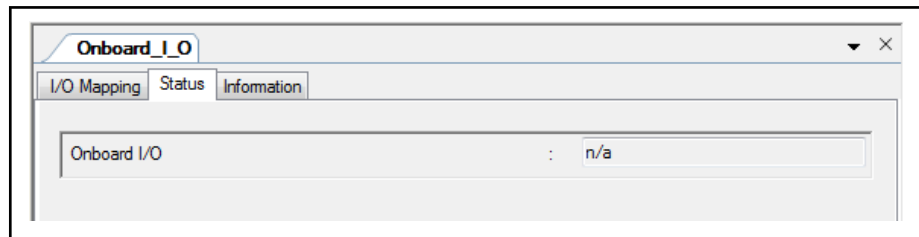


Fig. 3-78: Onboard status workspace

- This dialog displays the status information, e.g. "Running", "Not running (n/a)" of the respective device

"Information" tab Click on the "Information" tab to display the list.



Fig. 3-79: Onboard information workspace

This subdialog of the device dialog (Device editor) displays some general information from the device description file on the device currently selected in the device tree.

The following information is displayed:

- Name
- Vendor
- Categories
- Type
- ID
- Version
- Ordering number
- Description
- Image, if available

3.13.2 Creating Inline I/Os

Inline modules are connected at the right of the IndraLogic XLC/IndraMotion MLC control.

For details, refer to "Rexroth IndraControl L45/L65/L85 Control" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).



The response time (turnaround time) of the bus from writing to the output to reading the modified input value is

- for 1 ms cycle time - approx. 5 ms
- for 2 ms cycle time - approx. 6 ms



Check that no address overlaps, for example between Onboard I/Os and Inline I/Os.



Keep the starting addresses %IB0 or %QB0 for Onboard I/Os.

The starting addresses of the Inline I/O can then be set to %IB1 or %QB1 and for Profibus I/O e.g. to %IB500 or %QB500.

Creating Inline I/O modules

Insert the Inline modules from the library stock under **Periphery ► Inline** and add them via **drag&drop** or via the context menu/right-click **Add ► Module** to the Project Explorer.

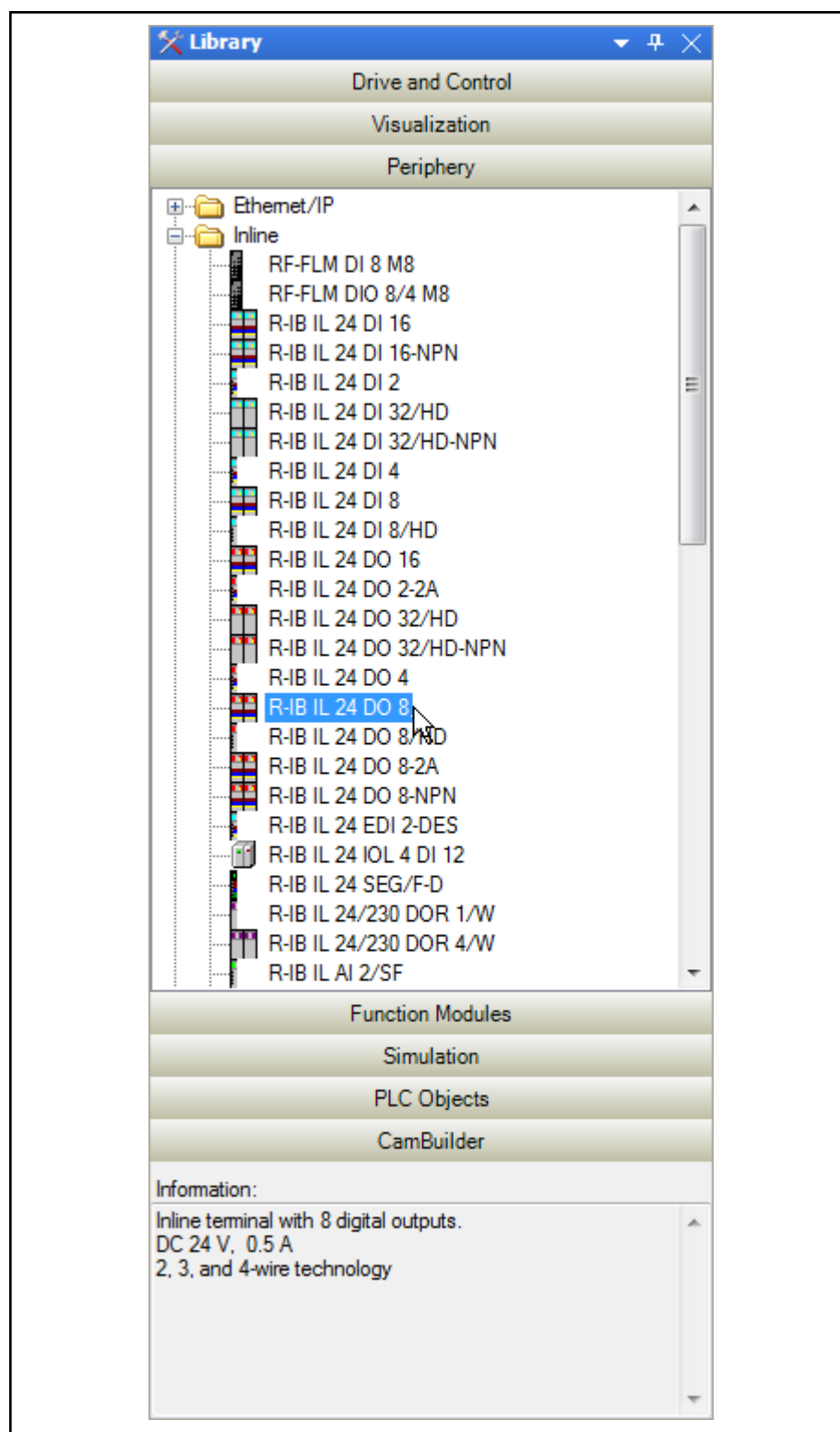


Fig. 3-80: Creating Inline I/Os – Selecting and dragging the module from the library

Drag the respective Inline module to the Project Explorer and drop it to the "Inline_I_O" folder.



Observe the assembly sequence during creation!

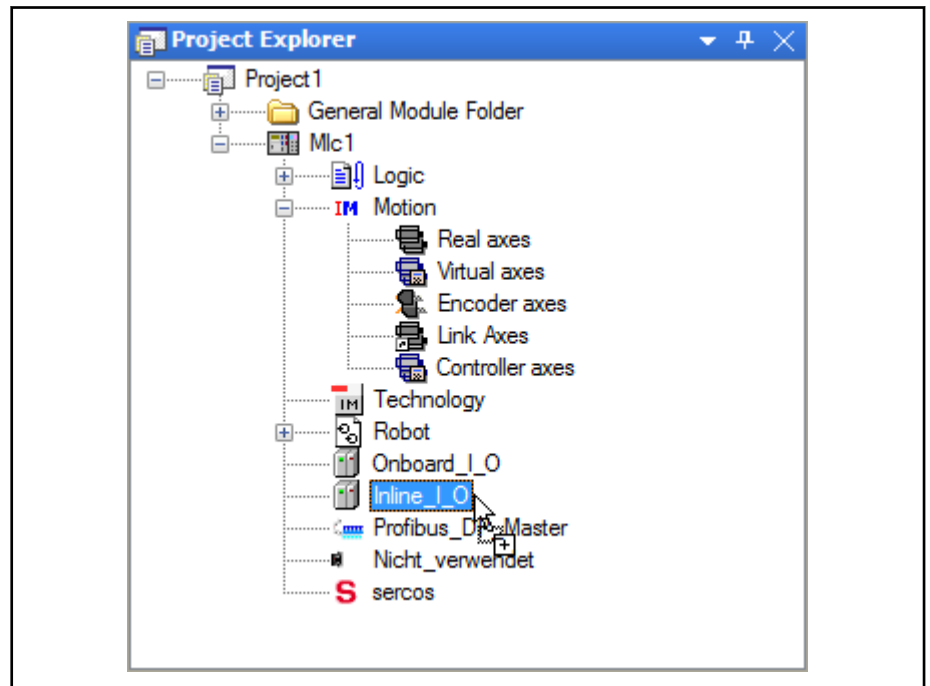


Fig. 3-81: Creating Inline I/Os – Dropping to the Project Explorer

or

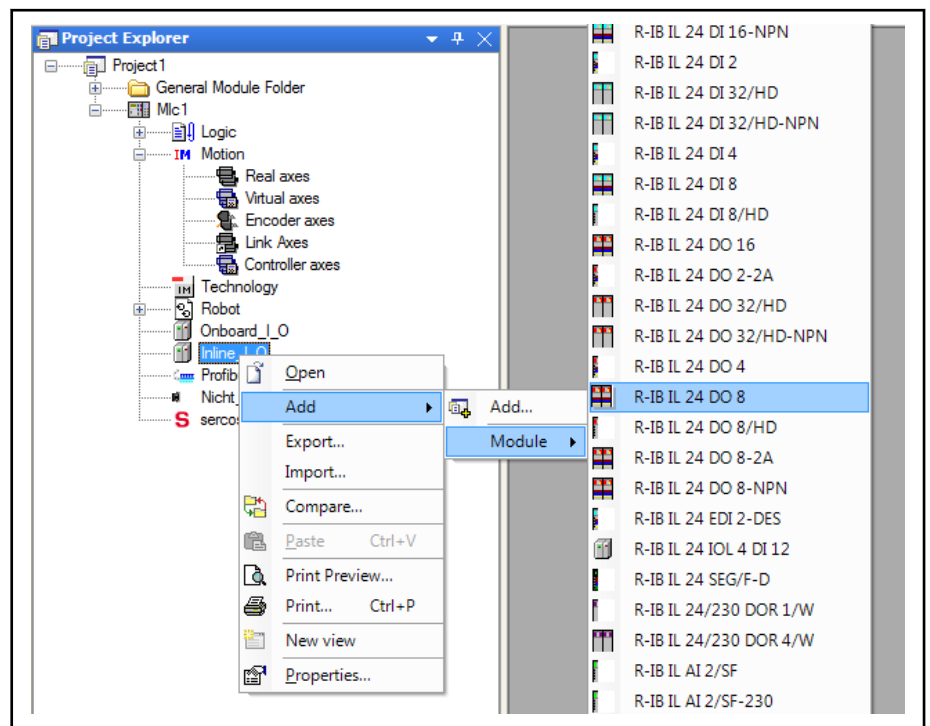


Fig. 3-82: Creating Inline I/Os – Selection via context menu

Settings

Make the required module settings for the respective module.

In the Project Explorer, double-click on the desired Inline module.

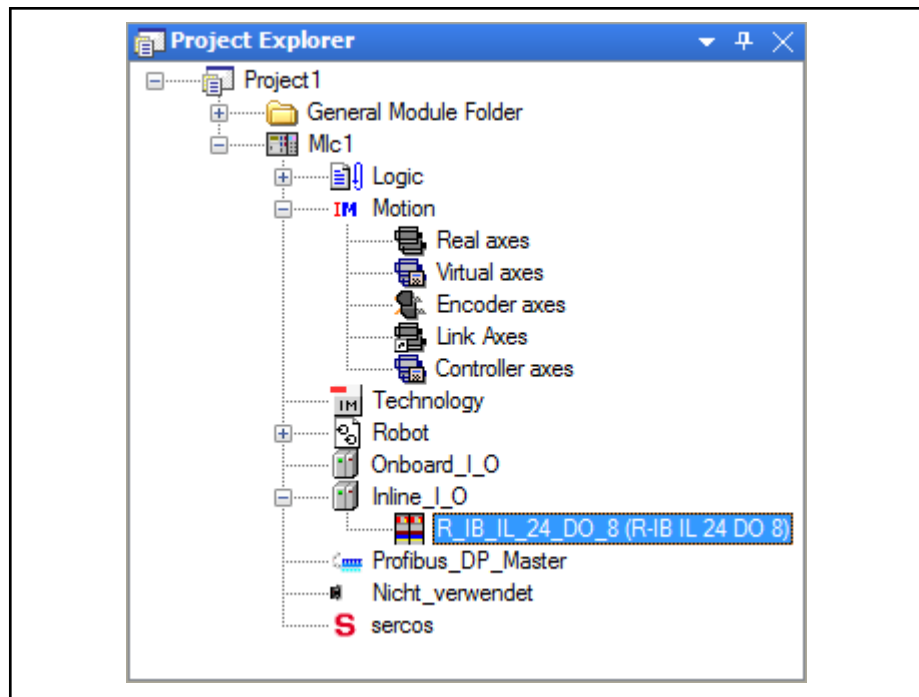


Fig. 3-83: Inline I/O module in the Project Explorer

This opens the "I/O Image" window in the workspace:

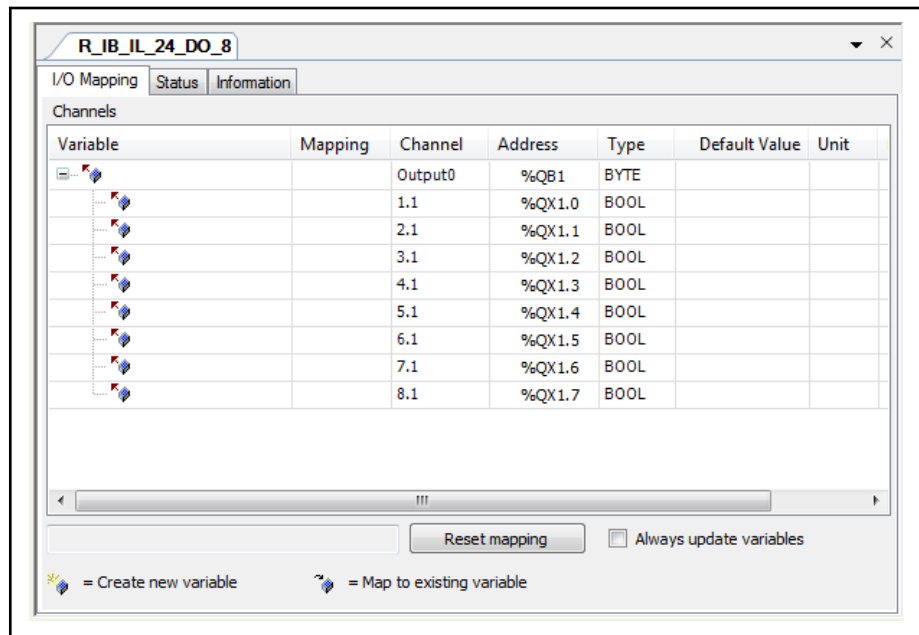


Fig. 3-84: Workspace Inline module "I/O Image"

"I/O Image" tab

Assign the I/O ranges of the Inline I/Os to the physical control addresses (I/O addresses of the PLC).

- Variable:** This column shows the outputs and inputs of the module (in this example). Click on the plus or minus symbol to switch between byte view and bit view.

Also assign a symbolic address to each absolute address (double-click on the respective field). After it has been entered, the symbolic address is automatically created as global variable in the PLC project.

- **Mapping:** If a **new variable is defined**, only one variable name has to be entered in the "Variable" column, for example: "bVar1". In this case, the symbol  is inserted in the **Mapping** column. Click on the icon and the variable is automatically **declared internally as global variable** and the icon changes to . After this point in time, the variable is globally available in the application.
- **Channel:** Symbolic channel name
- **Address:** I/O address. Enter the desired I/O address as byte address (e.g. %QB2). Entries in italics are for display purposes only and cannot be edited.

Manually and fixedly specified addresses are labeled with this symbol .

Fixedly specified addresses do not change when inserting additional I/O modules.

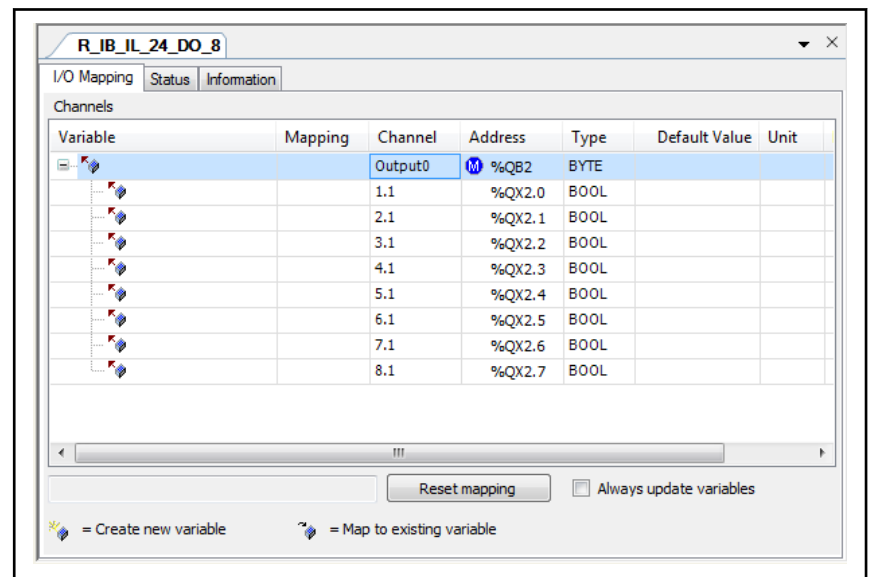


Fig. 3-85: Labeling fixedly specified address

- **Type:** Byte addresses are labeled with "BYTE" and bit addresses with "BOOL".
- **Current value:** Physical state of the input/output. The state is only displayed in diagnostic mode during communication between IndraWorks and the control.
- **Default value:** Preassignment of the variable (TRUE or FALSE)
- **Unit:** Unit for the parameter value, e.g. "ms" for milliseconds
- **Description:** Enter any comment on an address.
- **Reset Mapping:** Delete all variable assignments
- **Always update variable:**
 - Checkmark not set:
Only the variables used in the PLC program are updated
 - Checkmark set:
All variables are updated

"Status" tab Click on the "Status" tab to display the list.

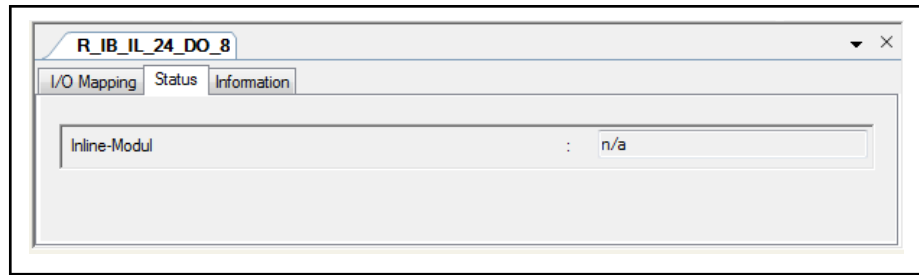


Fig. 3-86: Inline status workspace

- This dialog displays the status information, e.g. "Running", "Not running (n/a)" of the respective device.

"Information" tab

Click on the "Information" tab to display the list.

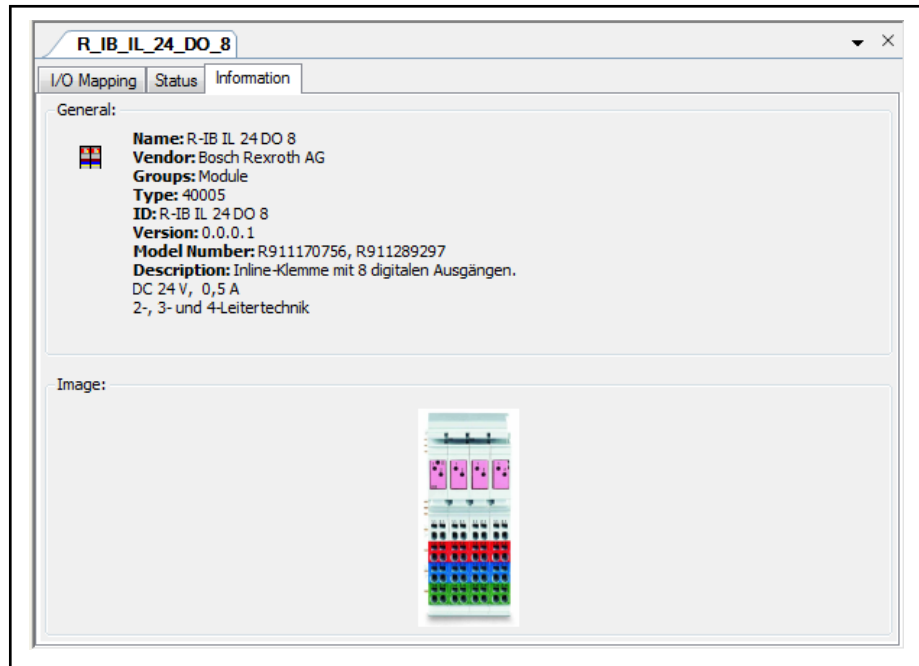


Fig. 3-87: Inline information workspace

This subdialog of the device dialog (Device Editor) displays some general information from the device description file on the device currently selected in the device tree.

The following information is displayed:

- Name
- Vendor
- Categories
- Type
- ID
- Version
- Order number
- Description
- Figure, if available

Enabling/disabling modules via the Project Explorer

"Enable" or "disable" the Inline modules configured on a control in the Project Explorer if required. To enable/disable, select/deselect the button at the icon of the Inline module.

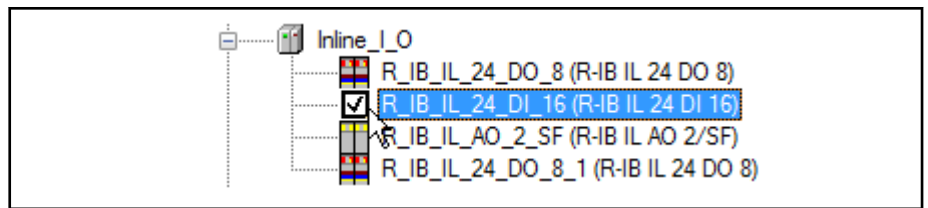


Fig. 3-88: Selecting/deselecting an Inline module

If a new Inline module is created, it is enabled by default. When loading the configuration, all enabled Inline modules are taken into account. Inline modules switched to passive mode are ignored.

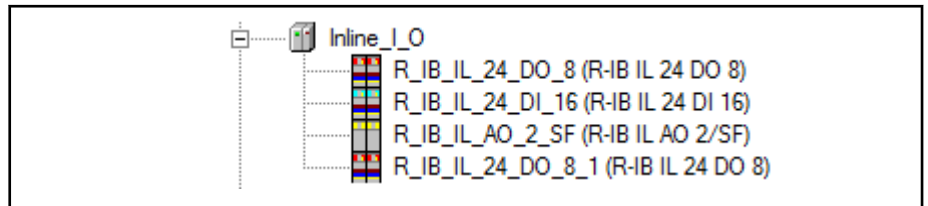


Fig. 3-89: Enabled state of an Inline module

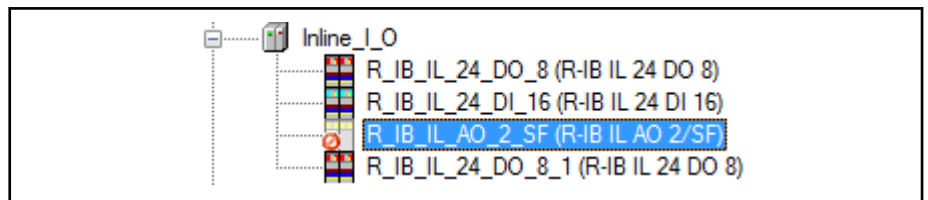


Fig. 3-90: Disabled state of an Inline module

Deactivating modules via "User-Defcs.cfg"

Use this function to disable Inline I/O modules configured in IndraWorks. Disable them by the definition in a stored file located on the Compact Flash card of the control. This impedes diagnostic messages for modules that are configured, but do not exist.

Enabling the function

The function is enabled by its existence and a valid file content "User-Defcs.cfg", stored in the partition "ata0b\ (USER)" of the Compact Flash card. Another path or file name can be defined by making entries in the "cfg file" of a system.

Example:

```
[IOSpecialDefcs]
IODeactFilePath=MyFilePath
IODeactFileName=MyFileName
```

Point in time of module deactivation

The "UserDefcs.cfg" is analyzed and the entered modules are disabled at this point in time and in the context of the internal event "PrepareUpdateConfiguration". Evaluation takes place in case of the following actions:

- Startup after power on
- Reset (warm)
- Reset (cold)
- Load program after reset (origin)

Structure of the file "UserDefcs.cfg"

The file is structured in a single or in multiple existing sections and the following contained entries:

- **Sections**

The denomination of a section is written in "[" and "]". A section ends with the beginning of the next section or with the end of the file.

The name consists of a symbol "InlineIO.Master." and the constant index "0" (due to the compatibility to the Profibus slave deactivation).

Example: [InlineIO.Master.0]

Special function: Due to the definition of character "X" for the index instead of a character, this section is ignored in the evaluation.

Several sections can be defined for the master index "0". All their entries are assigned to the Inline master. Together with the "x function" described above, different module groups can be handled easily

- **Module entry**

An entry to disable an Inline module consists of the keyword "ModuleDeactPosi", the assignment character "=" and the 1- or 2-digit decimal specification of the module position.

Example: ModuleDeactPosi = 3

The valid value range is 1...64. "0" is also valid, but not effective

- **Comments**

A semicolon (";") is defined as comment character. The text is not analyzed from the position of the semicolon up to the end of the line.

Example of the file "UserDefs.cfg"

```
;----- Master.0 -----
```

```
[InlineIO.Master.0]
```

```
ModuleDeactPosi = 3
```

```
ModuleDeactPosi = 7
```

```
ModuleDeactPosi = 15
```

```
ModuleDeactPosi = 16
```

```
;-----
```

3.13.3 Creating Profibus I/Os

The Profibus node is located below the Profibus I/O node. By default, this node is configured as master. Via the context menu or when creating a control (see Profibus DP configuration in [chapter 3.10 "Creating a control" on page 113](#)), it can, however, also be reconfigured as slave. Thus, I/Os created under a slave can be activated by a master of another control. However, the rest of this description is limited to the configuration and creation of a master and its slaves.

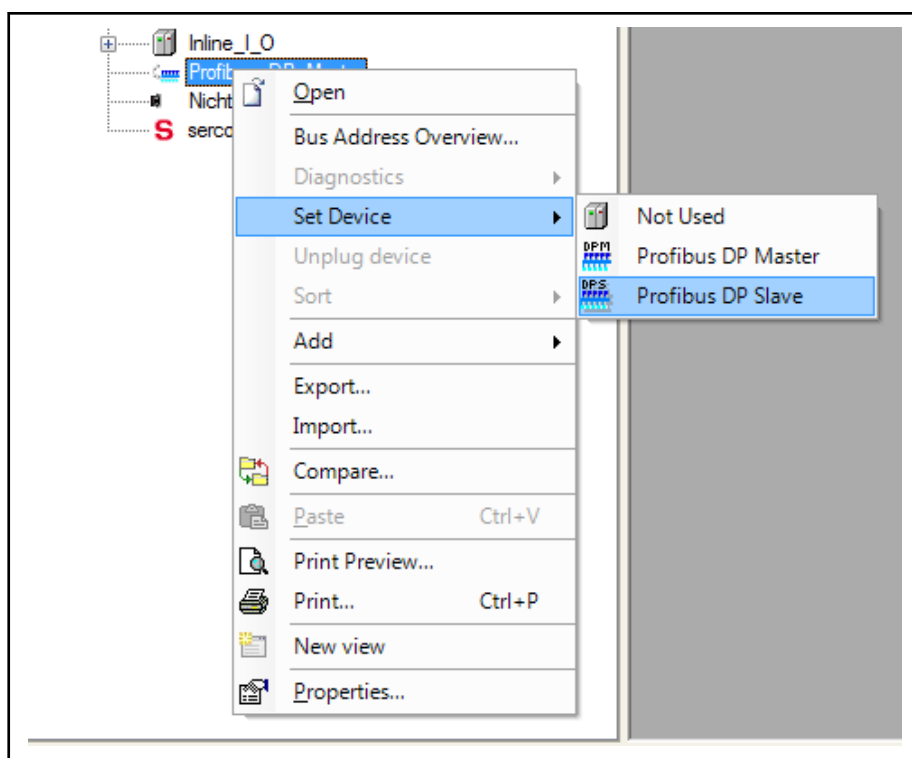


Fig. 3-91: Reconfiguring Profibus node as slave

Profibus DP master and slave configuration

For the configuration of the Profibus DP master and slave, refer to the documentation "IndraWorks 14VRS Field Buses" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

3.13.4 Creating a Profinet I/O Controller

The configuration in the control is based on the device description files for the Profinet I/O Devices and modules used and can still be adapted by the user in the configuration dialogs.

Use the **Scan** functionality to easily determine the existing hardware structure and transfer it to the device tree.

General information on the Profinet I/O

Profinet I/O is based on the Profibus DP function model, but uses **Ethernet TCP/IP** for cyclic communication between the central control and the decentralized field devices. Profinet I/O is well-suited to fast I/O data transfer, but it can also transmit service data, IT functions and parameters at the same time.

The field devices ("Profinet I/O Devices") are described by the manufacturer in so-called "device description files", which can be loaded using the device database after the field devices files have been installed on the local system. The field device signals are read into the PLC cyclically, processed in the PLC and then output to the field devices again.

In general, for the Profinet I/O, the master-slave procedure known from the Profibus is replaced by a "provider-consumer" model. However, for cyclic user data transfer, the "Profinet I/O-RT communication" requires a defined master/slave relationship. Therefore, there is also a master here ("Profinet I/O Controller"), slaves ("Profinet I/O Devices") and under one slave, the I/O modules.

Configuring the Profinet I/O controller and the I/O devices

For the configuration of the Profinet I/O controller and the I/O devices, refer to "IndraWorks 14VRS Field Buses" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

3.13.5 Creating Sercos III I/Os

The Sercos III master has the following functional characteristics:

- Support of up to 253 Sercos III I/O devices
- Support of 61 modules per device
- Support of one cyclic producing connection (in AT) and one cyclic consuming connection (in MDT) per device
- Support of devices with the SCP_FixCFG and SCP_VarCFG communication classes
- The "Configuration with connection length" configuration type is supported with the SCP_VarCFG communication class



Sercos III I/O data is only exchanged in the operating mode. If the control is switched to parameterization mode, e.g. for reconfiguration purposes, the I/Os are no longer changed. It is no longer possible to control or display these I/Os.

Instead of switching the complete control to the parameterization mode, the parameterization level can be used for axes. The I/Os remain available.

Address limitations

The addresses of the Sercos devices can be selected from a range between 1 and 253.

The number of axes (real, virtual, encoder, link and controller axes) reduces the number of Sercos devices.

Restrictions of the address range for Bosch Rexroth devices

For IndraDrive drives with firmware of up to MPx 08, addresses between 1 and 99 can be set.

For IndraDrive drives with firmware for MPx 16 and higher, addresses between 1 and 250 can be set.

For IndraDrive Mi drives, addresses between 1 and 99 can be set using the rotary switch. If rotary switches are set to 0, addresses between 1 and 250 can be used via the remote address specification.

For the S20 bus coupler (S20-S3-BK and S20-S3-BK+), addresses between 1 and 159 can be set via the rotary switches. If rotary switches are set to 0, addresses between 1 and 253 can be used via the remote address specification.

Configuring Sercos III master and slaves

For the configuration of the Sercos III masters and slaves, refer to the documentation "IndraWorks 14VRS Field Buses" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Replacing hardware of Sercos III I/O devices

When changing a Sercos III I/O device, the Sercos address cannot be set directly on the device, as it is possible e.g. in case of an IndraDrive drive via the display of the drive. For Sercos III I/O devices, the address has to be set via the Sercos III mechanism "Remote address specification". There are different options:

Option 1: With IndraWorks and the matching IndraWorks project of this machine.

The control reports the error "F0140001, Error in device configuration". To set the Sercos address, perform the following steps:

1. Switch the PLC to STOP.
2. Switch IndraWorks online.
3. The "Adjustment Sercos configuration" dialog opens automatically.

4. In this dialog, compare the configuration found with the configured devices and perform the assignment.
5. The **Remote Address Assignment** button is used to set the Sercos address of the devices.
6. Clear error and restart the PLC.

Option 2: Using the WebAssistant of the control.

The control reports the error "F0140001, Error in device configuration". To set the Sercos address, perform the following steps:

1. Log into the WebAssistant (rights to change parameters are required).
2. → The following steps have to be executed in the parameterization mode "P2".
Check in the "Sercos" field of the "Tools" navigation menu, whether the control mode is "P2".
If this is not the case, switch the control mode manually to P2.
3. Start the "Parameter editor" in the "Tools" navigation menu.
4. Select the control in the "Device selection" field.
5. Select the C-parameters in the "Parameter block selection" field.
6. Press the "Update" button behind the "Device selection". The C-parameters are then displayed.
7. Select the parameter "C-0-0510, sercos master, address configuration". The current value is displayed in the "parameter window".
8. A list of the found Sercos device are displayed according to the topology address. The topology addresses are output according to their wiring order, starting from the X7E1 port of the control (also for ring topology). For devices connected to X7E2 port of the control, the last device of the line is entered first.
9. In the parameter list, correct the address of the new device to the address defined in the project. The list is written with <RETURN> and the "remote address specification" is executed.
10. Clear error and switch to operating mode.

Option 3: Via machine HMI with support in the PLC program.

Using the PLC program and a respective extension of the machine HMI, also exchange the devices via the machine HMI. In the following examples, the IMC Interface (IndraMotion Control Interface with the ImcStatus, ImcCtrl structures) from the ML_TechInterface library is used for a simplified access to control data.

Variant 3 a): Permanently defined configuration in the PLC program.

By way of example, writing a configuration permanently defined as constant in the PLC program to the parameter "C-0-0510, sercos master, address configuration" is shown: Declaration part:

Program:

```
// This example writes the Parameter C-0-0510, Address configuration
PROGRAM Test_Set_SERCOS_Adr_W
```

Commissioning and operation

```

VAR_INPUT
    bConfirmWriteSercosConfig: BOOL;
    // Start writing the sercos configuration
END_VAR

VAR_OUTPUT
    bDoneWriteSercosConfig: BOOL;
    // Successful writing of the sercos configuration
END_VAR

VAR
    fbWriteC510: MB_WriteListParameter;
    Dummy: AXIS_REF;
END_VAR

VAR_CONSTANT
    NOF_SERCOS_DEVICES : UINT := 3;
    // Define the sercos configuration constant
    arSERCOS_Adr: ARRAY [1..NOF_SERCOS_DEVICES] OF UINT:= [1, 65, 66];
    uiNoOfBytes:  UINT:=2*NOF_SERCOS_DEVICES;
    // No. of sercos III devices * 2 (2 bytes per device)
END_VAR

```

Implementation part:

```

    // Error in drive configuration -> write back in Phase 2
    // In case of an exchange of an I/O or drive...
    // The user has to acknowledge this by
    // bConfirmWriteSercosConfig

IF bConfirmWriteSercosConfig = TRUE AND
    // Confirmation by user from HMI
    // Only allowed in CP2. Alternative to IMC Interface:
    // Read C-0-0452
    ImcStatus.Admin.ModeStatus_P2 = TRUE AND
    // allow only when "Error in drive configuration"
    // Is pending (C-0-0627)
    ImcStatus.Diag.Number = 16#F0140001 THEN
    // Write sercos configuration into C-0-510
    // "Address configuration"

    fbWriteC510(
        Execute:= TRUE,
        ParameterNumber:= GVL_C_Param_ID.FP_C_0_0510,
        NoOfBytes:= uiNoOfBytes,
        ValueAdr:= ADR(arSERCOS_Adr),
        Axis:= Dummy,
        Done=> bDoneWriteSercosConfig);

    // Error handling not implemented in this example

ELSE

    // Nothing to do...

    fbWriteC510(
        Execute:= FALSE,
        Axis:= Dummy);

    bDoneWriteSercosConfig:=FALSE;
END_IF

```

The Sercos configuration is predefined in "arSERCOS_Adr". In this example, the devices with the addresses 1, 65 and 66 are configured and connected in this order to X7E1 port of the control (or in case of ring topology, starting from the X7E1 port). If the devices are connected to X7E2, the order has to be reversed [66, 65, 1] if address 1 is directly connected to X7E2.

It is recommended to read out C-0-0510 at an executable and correctly wired system and then to define "arSERCOS_Adr". Also read out via HMI and store the configuration "arSERCOS_Adr" as RETAIN data (see below).

In the example, writing "arSERCOS_Adr" is triggered via the MB_WriteList-Parameter function block via the "bConfirmWriteSercosConfig" input. The "bConfirmWriteSercosConfig" input has to be set by the HMI.

Check the conditions, the parameterization mode P2 and the pending error "F0140001, Error in device configuration" as prerequisites. Depending on the application, it may be necessary to check further conditions or specify defined states. Following successful writing of the configuration, delete the error and switch to the operating mode. Both can be executed via the ImcCtrl structure of the IMC interface.

Variant 3 b): Retrieving configuration via HMI.

By way of example, reading the configuration from the parameter "C-0-0510, sercos master, address configuration" and writing back the configuration to this parameter is shown:

Program:

Global variables

```
VAR GLOBAL RETAIN
// Configuration data of the sercos addresses
arSERCOS_Adr: ARRAY [1..99] OF UINT;
// sercos configuration
uiNoOfBytes: UINT;
// no. of SIII devices * 2 (2 bytes per device)
END_VAR
```

Declaration part:

```
// This example reads and writes the Parameter C-0-0510,
// Address configuration
```

PROGRAM Test_Set_SERCOS_Adr_RW

```
VAR INPUT
bConfirmReadSercosConfig: BOOL;
// Start reading the sercos configuration
bConfirmWriteSercosConfig: BOOL;
// Start writing the sercos configuration
END_VAR
```

```
VAR OUTPUT
bDoneWriteSercosConfig: BOOL;
// Successful reading of the sercos configuration
bDoneWriteSercosConfig: BOOL;
// Successful writing of the sercos configuration
END_VAR
```

```
VAR
fbReadC510: MB_ReadListParameter;
fbWriteC510: MB_WriteListParameter;
Dummy: AXIS_REF;
END_VAR
```

Implementation part:

```
// Read the sercos configuration -> read if exchange of I/O or drive...
// The user has to acknowledge this by bConfirmReadSercosConfig
```

```
IF bConfirmReadSercosConfig = TRUE THEN
// Conformation by user from HMI
// Read sercos configuration into C-0-510 "Address configuration"
```

```
fbReadC510(
Execute:= TRUE,
ParameterNumber:= GVL_C_Param_ID.FP_C_0_0510,
NoOfBytes:= 198,
ValueAdr:= ADR(arSERCOS_AdrConfig),
Axis:= Dummy,
NoOfRecBytes=> uiNoOfBytes_AdrConfig,
Done=> bDoneReadSercosConfig);
```

```

IF fbReadC510.Done THEN
    bValidSERCOS_AdrConfig := TRUE;
END_IF

// Error handling not implemented in this example
ELSE
    // Nothing to do...

    fbReadC510(
        Execute:= FALSE,
        Axis:=     Dummy);

    bDoneReadSercosConfig:=FALSE;
END_IF

// Error in drive configuration -> write back in Phase 2 in case
// of an exchange of an I/O or drive...
// The user has to acknowledge this by bConfirmWriteSercosConfig

IF bConfirmWriteSercosConfig = TRUE AND
    // Confirmation by user from HMI
    ImcStatus.Admin.ModeStatus_P2 = TRUE AND
    // Only allowed in CP2. Alternative to IMC Interface: read C-0-0452
    ImcStatus.Diag.Number = 16#F0140001 AND
    // Allow only when "Error in drive configuration" is pending (C-0-0627)
    bValidSERCOS_AdrConfig THEN
    // Check that the configuration was read before

    // Write sercos configuration into C-0-0510 "Address configuration"

    fbWriteC510(
        Execute:= TRUE,
        ParameterNumber:= GVL_C_Param_ID.FP_C_0_0510,
        NoOfBytes:=      uiNoOfBytes_AdrConfig,
        ValueAdr:=       ADR(arSERCOS_AdrConfig),
        Axis:=           Dummy,
        Done=>           bDoneWriteSercosConfig);

    // Error handling not implemented in this example
ELSE
    // Nothing to do...

    fbWriteC510(
        Execute:= FALSE,
        Axis:=     Dummy);

    bDoneWriteSercosConfig:=FALSE;
END_IF

```

The Sercos configuration is read from C-0-0510 into "arSERCOS_Adr" and stored as RETAIN. Reading out has to be triggered on an executable system via HMI. The configuration is stored as RETAIN data in "arSERCOS_Adr". The parameter C-0-0510 is read via MB_ReadListParameter.

As before, writing "arSERCOS_Adr" is triggered via the MB_WriteListParameter function block via the "bConfirmWriteSercosConfig" input. The "bConfirmWriteSercosConfig" input has to be set by the HMI.

Following successful writing of the configuration, delete the error and switch to the operating mode. Both can be executed via the ImcCtrl structure of the IMC interface.

3.14 IP communication

3.14.1 Overview



The settings for the IP communication with IndraLogic XLC are only available on the IndraControl Lxx variants with Sercos interface.

The control system provides several Ethernet-based interfaces for different tasks and system topologies. The continuous networking based on the Ethernet provides a direct passage between the process and field levels, as well as between the different Ethernet interfaces. Thus, functions such as a firmware update and a fast backup/restoration of the drives of the control via Ethernet are possible. Direct communication of the control with a superordinate HMI or Enterprise Resource Planning System (ERP) is also possible.

The Ethernet-based interfaces provide the option of a non-real-time-capable channel based on the TCP/IP protocol family. This chapter describes the configuration and capabilities of the control system to integrate it into an existing network.

The following Ethernet-based interfaces are available:

1. The onboard **Engineering interface** is a standard TCP/UDP/IP interface to exchange data with the process control level/HMI and the Engineering PC
2. The onboard **Sercos III** interface is an open, real-time capable data bus to communicate with drives and I/Os of the system
3. The onboard **Realtime Ethernet** interface is a configurable multi-protocol interface to exchange data with the periphery or a third-party head control. This interface can be configured and supports multiple Realtime Ethernet protocols such as Ethernet IP, Profinet, Standard TCP/IP (see documentation "IndraWorks 14VRS Field Buses" in the chapter "TCP/IP and UDP communication via field bus interface" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).
4. Up to 64 controls can communicate in one cross link (C2C) in real time and thus exchange master axis positions via the optional **CrossComm Sercos III (CFL01.1-R3)** function module for example



C2C functionality via the optional function module **CrossComm Sercos III (CFL01.1-R3)** is only available for IndraMotion MLC.

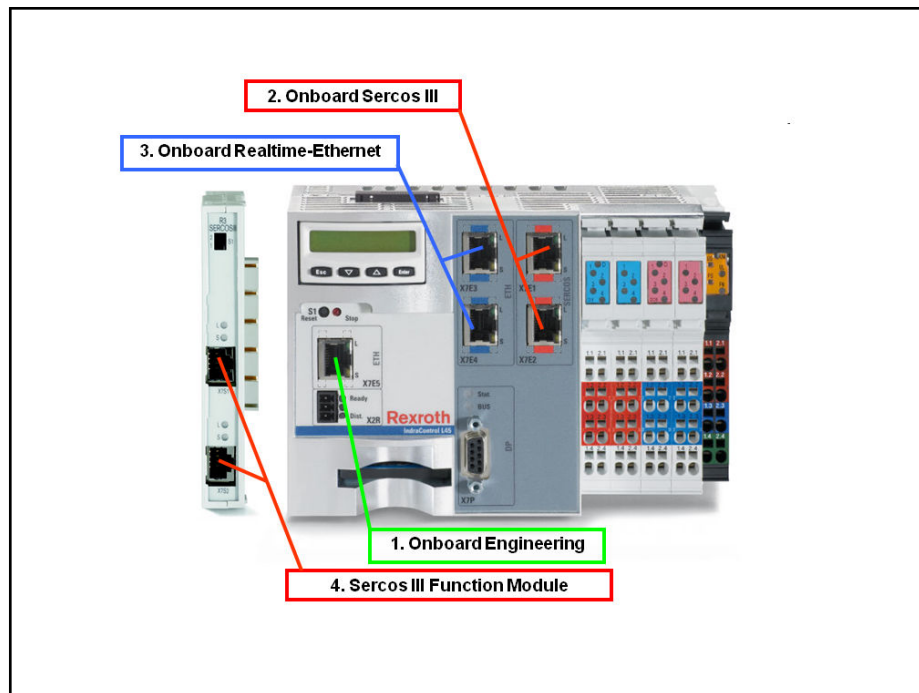


Fig. 3-92: Ethernet interfaces

To minimize configuration effort, the control provides presettings/default values for most of the typical automation applications for the above interfaces. Default setting objectives:

- **Connectivity:** Each free Ethernet interface provides the option of participating in the IP communication. Furthermore, communication with each IP device in the automation system can be established
- **Zero config:** The communication options are provided without additional configuration settings of the IP device
- **Flexible:** Special requirements and topologies can be implemented by means of manual IP settings

3.14.2 Basics

Bridge/bridging

Bridging refers to an IP forwarding procedure. A bridge connects several physical networks to one logical network. A bridge consists of several network interfaces, but is only provided with one IP address. Thus, a bridge with several physical network interfaces can be reached with the same IP address.

A bridge is mainly used to divide a network into different collision domains. Thus, the load in large networks can be reduced, since each network thread can only receive packages, whose recipient is also located in this network. The bridge knows all connected communication devices. The bridge forwards the received data telegram using the MAC address. Bridges work on layer 2 (backup/data link layer) of the OSI reference model.

- **Advantage:** Simple design or implementation, no maintenance
- **Disadvantage:** Possible loops can interfere with the network

Router/routing

Routing refers to an IP forwarding procedure. A router consists of several network interfaces, which also logically have their own IP address. In contrast to the bridge, the router analyses the incoming data packages according to their IP target address and forwards them accordingly (packages are routed). Forwarded packages either arrive in a directly connected target network (also

target subnetworks) known to the router or they are forwarded to another router also located in a directly connected network. Routers work on layer 3 (placement/network layer) of the OSI reference model.

- Advantage: Network size is not limited, looping is not significant
- Disadvantage: More technical effort than for bridging, greater configuration effort

3.14.3 Default setting

The IP default values contain the following settings:

- All Sercos III interfaces of the control are part of the **bridge** and thus provided with the same IP address. **Routing** is used as the forwarding procedure between all other Ethernet interfaces. The routing table is generated internally and automatically
- The **automatic IP address generation** for all Sercos III interfaces (on-board, Sercos III drives and I/Os and function module) and for the bridge is activated. The IP addresses of the Engineering and Realtime Ethernet interface are excluded and set separately
- With the default settings, the IP addresses are automatically generated (except for Engineering and onboard Realtime Ethernet). Only the following settings have to be made by the user:
 - Addresses of the Sercos drives and Sercos I/O
 - "C-0-0031, Control address"

Automatically generated IP address and subnet mask

	IP address	Subnet mask
Configuration C-0-0031 = 0 (default)		
All Sercos III interfaces of the control/bridge	172.31.254.254	255.255.0.0
All Sercos III drives and I/Os	172.31.254.<SercosAddress>	255.255.0.0
Configuration C-0-0031 > 0		
All Sercos III interfaces of the control/bridge	172.31.<C-0-0031>.254	255.255.0.0
All Sercos III drives and I/Os	172.31.<C-0-0031>.<SercosAddress>	255.255.0.0

Tab. 3-24: Automatically generated IP address and subnet mask

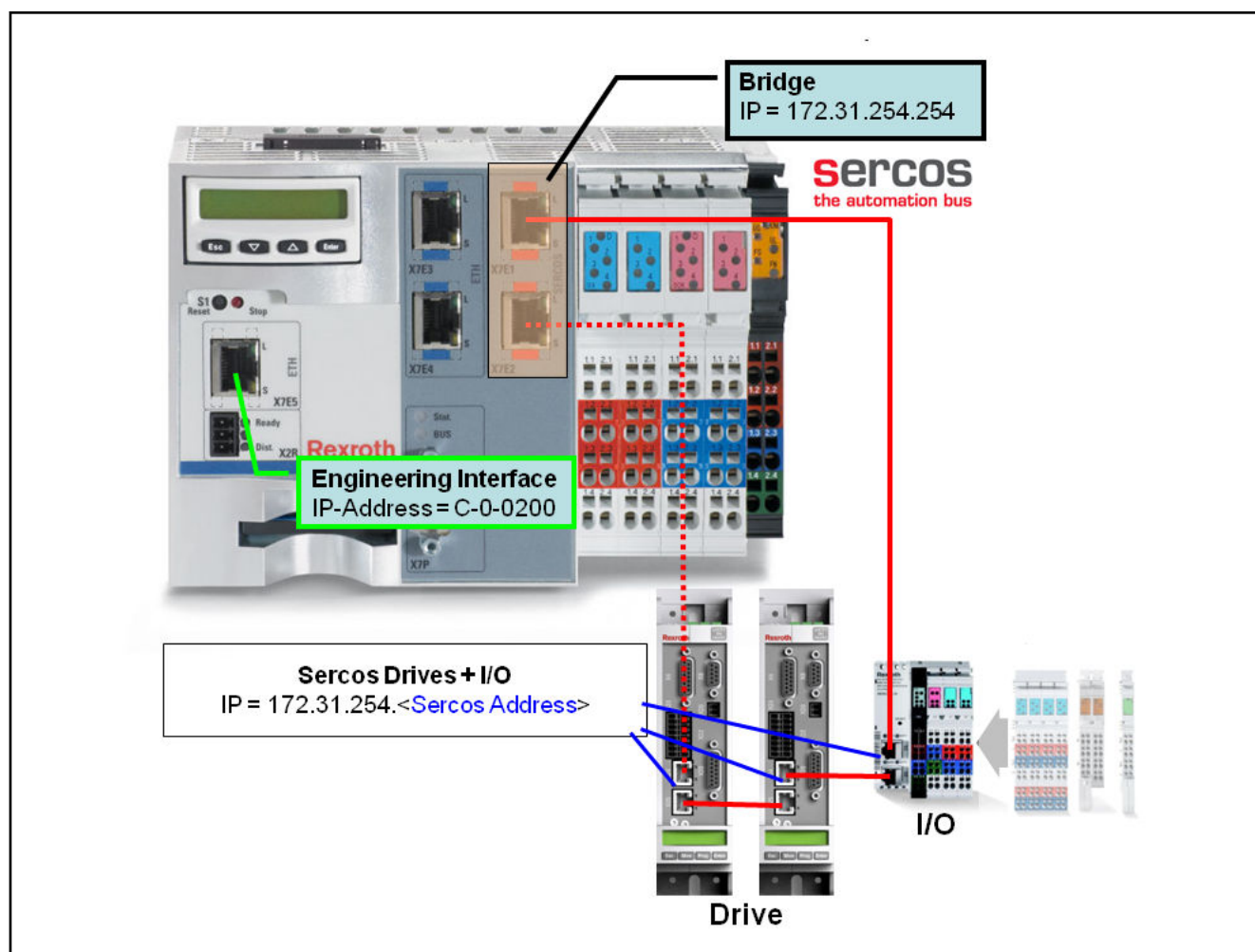


Fig. 3-93: IP settings with default configuration and C-0-0031=0

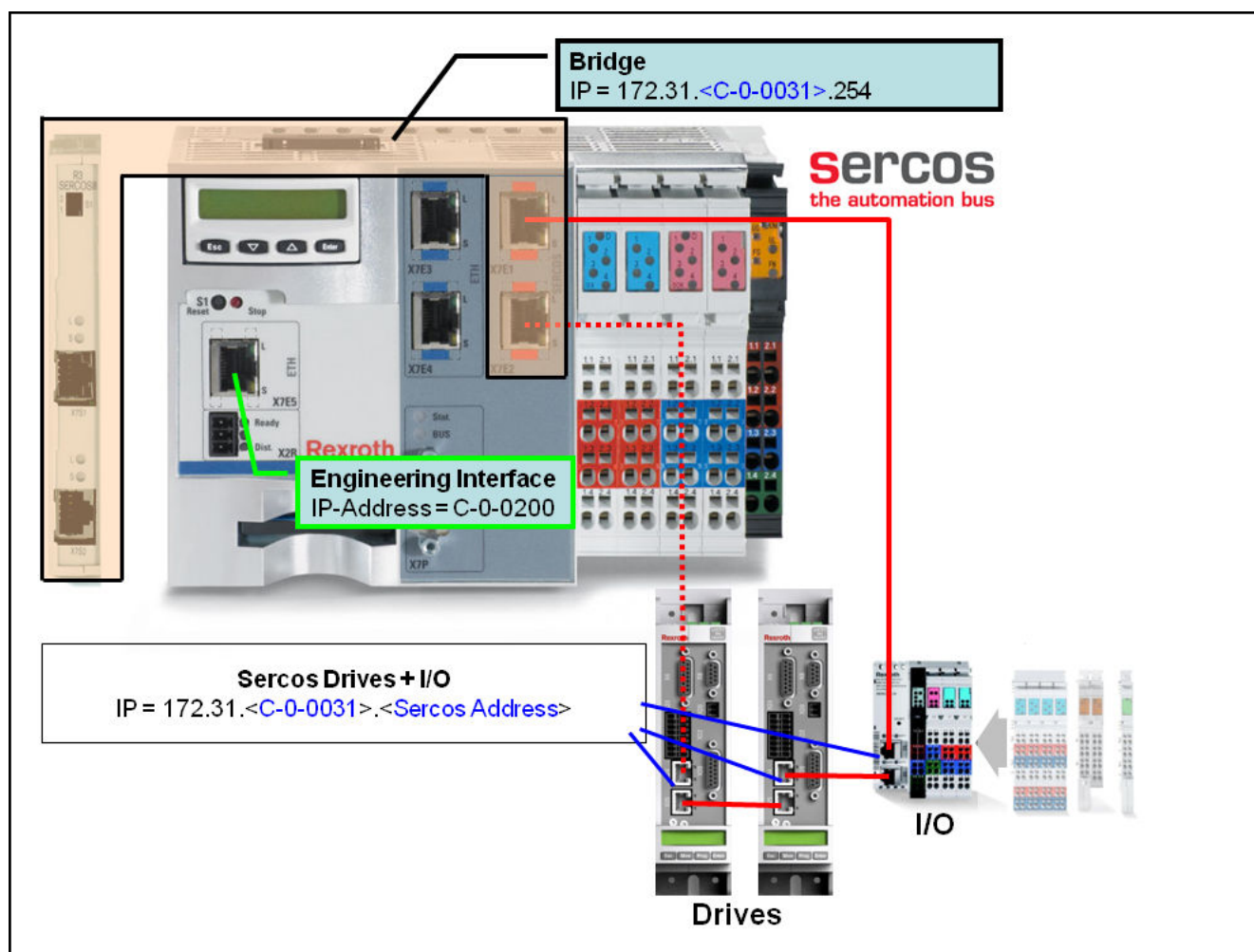


Fig. 3-94: IP settings with default configuration and C-0-0031 > 0

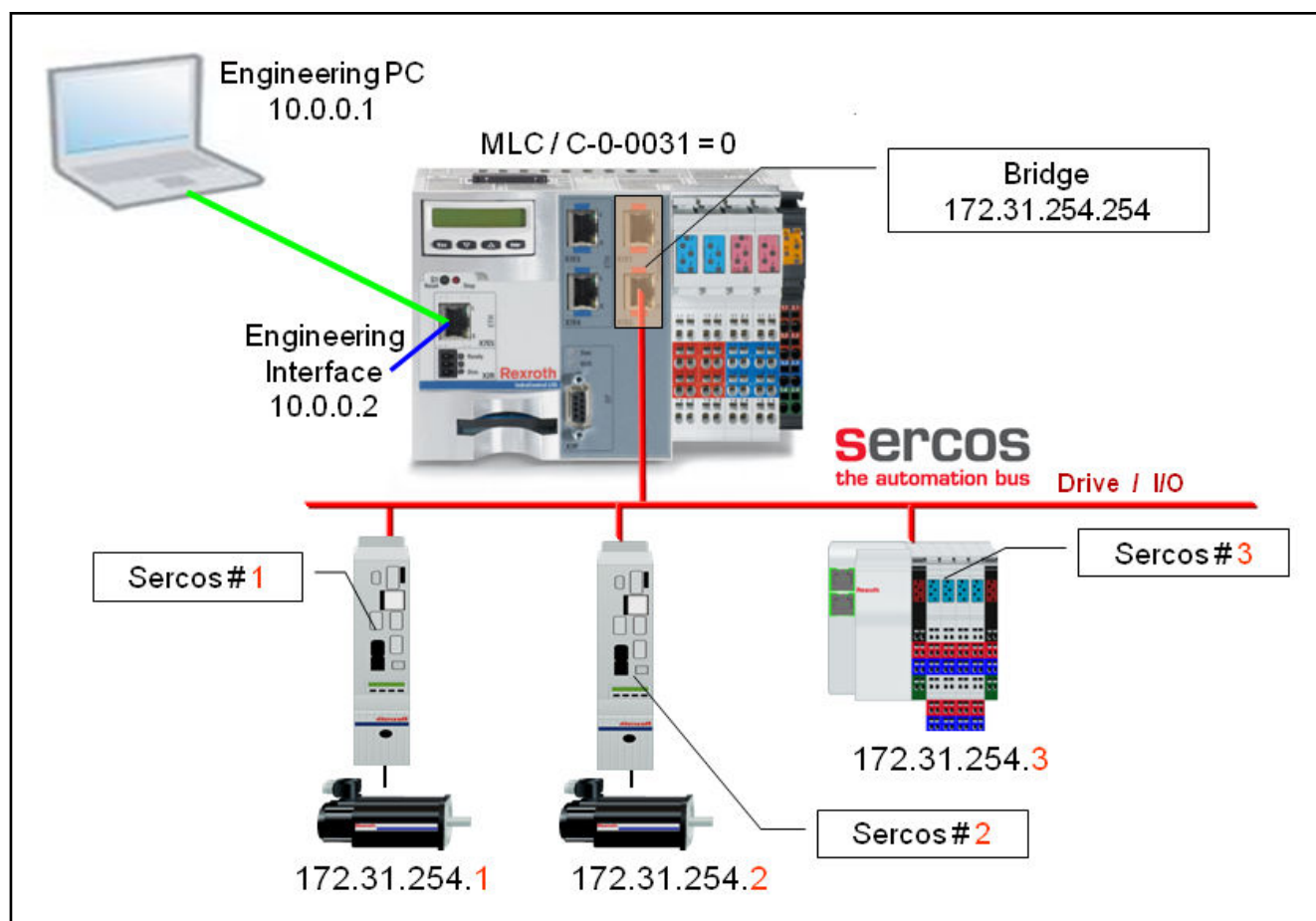


Fig. 3-95: Example: Minimum topology (default configuration)

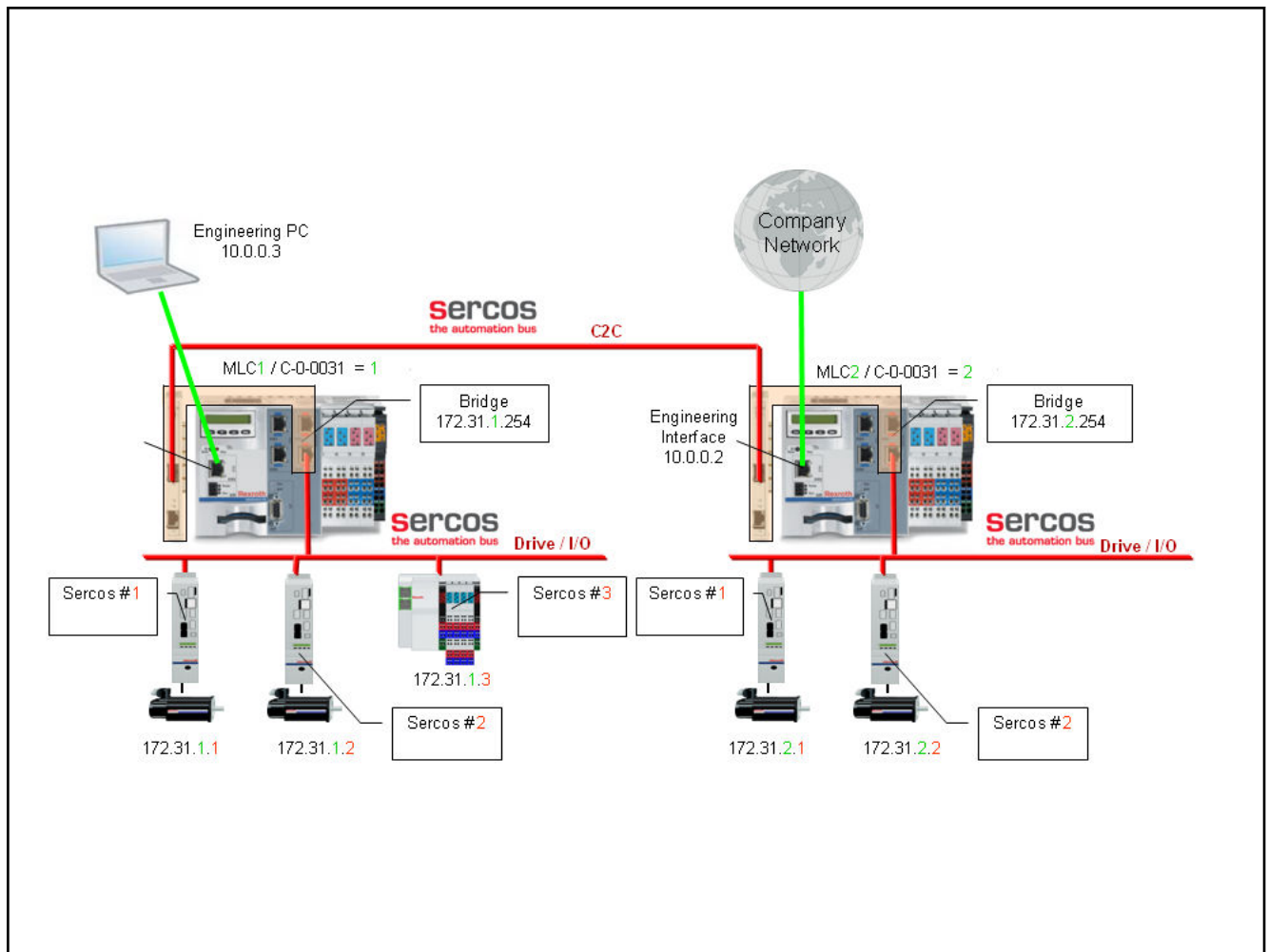


Fig. 3-96: Example: Bridging with the Sercos III function module (default configuration)



With the Engineering PC and via the IP channel of the Sercos III C2C connection, even the MLC2 control can be reached. Make the following settings:

- Parameterize controls as C2C master or slave via the parameter "C-0-0701, C2C, configuration of function modes"
- Control address of the respective control is specified via the parameter "C-0-0031, Control address" in the range 1...64
- Set the IP address of the C2C master as default gateway of the C2C slave controls

3.14.4 IndraWorks commissioning dialogs

To configure the Ethernet-based interfaces, commissioning dialogs are provided in IndraWorks. For these dialogs, go to **Communication** ► **Interfaces** in the context menu of the control.

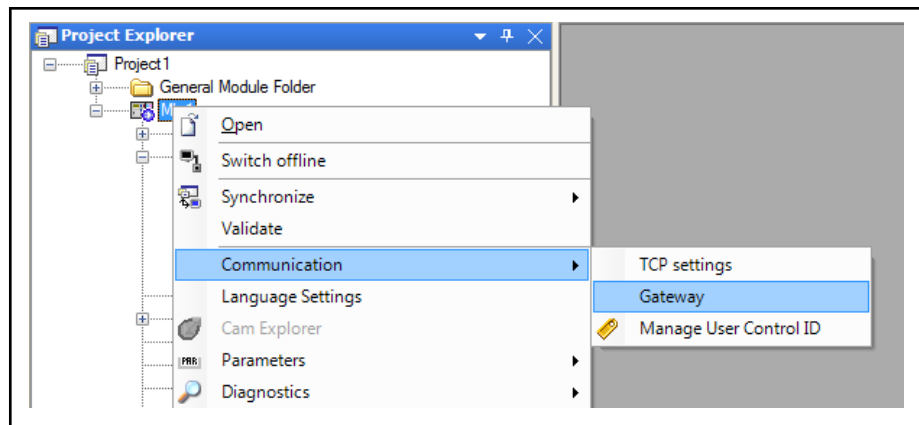


Fig. 3-97: Context menu to commission the Ethernet-based interfaces

Enable or disable the automatic address generation and the assignment to the bridge for the respective interfaces. Press **Apply Command Configuration** to apply the settings. Furthermore, load and enable the default IP settings (see [chapter 3.14.3 "Default setting"](#) on page 143) via the **Load Basic Network Parameters** button.

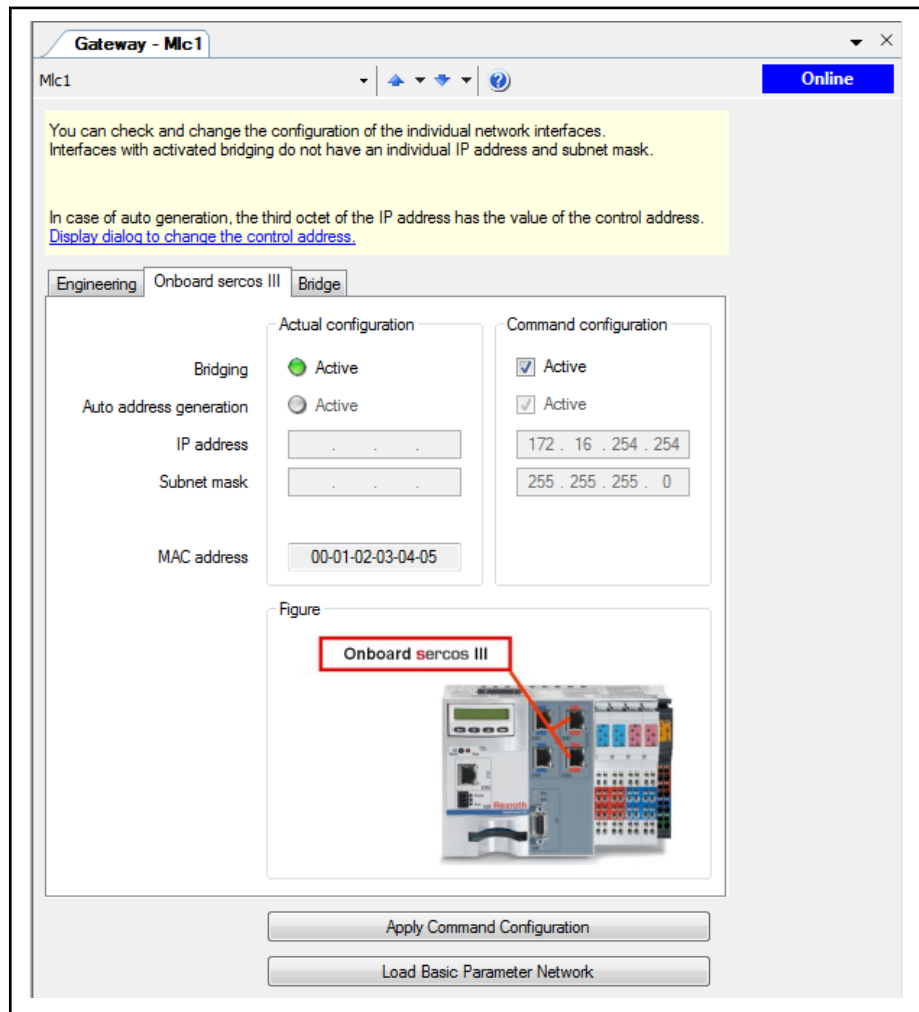


Fig. 3-98: Commissioning dialog to set the IP communication (in this case, bridging and automatic address generation enabled)

Onboard Realtime Ethernet Special features

The automatic address generation and the bridging for the onboard Realtime Ethernet is switched off by default. In this case, set the command configuration of the onboard real-time Ethernet (e.g. IP address) via additional IndraWorks dialogs. Depending on the project planning of this control, these dialogs are provided via the PROFINET_IO_Controller, Ethernet_IP_Scanner, Ethernet_Interface... nodes below the control.

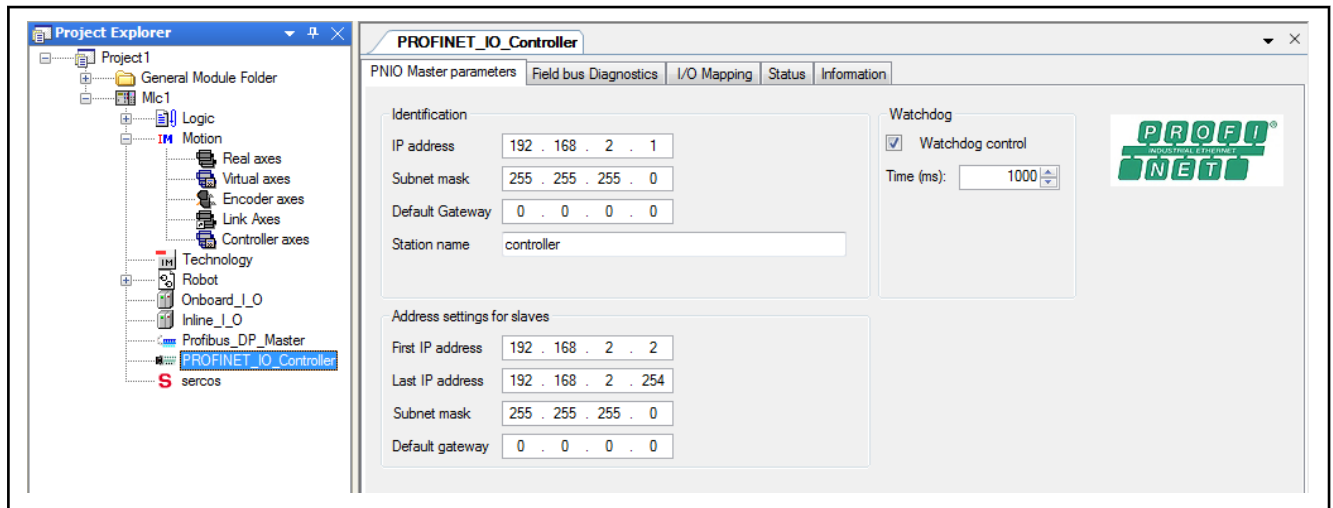


Fig. 3-99: Onboard Realtime Ethernet PROFNET_IO_Controller dialog



If the **automatic address generation** or the **bridging** is activated for the onboard Realtime Ethernet interface, the IP address is automatically assigned to the interface. The address settings in the Onboard real-time Ethernet dialogs are therefore **not applied**.

3.14.5 Automatic IP address generation

Depending on the setting in "C-0-0234, Automatic IP address generation, actual configuration", the IP addresses are assigned automatically (exception: Engineering interface) to assign a unique IP address to each IP device of the automation system. The IP addresses are generated according to the following rules:

Interface		Generated IP address	Generated subnet mask
Onboard Sercos III	C-0-0031 = 0	172.16.254.254	255.255.255.0
	C-0-0031 > 0	172.16. <C-0-0031>.254	255.255.255.0
Onboard Realtime Ethernet	C-0-0031 = 0	172.17.254.0	255.255.255.0
	C-0-0031 > 0	172.17. <C-0-0031>.254	255.255.255.0
Sercos III function module (C2C link)	C2C master (C-0-0701 Bit1 = TRUE)	172.16.0.254	255.240.255.0
	C2C slave (C-0-0701 Bit1 = FALSE)	172.16.0.<C-0-0031>	255.240.0.0
Bridge	C-0-0031 = 0	172.31.254.254	255.255.0.0
	C-0-0031 > 0	172.31.<C-0-0031>.254	255.255.0.0

Tab. 3-25: Automatic IP address generation of the control interfaces



The IP address in the IndraWorks dialogs Ethernet-IP (scanner or adapter) and Profinet (controller or device) is not applied if the automatic IP address assignment of the onboard Realtime Ethernet is switched on.

	C-0-0031 Control address	C-0-0235 bit 0 = 1 Onboard Sercos III in bridge	C-0-0235 Bit 0 = 0 Onboard Sercos III not in bridge
Sercos III drive or I/O address	0	172.31.254.<SercosAddress>	172.16.254.<SercosAddress>
	otherwise	172.31.<C-0-0031>.<SercosAddress>	172.16.<C-0-00031>.<SercosAddress>

Tab. 3-26: Automatic IP address generation of Sercos III drives and I/Os

Also refer to:

- C-0-0031, Control address
- C-0-0701, C2C, configuration of function modes
- C-0-0234, Automatic IP address generation, actual configuration
- C-0-0235, Automatic IP address generation, command configuration

3.14.6 Configuring the bridge

With the default settings, all Sercos III interfaces (onboard and function module) are part of the **bridge**. Broadcast telegrams thus create data traffic (Sercos III broadcast telegrams are excluded from this) in all Sercos III networks. This can cause reduced performance in very large Sercos III networks (for more than 500 IP devices). In such cases, individual Sercos III interfaces can be removed from the bridge via the parameter "C-0-0232, Bridge, command configuration of assigned interfaces". If the interface is not part of the bridge, routing is used as an alternative for other interfaces.

Furthermore, the onboard Engineering interface and the Realtime Ethernet interface can be included via the parameter C-0-0232. Thus, the broadcast telegrams are available across networks in the networks assigned to the bridge.

3.14.7 Involved IP communication parameters

IndraWorks commissioning dialogs (see [chapter 3.14.4 "IndraWorks commissioning dialogs" on page 147](#)) are available for the typical use cases using the parameters described below. It is only necessary to directly describe the respective parameters in special use cases.

The following table shows a brief overview on the relevant IP communication parameters. The following rules apply:

- The IP settings of the Engineering interface, the Sercos III interfaces and the bridge are applied with the command "C-0-1023 Command: Apply IP configuration". The command specification is defined for the onboard Sercos III interface via the parameter C-0-0220 for example. It is applied to the parameter C-0-0222 when the command "Apply network settings" is started
- In preparation: The IP settings of the Onboard Realtime Ethernet are specified in the IndraWorks dialogs (e.g. PROFINET_IO_Controller node). They are applied after a control restart. The command specifications are not explicitly available via parameters
- The default values for the Sercos III interfaces (onboard and function module) and the bridge are copied to the command configuration pa-

parameters and then automatically applied via the command "C-0-1024 Command: Load basic parameter of IP configuration". Furthermore, the default value of the IP address generation is written to the command value parameter (C-0-0235) and then automatically applied

- The parameter "C-0-0218 List of existing network interfaces" indicates the network interfaces on hardware-side
- The parameter "C-0-0219 Status of network configuration" indicates bit by bit for the individual interfaces whether changes are entered but not yet applied in the IP settings
- The parameter "C-0-0234 Automatic IP address generation, actual configuration" indicates the current setting of the automatic IP address generation (actual configuration) bit by bit
- The parameter "C-0-0235 Automatic IP address generation, command configuration" controls the automatic IP address generation bit by bit for all optional network interfaces on the control (command configuration)

Interface		IP address	Subnet mask	MAC address	Corresponding bit in C-0-0219 C-0-0235 C-0-0234
Engineering	Command configuration	C-0-0200	C-0-0201	C-0-0205	
Onboard Sercos III	Actual configuration	C-0-0222	C-0-0223	C-0-0224	Bit 0
	Command configuration	C-0-0220	C-0-0221		
Sercos III function module	Actual configuration	C-0-0227	C-0-0228	C-0-0229	Bit 1
	Command configuration	C-0-0225	C-0-0226		
Onboard Realtime Ethernet	Actual configuration	C-0-0242	C-0-0243	C-0-0244	Bit 2
	Command configuration	IW dialogs	IW dialogs		
Bridge	Actual configuration	C-0-0236	C-0-0237	C-0-0238	Bit 3
	Command configuration	C-0-0230	C-0-0231		

Tab. 3-27: Overview on the most important IP communication settings

3.14.8 Ethernet ports and firewall

The control and PC communicate via Ethernet. Several protocols are used depending on the use case. Firewalls - blocking the communication on some Ethernet ports - are installed on most of the PCs by default. An enabled firewall is not critical in most use cases. If communication problems occur between control and PC, the firmware settings have to be checked.

The control communicates with the other communication devices via the following Ethernet ports:

Port	Direction	Purpose	Communication partner
Complete port list	Documentation "Rexroth IndraControl Security Guide", subchapter "Port list"		
Common ports			
ICMP	Incoming	Ping	IndraWorks
TCP 20, 21	Outgoing and incoming	Firmware download (FTP) IndraLogic communication Motion communication	IndraWorks
TCP 23	Incoming	Telnet	
UDP 69	Outgoing	Firmware download, drives (TFTP)	IndraWorks
TCP 80	Incoming	IMST/web server (HTTP)	Web browser
TCP 6091	Outgoing	Robot Control	IndraWorks
TCP 1317	Incoming	PLC	IndraWorks
UDP 1740..1743	Incoming	PLC	IndraWorks
TCP/UDP 4840	Outgoing and incoming	OPC UA server	IndraWorks
TCP 5000..5003	Incoming	Parameter communication (SIS)	IndraWorks
TCP 5300	Incoming	MLPI	
TCP 11740, 11741	Incoming	PLC	IndraWorks
TCP 35021	Incoming	Parameter communication (SIP)	IndraWorks
50.000 to 65.535	Outgoing and incoming	Recommended ports for programming	

Tab. 3-28: Ethernet ports of the control

The "Direction" column refers to the control.

Incoming: Connection from the PC in the direction of the control. These connections are generally not critical for firewalls.

Outgoing: Connection from the control in the direction of the PC. These connections are generally blocked by a firewall. A firewall present on the PC has to be configured for these connections.

3.14.9 More information on the use of Ethernet-based interfaces

To use Ethernet-based interfaces, multiple functionalities are available. The following table provides an overview and refers to further documentation.

Functionality	Description	Related documentation
OPC server	Data exchange of the control with master level or HMI via OPC server	IndraLogic XLC IndraMotion MLC 14VRS HMI Connection, (part no. R911341497)
ModbusTCP	Data exchange of the control with third-party HMIs. The control is the ModbusTCP server	Rexroth IndraWorks 14VRS Basic Libraries IndraLogic 2G (part no. R911343920)

Functionality	Description	Related documentation
Network variables	Control-comprehensive data exchange of PLC variables via broadcast and UDP	IndraWorks 14VRS IndraLogic 2G PLC Programming System (part no. R911343571)
Sercos III CrossComm	A control-comprehensive data exchange in the link of up to 64 IndraMotion MLC controls with real-time properties to exchange master axis positions for example	Rexroth IndraControl Lxx14VRS Function Modules (part no. R911341583)

Tab. 3-29: Further information on the use of Ethernet-based interfaces

3.15 Axes

To create the different axis types, refer to [chapter 6 "Axes" on page 359](#).

3.16 Creating a kinematics



The Robot Control functionality, variant Robot Control V2 is only provided for MLC controls.

Robot Control V2

Procedure:

To add a new kinematics, click on **Add** below the "Robot" node.

A wizard guides the creation of a new kinematics:

Step 1: Entering device names, comment and author

The screenshot shows a software window titled "Insert Kinematics". Inside, it says "Step 1: General Settings" and "Inserting a kinematics". There are three input fields: "Device name" with the value "Kinematics2", "Comment" with a text area containing "<Please enter your comment here!>", and "Author" with the value "karlwalt". A "Select Template..." button is on the right. At the bottom are "Next >>", "Cancel", and "Help" buttons.

Fig. 3-100: Creating kinematics, step 1

Step 2: Enter the Robot Control version, kinematic number and kinematic type

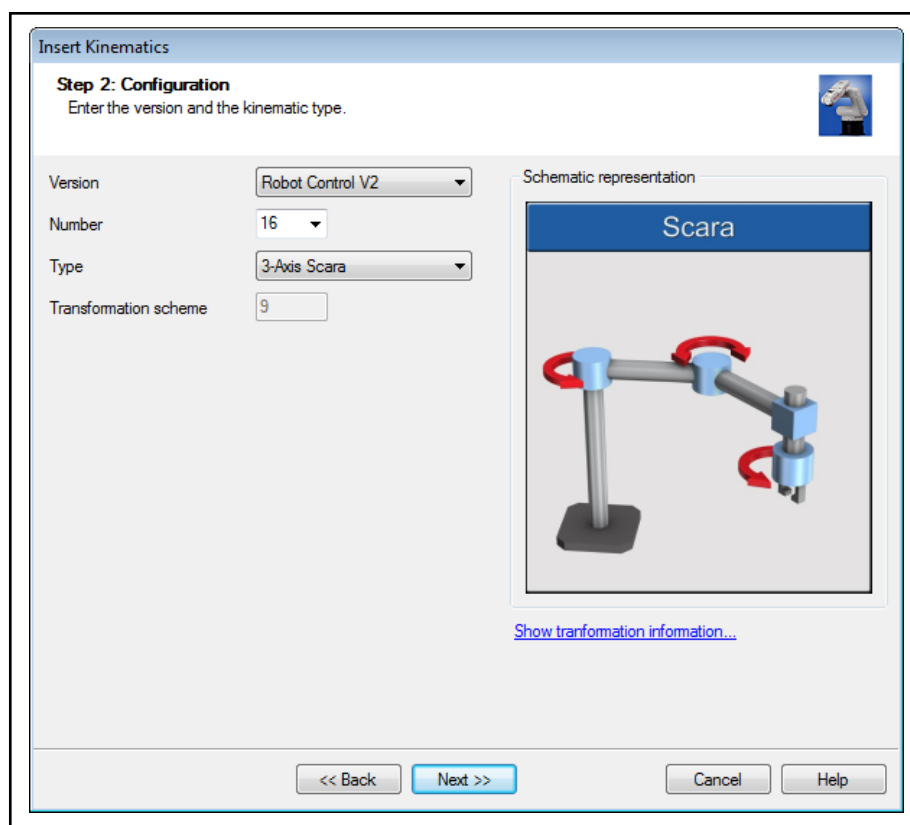


Fig. 3-101: Creating kinematics, step 2

Step 3: Assign axes

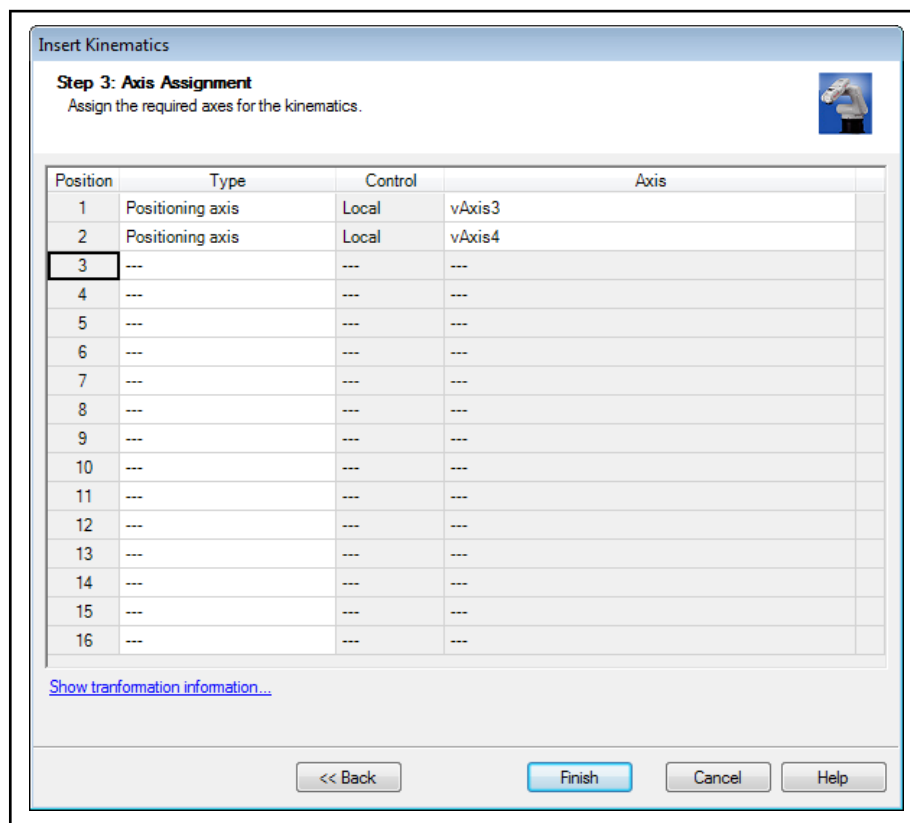


Fig. 3-102: Creating kinematics, step 3

The entered axes (positioning axes, orientation axes and belt axes) are applied to the parameter K-0-0008 (Axis configuration list).

After the kinematics has been created, a new menu item (kinematic name) is displayed below the "Robot" node.

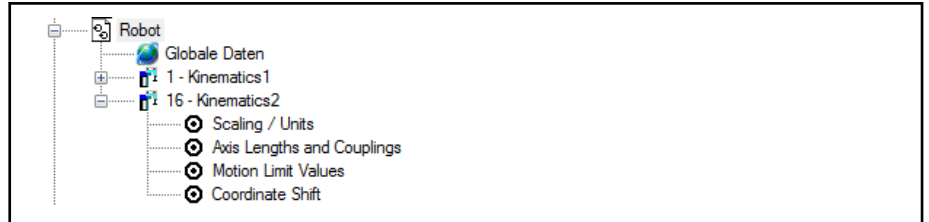


Fig. 3-103: New entry "Kinematics2"

For the creation of a Robot Control V2 program and its programming, refer to the documentation "MLC 14VRS Robot Control V2" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

3.17 Using a Robot Control V1 kinematics in compatibility mode

14VRS supports the Robot Control V2 functionality for the IndraMotion MLC controls.

- The Robot Control V1 kinematics in the 13VRS compatibility mode can be applied. Thus, the dialogs of the IndraWorks interface enable a corresponding 13VRS firmware.

The Robot Control V1 functionality is described in

- **Rexroth IndraMotion MLC 13VRS RCL Programming Instruction** (part no. [R911336297](#))
- **Rexroth IndraMotion MLC 13VRS Functional Description** (part no. [R911336295](#))

- The project can be converted to Robot Control V2.

The conversion is described in

- **Rexroth IndraMotion MLC 14VRS, Robot Control V2** (part no. [R911341588](#))

Chapter "Switching from Robot Control V1 to Robot Control V2".

Refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6.

3.18 Protocols - System security

3.18.1 General information

The IT security for embedded systems basically consists of data protection guarantee and information security. The following figure shows the key elements of a secure industrial automation component.

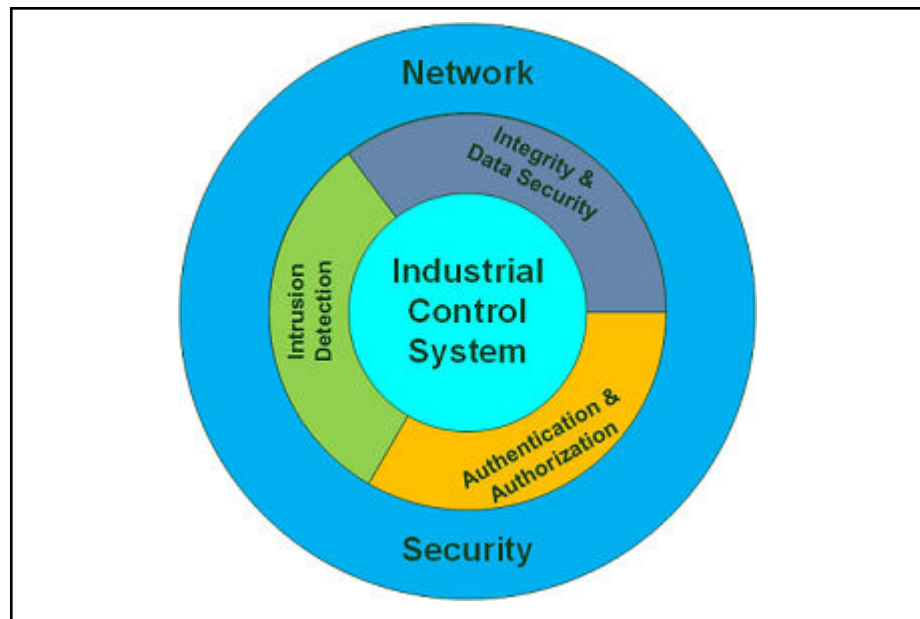


Fig. 3-104: Network security elements

From version 14V18, multiple elements of network security are addressed by mechanisms described in this chapter.

The safe communication is supported by the control types IndraControl XM2*, XM4*, VPx, CML75 and CML85 from version 14V18 (from 14V22 also by XM4*).

3.18.2 Network security

The following describes relevant protocols from the user point of view and describes the changes since 14V18.

The goal is that a secure communication is ensured on device level. SSL/TSL and SSH form the basis of network security. The user can disable unsecure services/protocols via the engineering tool IndraWorks as well as via defined software interfaces.

Secure command line: Secure Shell (SSH)

Status:	From 14V18
Available for:	XM21, XM22, XM42 (from 14V22), CML75, CML85, VPx
Port(s):	22
Substitute for:	Telnet

Tab. 3-30: Secure command line: Secure Shell (SSH)

The widely used standardized protocol Secure Shell (SSH) in the secure communication provides mechanisms to establish a secure, encrypted connection between two communication end points. Such a connection can be used to securely transfer data and commands and to tunnel unsecure protocols.

The command line provided via Telnet up to now is provided via SSH in future versions. The protocol Telnet is disabled due to security reasons and is not provided anymore from 14V20 for the controls with SSH.

The command line provided by SSH can be accessed via a client (e.g. PuTTY, Teraterm under Windows).



It is recommended that only qualified personnel accesses the control. Due to inappropriately executed commands, the device might go into a non-functional state.

Secure data transfer: Secure File Transfer Protocol

Status:	From 14V18
Available for:	XM21, XM22, XM42 (from 14V22), CML75, CML85, VPx
Port(s):	22
Substitute/supplement for:	FTP

Tab. 3-31: Secure data transfer: Secure File Transfer Protocol

The Secure File Transfer Protocol (SFTP) is used as mechanism for a secure data transfer. SFTP is part of the SSH service (refer to [chapter "Secure command line: Secure Shell \(SSH\)" on page 156](#)) and thus provides the same security mechanisms. Many common clients, e.g. WinSCP (Windows) or Filezilla (Windows, Linux, Mac OS) support the data transfer via SFTP.

To ensure downward compatibility, the unsecure File Transfer Protocol (FTP) is active upon the delivery of the control. Access data and passwords are transferred in plain text when using FTP (in contrast to SFTP). Thus, due to security reasons, it is strongly recommended to disable the protocol.

If FTP and SFTP are active on one control, SFTP is exclusively used as secure communication channel if an IndraWorks version with SFTP support is used.

In the MLC, the user can disable FTP.

FTP (refer to [chapter "Disabling unsecure protocols" on page 158](#)) can be disabled at any time via the context menu of the control in the project tree.

Secure data transfer: MLPIS

Status:	From 14V18
Available for:	XM21, XM22, XM42 (from 14V22), CML75, VPx
Substitute/supplement for:	MLPI

Tab. 3-32: Secure data transfer: MLPIS

The current MLPI server/client is compatibly extended by an encrypted variant based on TLS. The "mlpiApiConnect" function is used to decide in the client whether the communication is decrypted (only via TCP) or encrypted (TCP extended by TLS).

"mlpiApiConnect" is extended by security arguments. For the details, refer to the MLPI documentation under MlpiCore.

3.18.3 Integrity and data security

Status:	From 14V18
Available for:	XM21, XM22, XM42 (from 14V22), CML75, CML85, VPx

Tab. 3-33: Integrity and data security

First control boot after loading the system firmware

Upon the first boot in the system firmware (and after resetting to the factory settings) a pair of keys has to be generated for the secure communication

(SSH/SFTP, TLS). This is executed by the control. This process requires a certain amount of time causing a delay of the first boot. During this period, the control cannot be reached via protocol. Further booting is not delayed. New pairs of keys are not generated, as the existing ones are used.

Generating the key during the first boot is signaled via the LED DIA2 on the XM control (refer to "Display of the DIA2 LED" on page 52). For the VPx, it is displayed in the SysTray and for CML controls in the display.

3.18.4 Security in practice

Disabling unsecure protocols

Via the "Protocols" dialog Below the menu item "Communication" from the context menu of the XLC/MLC controls

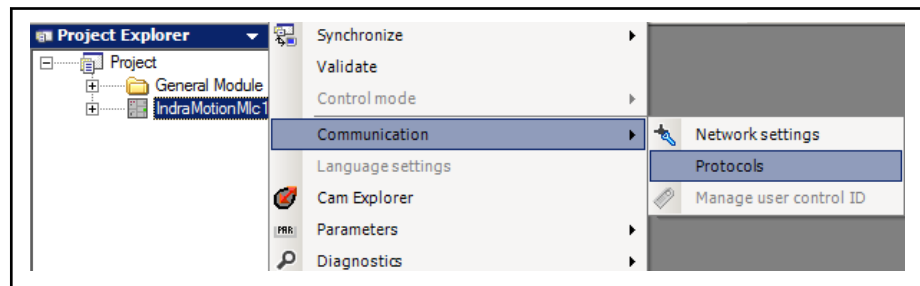


Fig. 3-105: Calling the "Protocols" menu for XLC/MLC controls

Different communication protocols are displayed for the control in the "Protocols" dialog. Unsecure protocols for which a secure variant is available, are flagged with a warning symbol. Protocols that are not required or unsecure can be disabled in this dialog.

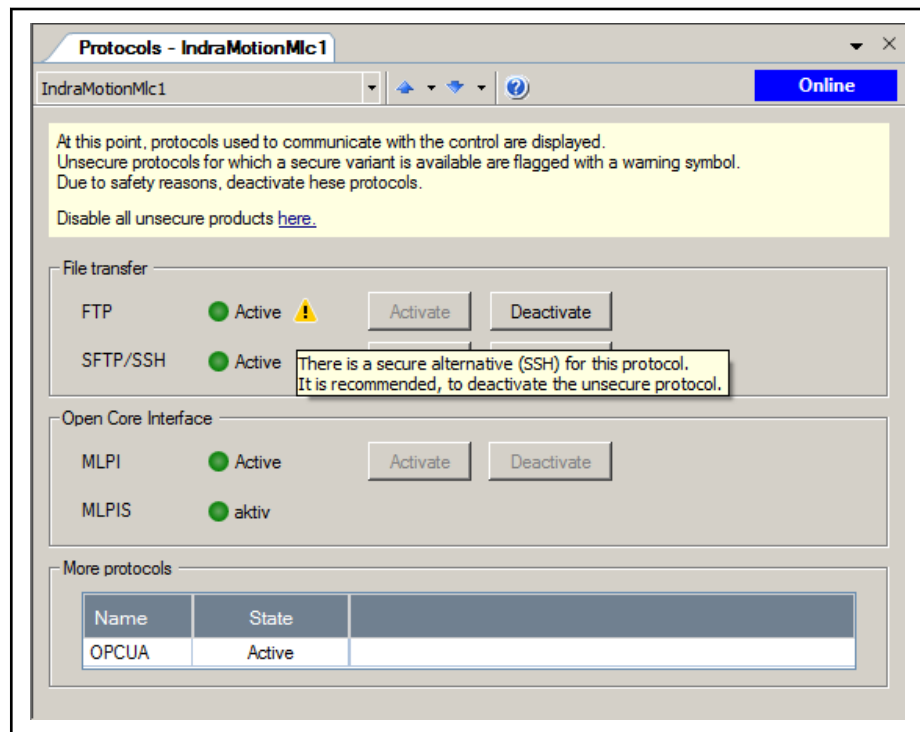


Fig. 3-106: "Protocols" menu with state overview and option to disable protocols on the control

Enabling disabled protocols

Disabled protocols can be enabled again via the "Protocols" dialog used to disable the protocol

Disabled protocols are also enabled by resetting to the factory settings.



When resetting, all project data stored on the control is deleted. All pairs of keys, also for SSH/SFTP, are newly generated. This protects customer data against unauthorized access.

There are several options for resetting:

Resetting the control via IndraControl First Touch

The procedure is described in the "IndraControl First Touch" documentation, see [chapter "Firmware management" on page 64](#)

Deleting the firmware using operating elements of the device

The procedure is described in the "IndraLogic XLC/IndraMotion MLC Operating and Display Elements" documentation, see ["Reset button" on page 48](#)



Following a reset, reload a system firmware via the commissioning software "IndraControl FirstTouch", see [chapter "Firmware management" on page 64](#)

IndraWorks Engineering

For the user, the behavior does not change compared to 14V18 when accessing control data via the functions provided by IndraWorks (e.g. project download, parameter editor, backup & restore).

External file access

Accessing files on the memory card externally (outside the engineering interface IndraWorks), a client supporting the SFTP protocol is required (refer to [chapter "Secure data transfer: Secure File Transfer Protocol" on page 157](#)), e.g. WinSCP (Windows) or Filezilla (Windows, Linux, Mac OS).



It is recommended that only qualified personnel accesses the system partition. In case of an inappropriate access, the functionality of the firmware and thus the device can be affected negatively.

Using the function blocks of the RIL_SocketComm.library in the PLC

Function blocks allowing data access via FTP/TFTP cannot be used anymore to access other controls with a disabled FTP server function. This affects the following function blocks:

- IL_FTPPutFileAsync
- IL_FTPGetFileAsync
- IL_FTPPutAsync
- IL_FTPGetAsync
- IL_TFTPPutFileAsync
- IL_TFTPGetFileAsync

Function blocks supporting access via SFTP are provided in future.

4 Control

4.1 Project structure

A project is characterized by a control instance (e.g. Mlc1).

The control instance consists of its context menu and several nodes: a Logic, a Motion and a Sercos node***; Robot*, Onboard I/O**, Inline I/O, Profibus/M**, Profinet_IO_Controller** folders are also available. Function module folders (e.g. Fast I/O (CFL01.1-E2)) can be added to the control.

* - only IndraMotion MLC

*** - not IndraLogic XLC without Sercos

The "Logic" node is provided with the "Application" subfolder. This contains:

- MlcVarGlobal
- UserVarGlobal
- Library manager
- MotionProg (PRG)
- PlcProg (PRG)
- Symbol configuration
- Task configuration (includes MotionTask and PlcTask)

The "Motion" node is provided with the following subfolders in which the individual axis instances can be created:

- Real axes
- Virtual axes
- Encoder axes
- Link axes (only IndraMotion MLC)
- Controller axes (only IndraMotion MLC)

Context menu and folder differ depending on their operating state (offline or online). For the offline state, refer to [chapter 3 "Commissioning and operation" on page 29](#).

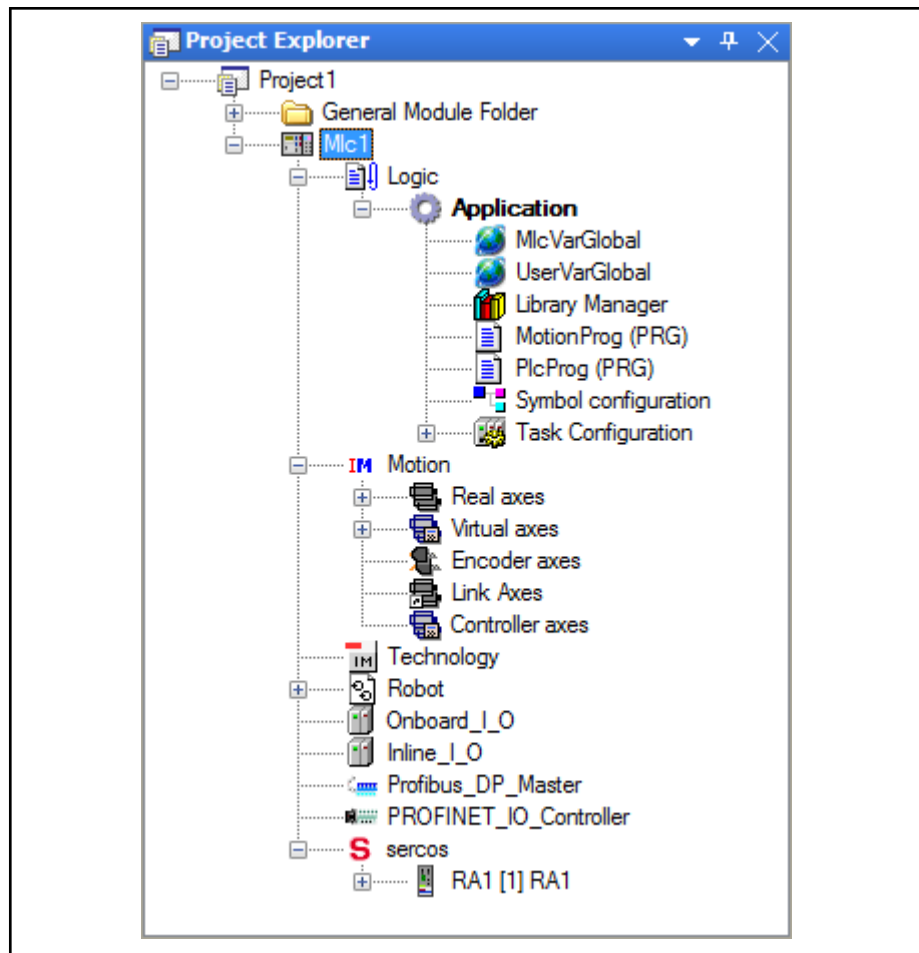


Fig. 4-1: Example: Tree structure of an IndraMotion MLC project

4.2 Toolbar of the control

The toolbar "XLC/MLC-Info" of the control shows the current status and provides direct access to frequently required functions. It is structured as follows:



Fig. 4-2: Toolbar of the control

The fields have the following functions (from left to right):

- IP address of the control ①
- Switching device online ②
- Downloading Motion configuration from PC to control ③
- Perform parameter adjustment for the control ④
- Compare Motion configuration in the project with the Motion configuration in the control ⑤
- Switch device offline ⑥
- Start the parameter editor of the control ⑦

Click to open the "Parameter Editor" dialog (see [chapter "Parameter editor" on page 222](#))

- Axis status: Displays whether axes rotate. Click to open the "Device Status" dialog (see [chapter "Device status" on page 234](#)) ⑧
- Warning: Displays whether a warning is present in the control. Click to open the "Error Memory" dialog (see [chapter "Error/diagnostic memory" on page 238](#)) ⑨
- Error: Displays whether an error is present in the control. Click to open the "Error Memory" dialog (see [chapter "Error/diagnostic memory" on page 238](#)) ⑩
- Clear Error: Click on this icon to acknowledge the current error message present on the control ⑪
- Select the current control mode ⑫
- Select the control mode "P0: Download mode" ⑬
- Select the control mode "P2: Parameterization mode" ⑭
- Select control mode "BB: Operating mode" ⑮

Control mode The control mode indicates the operating state of the control from the point of view of the drive technology and is closely related to the Sercos communication phases P0, P2 and P4, although the focus is more on Engineering.

Download mode (P0): This operating state is used to load a new firmware into the control. Only very few control parameters can be modified in this operation mode and parameters of Sercos devices cannot be accessed at all. The **P0** mode is also used to include devices in the Sercos bus. The **P0** mode is implicitly run through when switching from **BB** to **P2**. Depending on the error reaction "[Settings](#)" on [page 193](#), it might be switched automatically to this state if the Sercos bus is interrupted.

Parameterization mode (P2): This operating state is used to parameterize Motion and control functions (that means that nearly all parameters can be modified). During this period, no motion commands are sent to the drives. From the view of the Sercos bus, the acyclic communication is established, but not yet the cyclic communication.

Operating mode (BB): This operating state runs the Motion functionality (drives process the motion commands of the control). These motion commands are normally controlled by the PLC and, in this case, the PLC has to be in RUN state to send useful motion commands to the drives. Since the parameterized Motion functions can be executed in the operating mode (BB), only very few parameters can be modified. Due to the similarity with the Sercos bus behavior, this state is named "Phase 4" or "P4". From the view of the Sercos bus, acyclic as well as cyclic communication are established.

4.3 Control - Nodes

4.3.1 Overview on nodes

The nodes below the control result from their configuration:

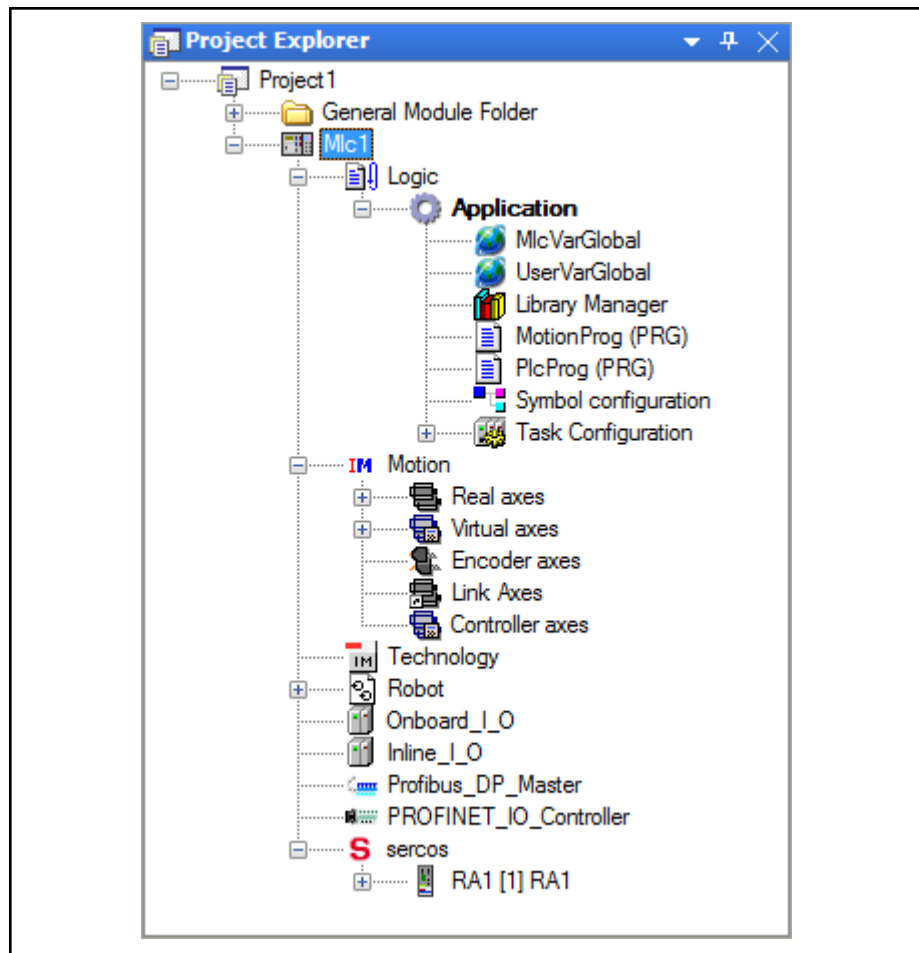


Fig. 4-3: Example: Nodes of the IndraMotion MLC control based on the IndraControl L65 hardware

- [chapter 4.3.2 "Logic" on page 165](#), transition to PLC programming
- [chapter 4.3.3 "Motion" on page 168](#), basic principle of motion programming
- [chapter 3.16 "Creating a kinematics" on page 153](#), creation of a kinematics (only IndraMotion MLC)
- [chapter 4.3.4 "Technology" on page 171](#), dialogs for PLC technology function blocks (only IndraMotion MLC)
- Options to connect and configure the input/output periphery (L45/L65/L75)
 - [chapter 4.3.6 "Onboard I/Os" on page 187](#), 1 byte fast inputs and outputs each*
 - [chapter 4.3.7 "Inline I/Os" on page 188](#), configurable Inline modules
- Options to connect and configure the input/output periphery (XM2)
 - [chapter 4.3.7 "Inline I/Os" on page 188](#), configurable S20 modules
- [chapter 4.3.9 "Profibus/M" on page 188](#), field bus to connect Inline modules, HMI devices, etc.
- [chapter 4.3.10 "Profinet I/O controller" on page 188](#), field bus to connect Profinet modules

- Function modules, here CrossComm Sercos II (CFL01.1-Q2), see [chapter 4.3.11 "Function modules" on page 189](#) (IndraMotion MLC only)
- [chapter 4.3.12 "Sercos" on page 189](#), field bus to operate standard drives

* - only IndraLogic XLC/IndraMotion L45/L65/L75

4.3.2 Logic

"Logic" subfolder

The "Logic" node maps the "IndraLogic" PLC programming system.

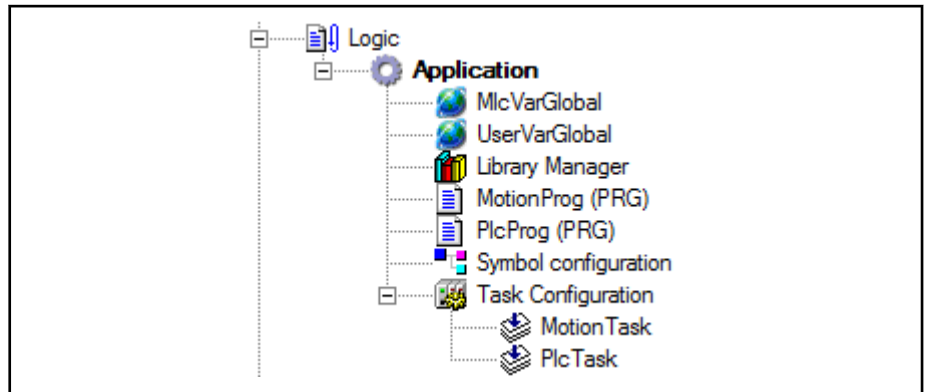


Fig. 4-4: "Logic" node and its subfolders

After the control was applied to the Project Explorer, two program files are automatically created below the "Application" folder and assigned to the two following configured tasks:

- "MotionProg" assigned to the "MotionTask" task (Sercos-controlled high-priority task)
- "PlcProg" assigned to the "PlcTask" task (freely running low priority or time-controlled low priority task)

Both programs contain only one dummy network each to ensure that the PLC project can be compiled. The networks can be deleted later. The differences in program use result due to their task assignment.

The "MlcVarGlobal" file contains AXIS_REF and, for the IndraMotion MLC, the touch probe declarations.

The "UserVarGlobal" file is empty. Users can declare global variables.

The "Library Manager" can be used to add and install libraries (see [chapter 5.3 "Library management" on page 323](#)).

The two preconfigured tasks are integrated into the overall task system of the control (see [chapter 5.4 "Task system" on page 329](#)).

"Logic" – Context menu

The context menu of the "Logic" node contains the following menu items:

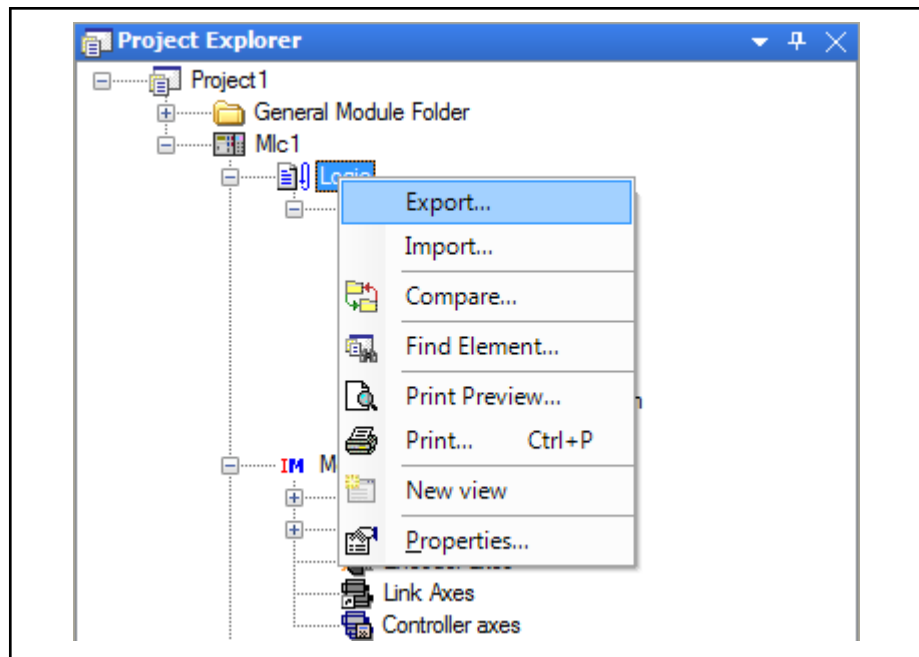


Fig. 4-5: Example: Context menu of the IndraMotion MLC "Logic" node

- **Export...** - Saves the "Logic" elements to a file
- **Import...** - Imports "Logic" elements from an export file on the PC. The "Logic" elements to be imported can be selected before the import
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging"](#) on page 272
- **Find Element...** - Searches for elements below the node
- **Print Preview...** - Preview of the "Logic" components selected for printing
- **Print...** - Prints the selected "Logic" components



As the source code of a PLC project is generally very comprehensive, large volumes of paper can be generated! Use the print option of the individual PLC editors.

- **New View** - Displays the node in individual view
- **Properties...** - Displays and changes the properties. The following properties can be modified:
 - Exclude from build
 - External implementation
 - Enable system call
 - Specify compiler definitions

Application – Toolbar



Fig. 4-6: IndraLogic toolbar

The toolbar provides the following functions (from left to right):

- **Build Application** - Compiles the currently active PLC application

- **Login** - Enables the PLC monitoring mode. A connection is established to the PLC of the control. If the PLC program is not current, it is compiled in advance and loaded to the control
- **Log Out** - Ends the monitoring mode. The PLC connection to the control is disconnected
- **Start** - Starts the PLC

This command is located on the IndraLogic menu bar and in the "Debug" menu. This command starts the active application in the IndraWorks project. The active application can be set at the "Application" node via the context menu "Set Active Application"

- **Stop** - Stops the PLC

This command is located in the IndraLogic menu bar and in the "Debug" menu. This command stops the active application in the IndraWorks project. The active application can be set at the "Application" node via the context menu "Set Active Application"

Application – Context menu

With the "Application" subfolder highlighted, right-click to open the context menu.

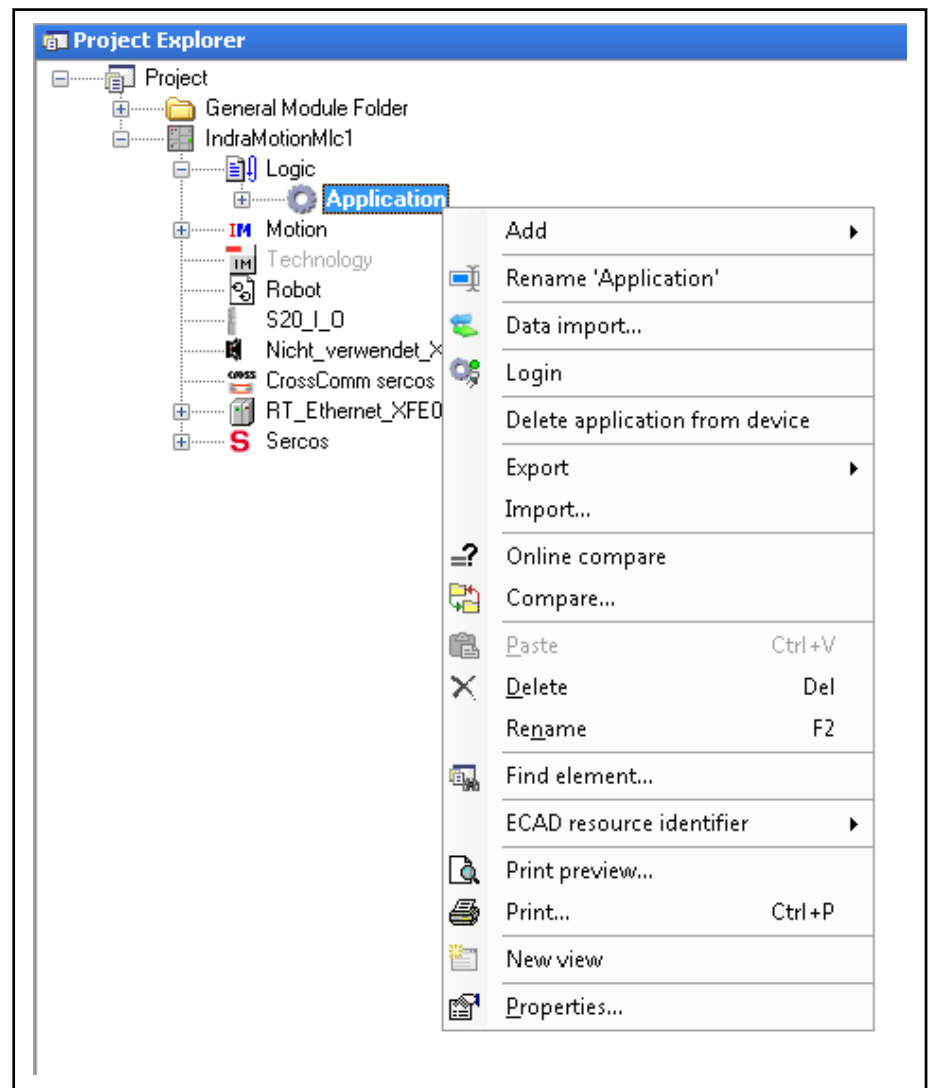


Fig. 4-7: Context menu of the "Application" subfolder

The context menu of the "Application" folder contains the following menu items:

- **Data Import...** - Imports PLC data from other projects
This menu item can also be used to apply the PLC part and field bus configuration of IndraWorks or IndraLogic projects based on IndraLogic 1.
- **Login** - Log in to the PLC



If there are several controls in the project, ensure that the application was set to active before logging in via the "Debug" menu.

- **Add** - Adds objects, POU's, folders, etc.
- **Export...** - Saves "Application" elements to a file
- **Import...** - Imports "Application" elements from an export file on the PC. The "Application" elements to be imported can be selected before the import
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Rename** - Renames the node
- **Find Element...** - Searches elements below the node
- **Print Preview...** - Preview of the "Application" components selected for printing
- **Print...** - Prints the selected "Application" components
- **Add** - Adds PLC-specific objects
- **New View** - Displays the node in individual view
- **Properties...** - Displays and changes properties

4.3.3 Motion

General information



In IndraLogic XLC controls, this node is only available on controls with a Sercos interface.

In **offline mode**, different types of axes can be created in the "Motion" node:

- Real axes based on IndraDrive, SercosDrive, EcoDriveCS or Hydraulic-Drive devices (only IndraMotion MLC)
- Virtual axes (can be used as virtual master axes)
- Encoder axes (real master axes). The encoder uses the plug-in card in the drive electronics of a real axis drive
- Link axes applying axis information via the CrossComm Sercos II (CFL01.1-Q2) function module for the cross communication (only IndraMotion MLC)
- Controller axes are used to implement the controller of an axis into the PLC and to command this axis like all other axes (only IndraMotion MLC)

For each axis type, a folder is provided, in which the respective axis instances can be configured.

At first, the folders are empty.

A real axis is created via **drag&drop** or **copy&paste** of the respective library element (see also [chapter 6.3.3 "Creating a real axis" on page 370](#)).

A virtual axis is created via the "Add" context menu item (see also [chapter 6.4.2 "Creating a virtual axis \(virtual master axis\)" on page 391](#)).

An encoder axis is created via the "Add" context menu item (see also [chapter 6.7.2 "Creating an encoder axis \(real master axis\)" on page 427](#)).

A link axis (only IndraMotion MLC) is also created via the "Add" context menu item (see also [chapter 6.6.2 "Creating a link axis" on page 422](#)).

A controller axis (only IndraMotion MLC) is also created via the "Add" context menu item (see also [chapter 6.5.2 "Creating a controller axis" on page 399](#)).

Each axis of an axis type can be configured using the corresponding dialogs:

- Real axis - [chapter 6.3.4 "Real axis – Dialogs" on page 373](#)
- Virtual axis - [chapter 6.4.3 "Virtual axis - Dialogs" on page 394](#)
- Encoder axis - [chapter 6.7.3 "Encoder axis - Dialogs" on page 431](#)
- Link axis (only IndraMotion MLC) - [chapter 6.6.3 "Link axis - Dialogs" on page 425](#)
- Controller axis (only IndraMotion MLC) - [chapter 6.5.3 "Controller axis - Dialogs" on page 410](#)

In **online mode**, the operating state of the "Motion" calculation is displayed at the "Motion" node. This operating state is directly coupled to the control mode. The following states are possible:

- **"Initialized"**: Download mode: Motion calculation not active, parameterization only limited (respective control mode "P0")
- **"Stop"**: Parameterization mode: Motion calculation not active, parameterization possible (respective control mode P2)
- **"Checking"**: Parameterization verification active. At missing parameterization, the Motion calculation can possibly not be started (respective control mode "P3")
- **"Running"**: Operating mode: Motion calculation active (respective control mode "BB")

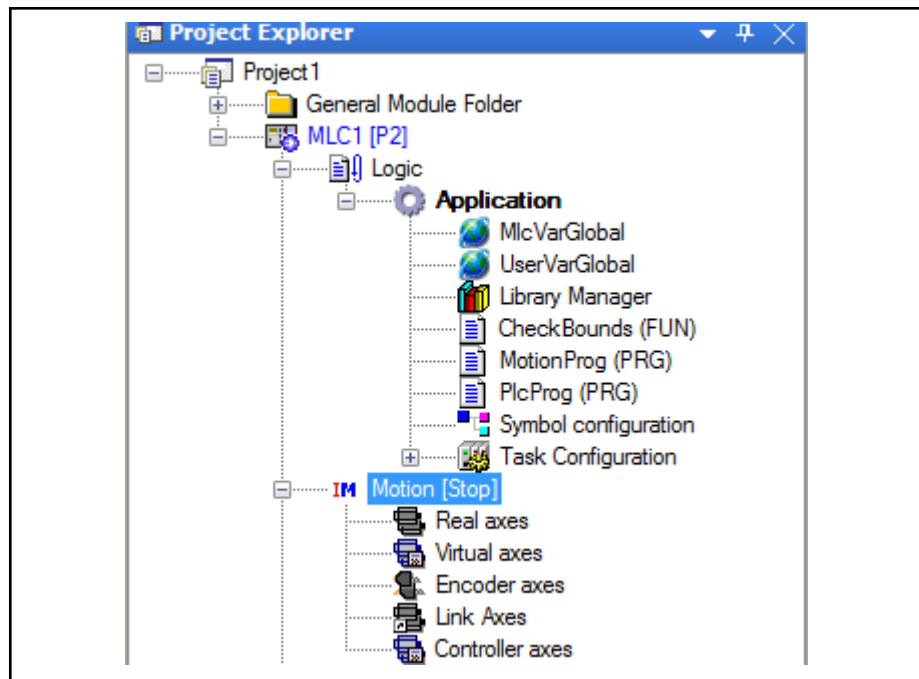


Fig. 4-8: "Motion" node in online mode

Motion – Context menu

For commands on the complete Motion functionality (that is on all axes), go to the context menu of the "Motion" node.

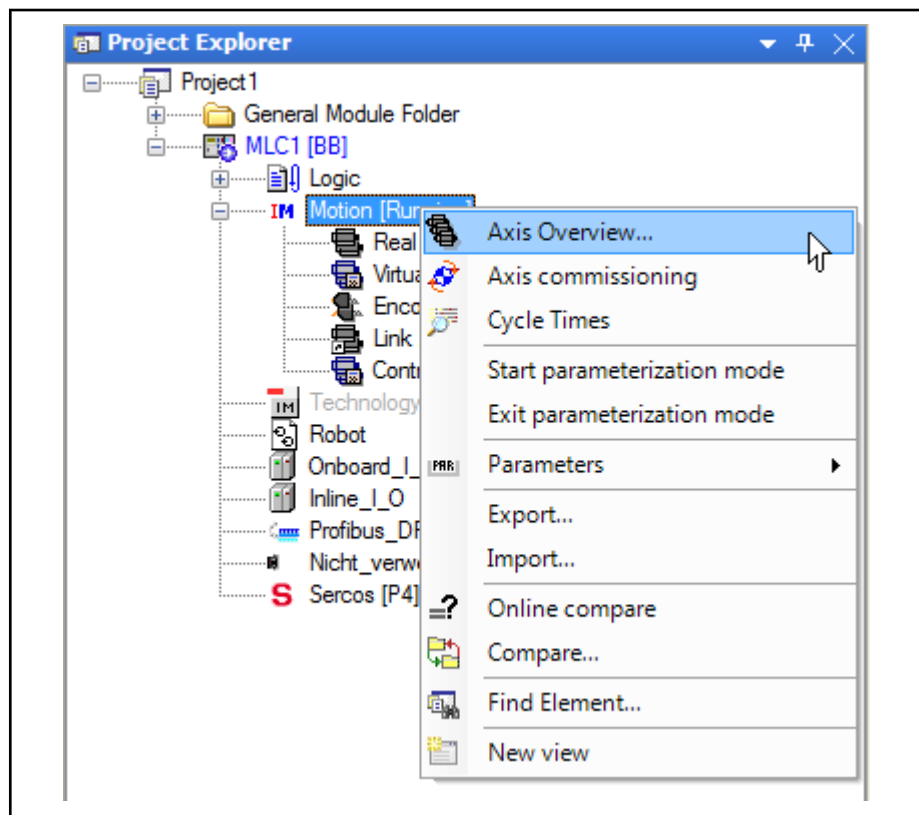


Fig. 4-9: Context menu of the Motion node

- **Axis Overview...** - Edits, duplicates, adds or removes axes

- **Axis Commissioning** - Moves axes without creating a PLC program before (see [chapter 7.11 "Axis commissioning" on page 554](#))
- **Cycle Times** - Shows the current behavior of the task management and can be used to set its timing (see [chapter 7.2 "Cycle times" on page 519](#))
- **Start Parameterization Mode** - Use this command to switch all axes to the parameterization mode. The Sercos bus remains in phase 4. The parameterization mode allows to reparameterize axes while the PLC is running and still controls all Sercos I/O devices. For more information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#). If one of the axes cannot be switched to the parameterization mode, the "Error/Diagnostic Memory" dialog is displayed (see [chapter "Error/diagnostic memory" on page 238](#))
- **Exit Parameterization Mode** - Exits the parameterization mode of all axes in the parameterization mode. This command can be started in the phases 2 and 4. For more information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#). If the parameterization mode cannot be exited for one of the axes, the "Invalid Parameters" dialog is displayed (see [chapter "Invalid parameters" on page 241](#))
- **Export...** - Saves "Application" elements to a file
- **Import...** - Imports "Application" elements from an export file on the PC. The "Application" elements to be imported can be selected before the import
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Find Element...** - Searches elements below the node
- **New View** - Displays the node in individual view

Each axis creates its own environment:

- For the contents of the context menus of the different axis types, refer to:
 - [chapter 6.3.5 "Real axis – Context menu" on page 376](#)
 - [chapter 6.4.4 "Virtual axis - Context menu" on page 395](#)
 - [chapter 6.7.4 "Encoder axis - Context menu" on page 432](#)
 - [chapter 6.6.4 "Link axis – Context menu" on page 425](#) (only IndraMotion MLC)
 - [chapter 6.5.4 "Controller axis - Context menu" on page 415](#) (only IndraMotion MLC)

To go to the individual software tools, use the context menus and dialogs.

4.3.4 Technology

Introduction



This node exists only for MLC controls.

Supported technology functions of the PLC program of the control are automatically visualized below the "Technology" node. Supported technology functions are organized in groups. Which groups and supported functions exist, can be determined via the "Properties" dialog. For more information, refer to [chapter "Context menu" on page 173](#).

If an instance of a supported technology function is available in the PLC program, it is displayed below the "Technology" node after a successful program compilation. Instances are displayed in their respective group folder. The dialogs (visualizations) belonging to an instance are located below an instance.

Dialogs of an instance are only available if the PLC application is logged in. Otherwise, the dialogs are grayed out and not available.

Example:

Technology function instance "MB_WinderDancerCtrlType01"

This technology function is part of the to the "Winder" group.

The instance is called "fbWinderDancerCtrlType02" and is provided with the following dialogs:

- Dancer control
- Dancer limitation
- Diameter calculation
- Diameter limitation
- Status
- Complete overview

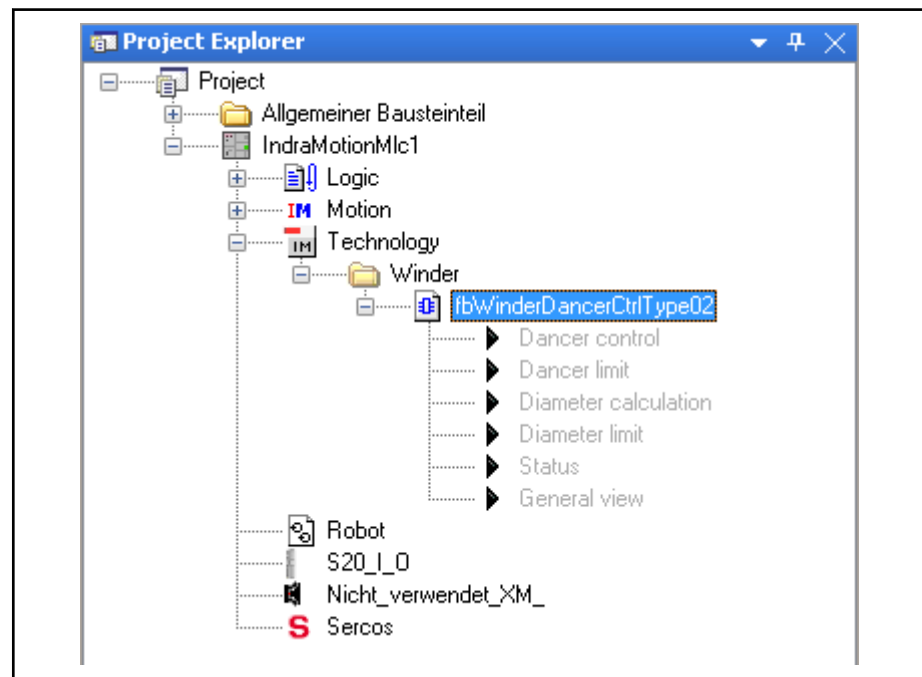


Fig. 4-10: Technology nodes with technology instances and dialogs

Tooltip An instance in the project tree provides additional information on the technology function and the exact storage location in the PLC program via the tooltip. Therefore, move the mouse pointer across the instance.

For more information on the technology dialogs, see [chapter "Dialogs" on page 178](#).

Context menu Open the POU via the context menu and the "Go To Definition" function. The technology instance is declared in the POU.

Help connection The "Technology" node is connected to a help. Press <F1> to open the help if the "Technology" node or a subordinate element was highlighted. The help is displayed depends on the selected node:

- **Technology node:** The general help on the "Technology" node is opened
- **Group, instance or dialog nodes:** The special help on the respective technology group is opened

Context menu

The context menu of the technology node includes the following commands:

- **Activated** - Enables/disables the "Technology" folder
- **Add** - Special wizards can be opened in the submenu. These wizards can be used to generate instances of technology functions in the PLC program.

For more information, refer to [chapter "Technology wizards" on page 174](#)

- **New View** - Displays the "Technology" node in a new Project Explorer window
- **Properties...** - Displays the groups supported by the "Technology" node and their respective technology functions. Additionally, the available technology dialogs are listed for each technology function

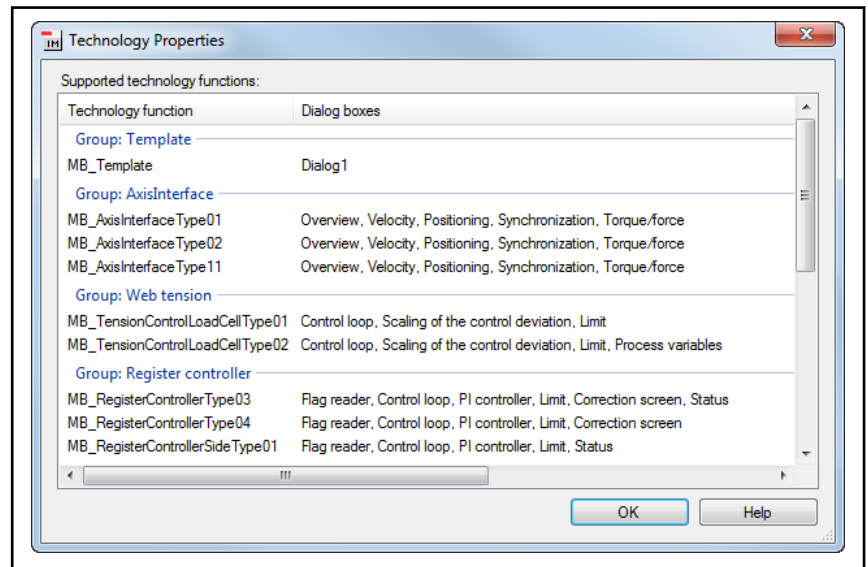


Fig. 4-11: Properties of the "Technology" node

- **Find Element...** - Searches an instance or dialog for example. The function is only available if the "Technology" node is not empty

"Options" menu

An "Options" menu is available for the "Technology" node. For the "Options" menu, go to **Tools ► Options ► XLC/MLC "Technology"**.

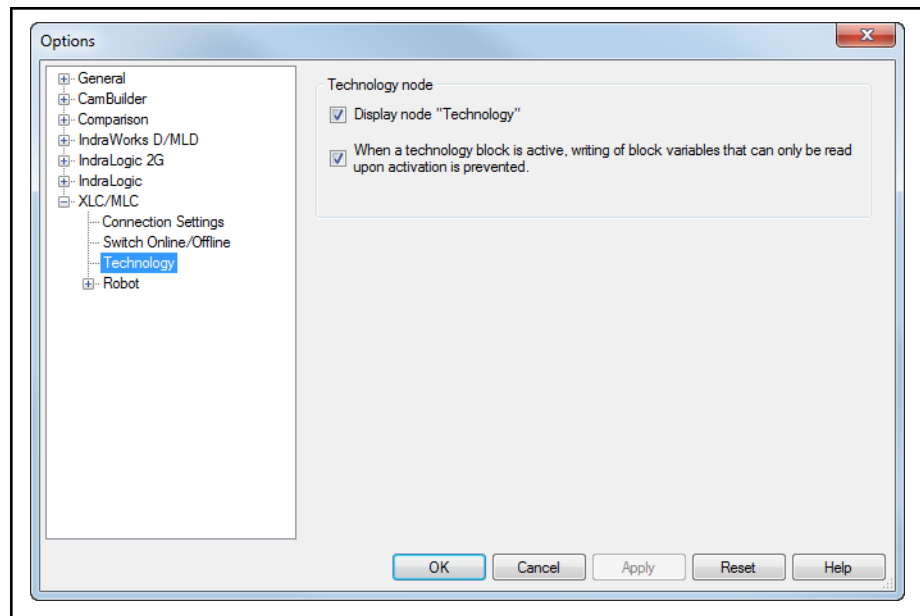


Fig. 4-12: Technology options menu

The settings of the "Options" menu affect all technology nodes of the project:

- **Display node "Technology":** Enables/disables the "Technology" node in the device project
- **When a technology function block is active,...:** , some input variables of technology functions are only loaded when a technology function is enabled (e.g. at a positive edge at "Enable"). The technology dialogs impede the entry of new values for these variables while the technology function is active. An information dialog is displayed instead after the entry.

This behavior can be deactivated and activated again via the option described in the menu dialog. If the function is disabled, writing on such input variables is always allowed. If the function is enabled, an information dialog is displayed when entering a new value for a respective variable. For more information, also refer to [chapter "Dialogs" on page 178](#)

Technology wizards

General information



Currently, only available for the "Winder" technology function.

For the submenu item "Add", go to the context menu of the "Technology" node. Technology wizards are located below. They are used to select, configure and generate special technology functions step by step in the PLC program.

The following steps are always performed by a technology wizard

- Selecting a technology function
- The corresponding PLC library is automatically added to the library manager of the application
- Selecting the POU to create the technology instance in
- Configuring and connecting inputs and outputs of the technology function
- Preview of the code changes

- Automatic PLC code generation in the selected POU

Example of the "winder" technology wizard

Representing the mentioned steps using the "Winder" technology wizard as example

1. Functional selection

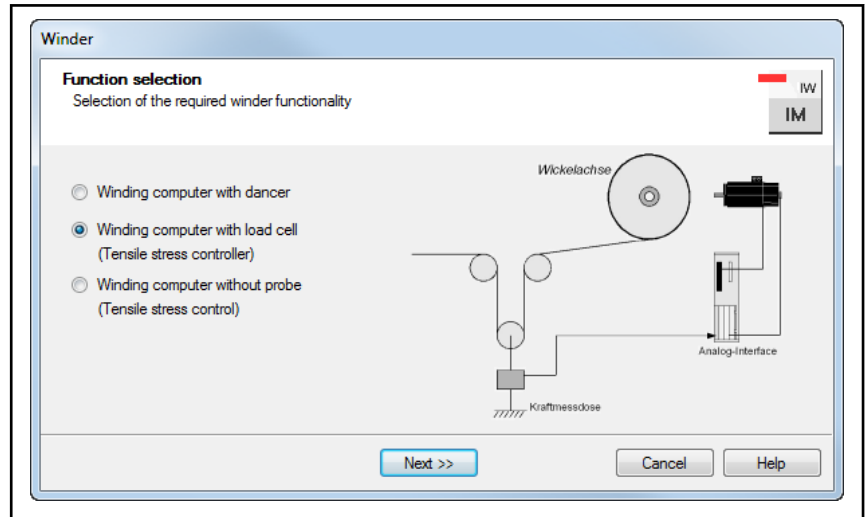


Fig. 4-13: Selecting the desired winder function

- Automatic insertion of the "RMB_TechWinder" library. If this library is not installed or the library manager cannot be checked out in case of a version-controlled project, this step causes an error.

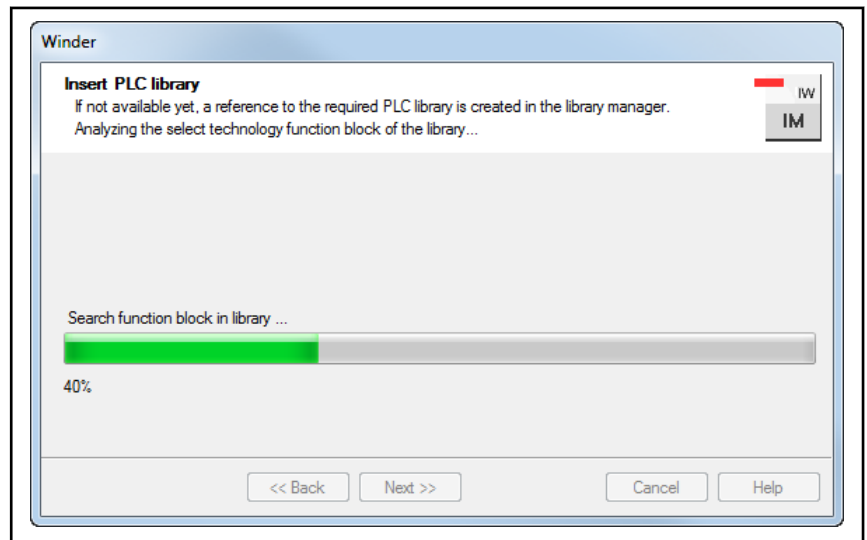


Fig. 4-14: Inserting the PLC library

3. Selecting the POU and the instance name. All possible POU's of the application are provided here. An instance name is also suggested. If this name already exists in the selected POU, an error message is displayed and the next processing step cannot be started.

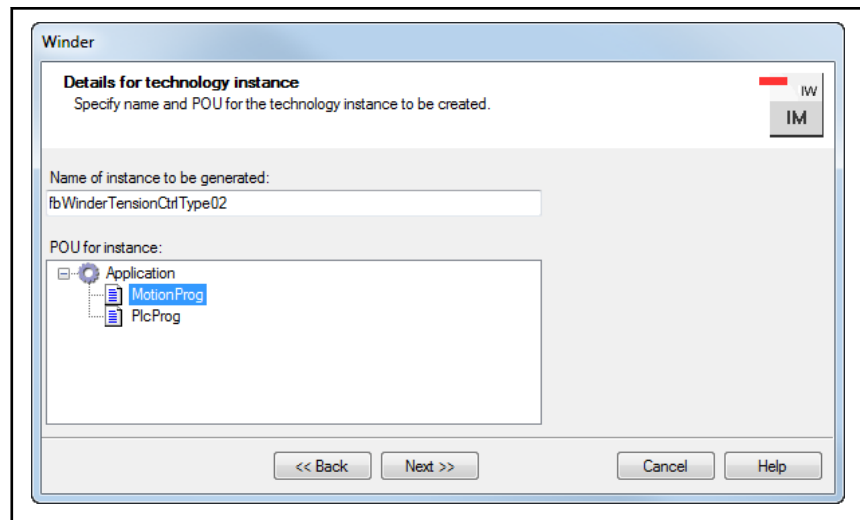


Fig. 4-15: Selecting a POU for the technology instance

4. Configuring the technology function. In this step, all input, output and input/output variables of the technology functions are shown in a table. There are different configuration options:
 - Either a specified value or a variable name can be entered for all input variables
 - Use the "..." button to open the input wizard dialog for the variable
 - Only wired variables may be specified for output variables. Specified values are of no use
 - For Boolean variables, either the value "True" or "False" can be selected in the drop-down menu
 - For Enum variables, a valid Enum value can be selected in the drop-down menu
 - Complex data types (e.g. structures) can be expanded via the black arrow at the left line margin
 - The "Comment" column displays the variable description stored in the PLC library. This description is only available in English

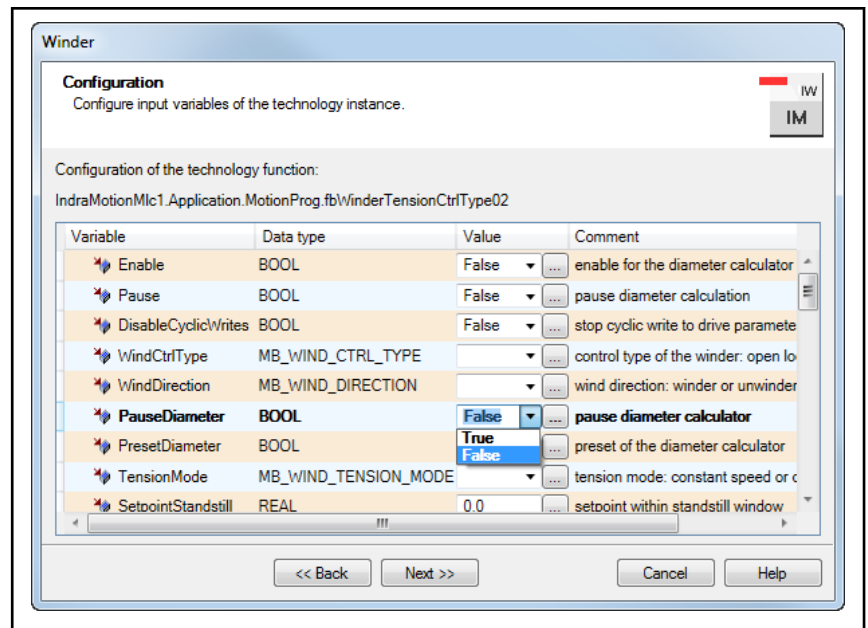


Fig. 4-16: Configuring the technology instance

5. Preview of the code change. The displayed code is added to the end of the declaration part of the selected POU. Press << Back to adjust the configuration. The new code includes:
 - Instance declaration This configures the input variables
 - Example code with comments for the instance call. It can be inserted into at a suitable location in the program. This instance call includes the application of all selected variables specified in the configuration

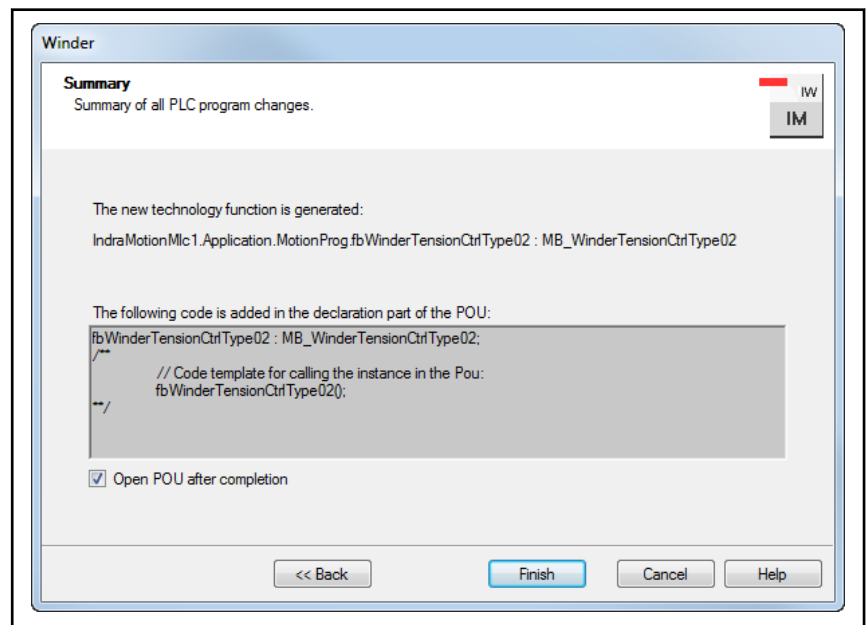


Fig. 4-17: Preview of the code change

6. PLC code generation. If the checkbox "Open POU after completion" was not deselected in step 5, the changed POU is opened after completing the wizard.

Dialogs

Dialogs, general

Availability If an instance of a supported technology function is available after the compilation of the PLC program, it is displayed in the respective folder.

One or several dialogs visualizing the technology function belong(s) to the instance. To open a dialog, the respective node in the Project Explorer has to be executed (click on Enter or double-click).



Technology dialogs are only available if the PLC application is logged in. If the application is disconnected while a dialog is open, the dialog is disabled.

Navigation To switch between the dialogs, different functions can be used.

1. Open the dialog via the Project Explorer.
2. Change between the dialogs via navigation arrows or the navigation menu in an open dialog. These buttons allow direct jumping to another dialog of the same technology instance.

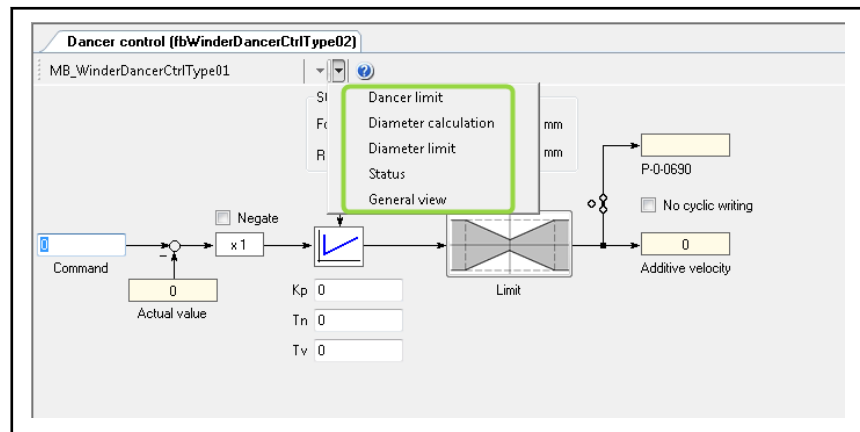


Fig. 4-18: Navigation arrows and navigation menu of the "Dancer control" dialog

3. Change between the dialogs via hyperlinks in the opened dialog. These hyperlinks allow direct jumping to another dialog of the same technology instance.

Dialog contents In the technology dialogs, process-relevant information is displayed. Provided information:

- PLC variables
- Sercos parameters

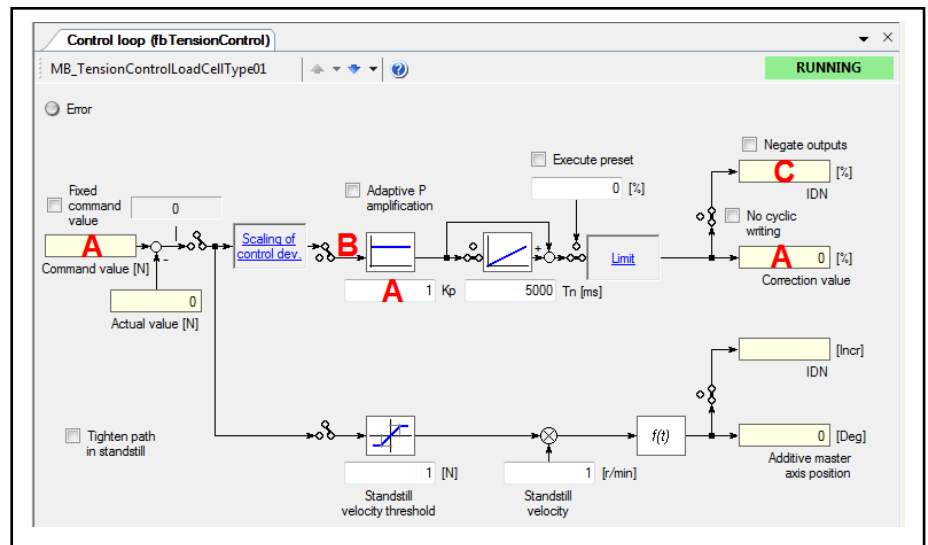


Fig. 4-19: Exemplary contents in the "Control loop" dialog of the technology function "MB_TensionControlLoadCellType01"

PLC variables

PLC variables can be write-protected (see 'A' in fig. 4-19 "Exemplary contents in the Control loop dialog of the technology function MB_TensionControlLoadCellType01" on page 179). Open a "Properties" dialog with detailed information on this PLC variable via the context menu of the respective dialog elements (e.g. text box). Therefore, the context menu (right-click) of the dialog element.

If a dialog element of a PLC variable provides an input option (e.g. a text box), this dialog element might be blocked. Some input variables are only applied by the technology function if this variable is enabled (e.g. at a positive edge at "Enable"). If the technology function is active, writing on the input is disabled. This is shown by a respective note.

With **OK**, the value is still written but does not affect the technology function. To activate and deactivate this note, see [chapter "Options" menu](#) on page 173.

PLC variables can also be visualized by signal flow paths (see 'B' in fig. 4-19 "Exemplary contents in the Control loop dialog of the technology function MB_TensionControlLoadCellType01" on page 179). Transmission elements in these paths (e.g. interconnect points, branches, lines or arrows) are shown, opened or deviated according to the state of one or several variables.

Sercos parameters

In technology dialogs, Sercos parameters are also shown (see 'C' in fig. 4-19 "Exemplary contents in the Control loop dialog of the technology function MB_TensionControlLoadCellType01" on page 179).

Therefore, two conditions have to be met

1. The device has to be "online". That means there has to be a connection to the Motion system. If this is not the case, the dialog element shows "offline".
2. A respective axis has to be assigned to the technology instance. In the example above, parameter "P-0-0694" is assigned to the "slave" axis. If no "slave" axis was assigned to the technology instance during the cyclic call, the dialog element does not display any content.

The parameter editor can be directly opened via the context menu (right-click) of such a dialog element.

"AxisInterface" group

This group displays the instances of the technology function MB_AxisInterfaceType01, MB_AxisInterfaceType02 und MB_AxisInterfaceType11 (ML_TechInterface.library).

The special feature of this group is that instances are only displayed if an axis is also assigned to them. This takes only place via the variable "AdminCtrl.Axis" at PLC program runtime. If the "AxisInterface" is empty, either no axis is configured or the instance has not yet been assigned to an axis.

The additional operation modes of the function block "MB_AxisInterfaceType02" such as ModeCoordinated, ModeCyclicPosition, etc. are not supported by the dialogs.

For a detailed description of the function blocks of the "ML_TechInterface.library", refer to the documentation "IndraLogic XLC IndraMotion MLC 14VRS, Generic Application Template", chapter "MB_AxisInterfaceType01", "MB_AxisInterfaceType02" and "MB_AxisInterfaceType11" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

Interface description of the function blocks MB_AxisInterfaceType01, MB_AxisInterfaceType02 and MB_AxisInterfaceType11

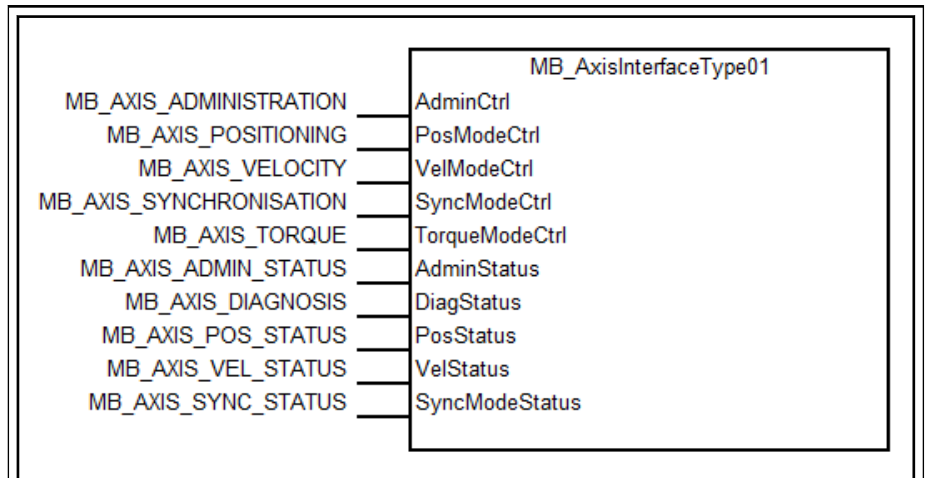


Fig. 4-20: MB_AxisInterfaceType01

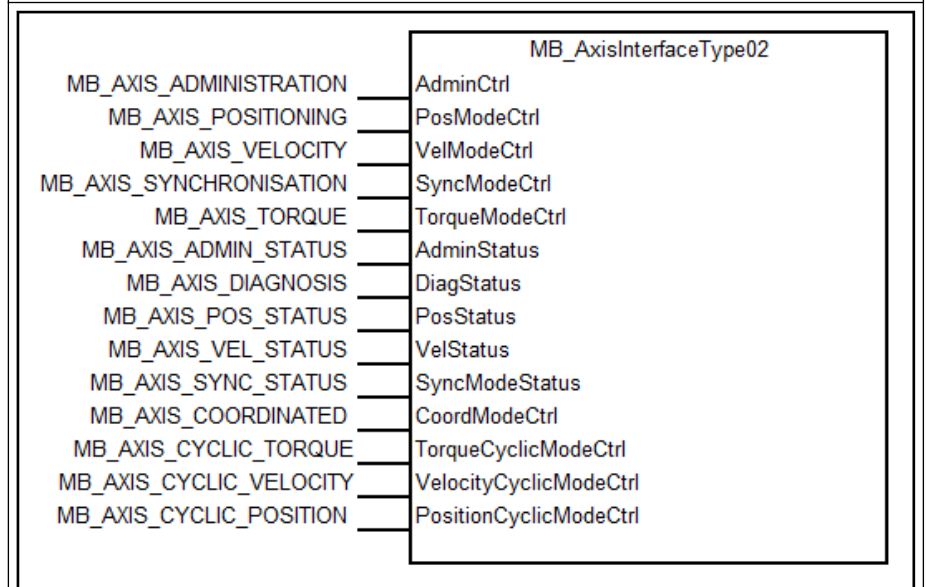


Fig. 4-21: MB_AxisInterfaceType02

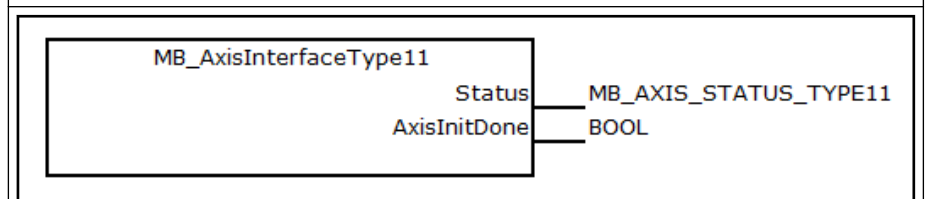


Fig. 4-22: MB_AxisInterfaceType11

**Dialogs of the technology functions of the function blocks
MB_AxisInterfaceType01, MB_AxisInterfaceType02 and
MB_AxisInterfaceType11**

Dialog	Description
Overview	Overview on the respective axis, its status and the operating state and the input option for position and velocity command values
Velocity	State monitoring in the operating mode "MB_AXIS_MODE.ModeVel" <i>Command value specification possible for</i> • Velocity • Acceleration • Deceleration
Positioning	State monitoring in the operation modes for positioning <i>Command value specification possible for</i> • Position • Velocity • Acceleration • Deceleration
Synchronization	State monitoring in the operation modes for synchronization <i>Command value specification possible for</i> • Input and output compilation • Fine adjustment • Phase offset • Direction of synchronization • Starting mode • Special input fields for cams and FlexProfiles
Torque/force	State monitoring in the operating mode "MB_AXIS_MODE.ModeTorque" <i>Command value specification possible for</i> • Torque/force • Torque/force ramp

"Web Tension" Group

The "Web Tension" group contains instances of the following technology function blocks (ML_TechMotion.library/ ML_TechTensionAdvanced.library):

- MB_TensionControlLoadCellType01
- MB_TensionControlLoadCellType02

For a detailed description of the function blocks of the "ML_TechMotion.library" and "ML_TechTensionAdvanced.library", refer to the documentation "MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

MB_TensionControlLoadCellType01

Dialog	Description
Control loop	Schematic representation of the control loop
Limitation	Limitation variables

MB_TensionControlLoadCellType02

Dialog	Description
Control loop	Schematic representation of the control loop
Limitation	Limitation variables
Process variables	Overview on process variables

"Register Control" group

The "Register Control" group includes instances of the following technology function blocks (ML_TechRegi.Library):

- MB_RegisterControllerType02
- MB_RegisterControllerType04
- MB_RegisterControllerSideType01

For a detailed description of the function blocks of the "ML_TechRegi.Library", refer to the documentation "MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

MB_RegisterControllerType02

Dialog	Description
Mark reader	Settings of the mark reader
Control loop	Schematic representation of the control loop
PI-controller	Settings of the PI-controller
Limitation	Limitation variables
Correction window	Settings of the correction window
Status	General status

MB_RegisterControllerType04

Dialog	Description
Mark reader	Settings of the mark reader
Control loop	Schematic representation of the control loop
PI-controller	Settings of the PI-controller
Limitation	Limitation variables
Correction window	Settings of the correction window

MB_RegisterControllerSideType01

Dialog	Description
Mark reader	Settings of the mark reader
Control loop	Schematic representation of the control loop
PI-controller	Settings of the PI-controller
Limitation	Limitation variables
Status	Settings of the correction window

"Touch Probe" group

The "Touch Probe" group includes instances of the following technology function blocks (ML_TechMotionBase.library):

- MB_InitTouchProbe
- MB_TouchProbe
- MB_TouchProbeContinuous
- MB_WriteExpectWindow

For a detailed description of the function blocks of the "ML_TechMotionBase.library", refer to "MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

MB_InitTouchProbe

Dialog	Description
Basic settings	Basic settings of the technology function
Expectation window	Settings of the expectation window
Status	General status

MB_TouchProbe

Dialog	Description
Status	General status

MB_TouchProbeContinuous

Dialog	Description
Status	General status

MB_WriteExpectWindow

Dialog	Description
Expectation window	Settings of the expectation window
Status	General status

"Winder" group

The "Winder" group includes the following technology function blocks (RMB_TechWinder.library):

- MB_WinderDancerCtrlType01
- MB_WinderTensionCtrlType02

For a detailed description of the function blocks of the "RMB_TechWinder.library", refer to "MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

MB_WinderDancerCtrlType01

Dialog	Description
Dancer control	Control loop of the dancer
Dancer limitation	Limitation of the dancer controller
Diameter calculation	Diameter calculation of the winder
Diameter limitation	Limitation and average calculation of the diameter, gear fine adjustment
Status	General status

MB_WinderTensionCtrlType02

Dialog	Description
Open-loop tension control	Sensorless open-loop tension control and calculation of the torque limit. Display only in "OPEN_LOOP" mode
Closed-loop tension control	Closed-loop tension control with load cell and calculation of the torque limit. Display only in "CLOSED_LOOP" mode
Friction torque compensation	Characteristics for the compensation of the friction torque
Acceleration compensation	Characteristics for the compensation of the acceleration torque
Web tension	Parameterization of the web tension behavior
Diameter calculation	Diameter calculation of the winder
Diameter limitation	Limitation and average calculation of the diameter, gear fine adjustment
Status	General status

"SmartBelt" group

This group displays the instances of the technology function blocks "MB_SmartBeltType01" (ML_TechMotion.library).

For a detailed description of the function blocks of the "ML_TechMotion.library", refer to "IndraMotion MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

MB_SmartBeltType01

Dialog	Description
Belt parameters	Measurements of the correction belt and basic settings
Correction parameters	Parameterization of the correction behavior
Status	General status, correction status and statistics

"Sag Control" group

The "Sag Control" group includes instances of the following technology function blocks (ML_TechMotion.library).

- ML_SagControlA
- ML_SagControlC

For a detailed description of the function blocks of the "ML_TechMotion.library", refer to "IndraMotion MLC 14VRS Technology Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

ML_SagControlA

Dialog	Description
Sag control	Parameterization of the sag control
Status	General status, sag controller status

ML_SagControlC

Dialog	Description
Sag control	Parameterization of the sag control
Status	General status, sag controller status

4.3.5 Robot

General information



This folder is only available for MLC controls.

Predefined kinematics can be created in the "Robot" folder. To create a kinematics, refer to [chapter 3.16 "Creating a kinematics" on page 153](#).

Robot - Context menu

The context menu of the "Robot" folder contains the menu items:

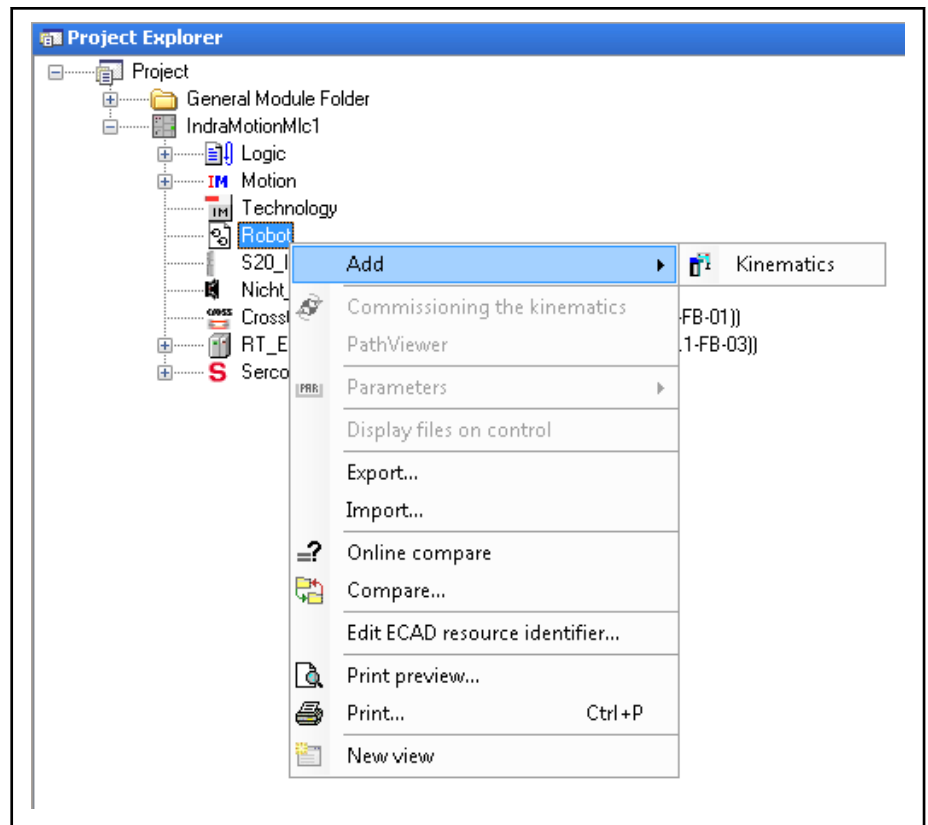


Fig. 4-23: Context menu of the "Robot" folder

- **Add**- Adds a kinematics to the project, see [chapter 3.16 "Creating a kinematics"](#) on page 153
- **Parameter** - Performs the following actions:
 - Load Basic Parameters...
 - Parameter Adjustment... (only in online mode)
 - Export...
 - Import...
- **Display files on control** - Selection dialog to display files (*.IRD, *.PKT, *.QLL, *.SYM) on the MLC control with name, size and date (only in online mode)
- **Export...** - Saves "Robot" elements to a file [chapter 4.4.14 "Exporting"](#) on page 268
- **Import...** - Imports Robot elements from a file, refer to [chapter 4.4.15 "Importing"](#) on page 270
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging"](#) on page 272
- **New view** - Displays nodes in individual view

4.3.6 Onboard I/Os



This node is only available for an IndraMotion MLC L45/L65/L75 and IndraLogic XLC L45/L65/L75.

The input/output environment of the control can be configured as follows:

- **Onboard** - outputs (also refer to [chapter 3.13.1 "Creating Onboard I/Os"](#) on page 124)

The individual options are described in detail in the documentation "IndraWorks 14VRS Field Buses", chapter "Configuring Onboard I/Os (dialogs)" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

4.3.7 Inline I/Os

The input/output environment of the control can be configured as follows:

- Inline modules (refer to [chapter 3.13.2 "Creating Inline I/Os" on page 127](#))

The individual options are described in detail in the documentation "IndraWorks 14VRS Field Buses", chapter "Configuring Inline I/Os (dialogs)" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

4.3.8 S20 I/O

The local input/output periphery of an XM control can be configured using the following options:

- S20 modules

4.3.9 Profibus/M

The individual options are described in detail in [chapter 3.13.3 "Creating Profibus I/Os" on page 134](#).

4.3.10 Profinet I/O controller

If a control is created, but no controller is selected for the Realtime Ethernet configuration, the folder name "Not_Used" is displayed in the Explorer. Via the context menu item **Set Device** of the node, the Profinet IO controller can be created.

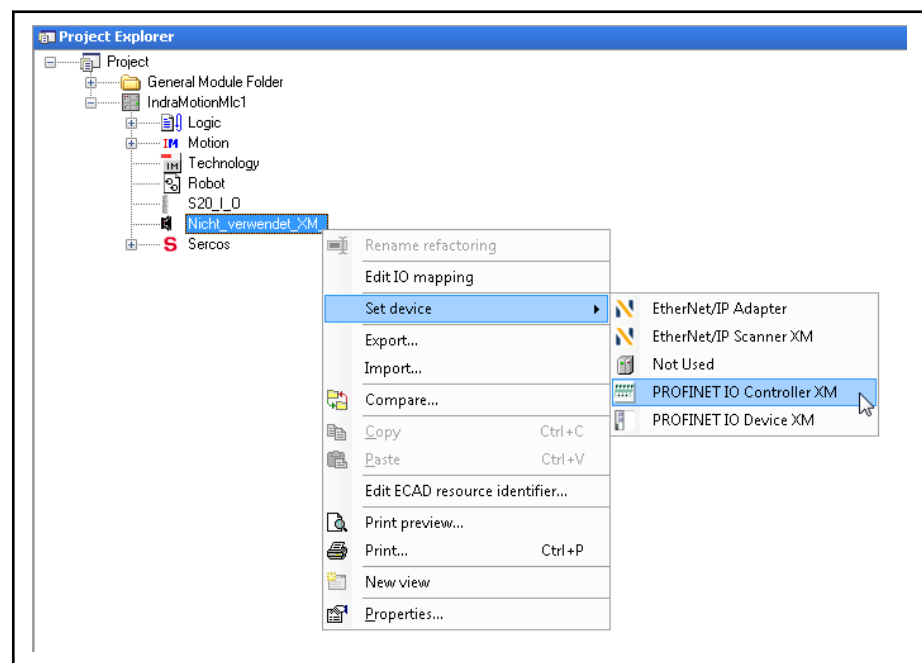


Fig. 4-24: Creating Profinet I/O controller

The individual options are described in detail in [chapter 3.13.4 "Creating a Profinet I/O Controller" on page 135](#).

4.3.11 Function modules

The function module folders follow the "Profinet IO-Controller" folders.

The individual function modules and their configurations are described in detail in the documentation "Rexroth IndraControl Lxx 14VRS Function Modules", see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#).

4.3.12 Sercos

General information

The Sercos node is only available for the IndraLogic XLC controls if the control is provided with a Sercos interface.

This node represents Sercos II (IndraMotion MLC only) and Sercos III master communication. The Sercos II master communication is only available when using the Sercos II (CFL01.1-Q2) function module.

The Sercos node of the control accepts all devices that run physically on the Sercos bus (e.g. IndraDrive, SercosDrive, EcoDrive Cs).

The current state of the Sercos bus is displayed in square brackets in the node name if the control is in online mode.



The Sercos phase is displayed at the Sercos node and in the toolbar. The control is displayed at the control node and in the toolbar. Normally, they are both the same. Setting the response to communication errors to F2 or F5 errors, the control mode and the Sercos phase can be different in specific cases (see ["Settings" on page 193](#)). The Sercos phase can only be changed via the control mode (e.g. via the toolbar).

The devices are transferred from the library to the node via drag&drop or copy&paste (for an example, see [chapter 6.3.3 "Creating a real axis" on page 370](#)). The addressing of the devices is specified by their set Sercos address. Technically speaking, the user has thus fulfilled all prerequisites for the configuration (sequence in the Project Explorer).

If a device (real axis) was dragged to the Sercos node, it is displayed twice in the Project Explorer:

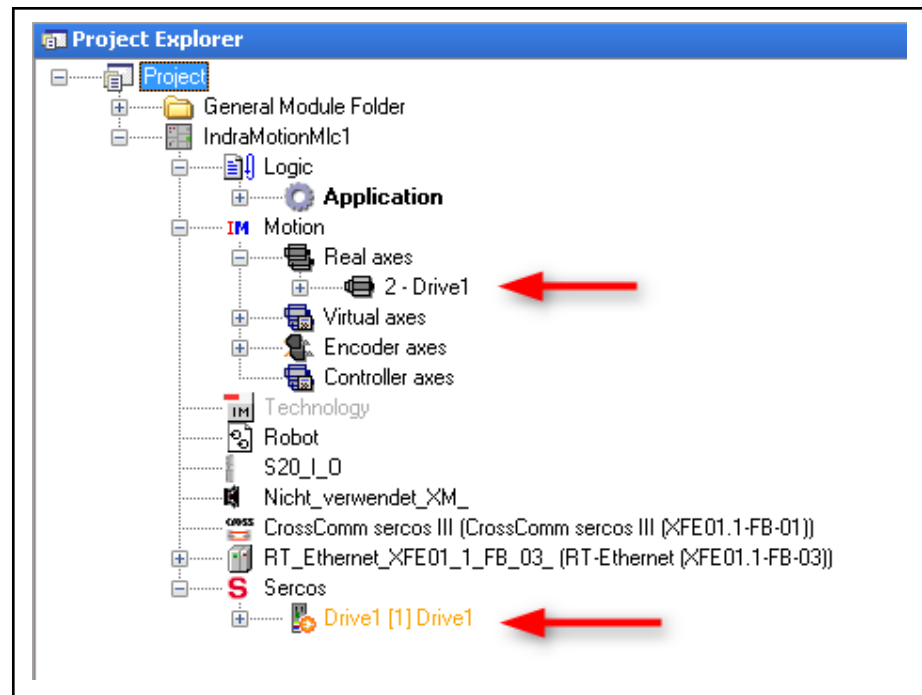


Fig. 4-25: Creating a real axis RA1 - Overview in the Project Explorer



Use the upper dialogs under **Motion -> Real Axes-> <AxisName>** to configure the respective device.

The dialogs under **Sercos -> <AxisName>** are special drive dialogs only accessing S- and P-parameters.

Caution: The user settings made in the drive dialogs are partially overwritten by the A-parameter setting of the upper dialogs without warning (see chapter "Parameterization and programming, A- and C-parameters overlap S- and P-parameters").

Sercos - Context menu

Overview on menu items

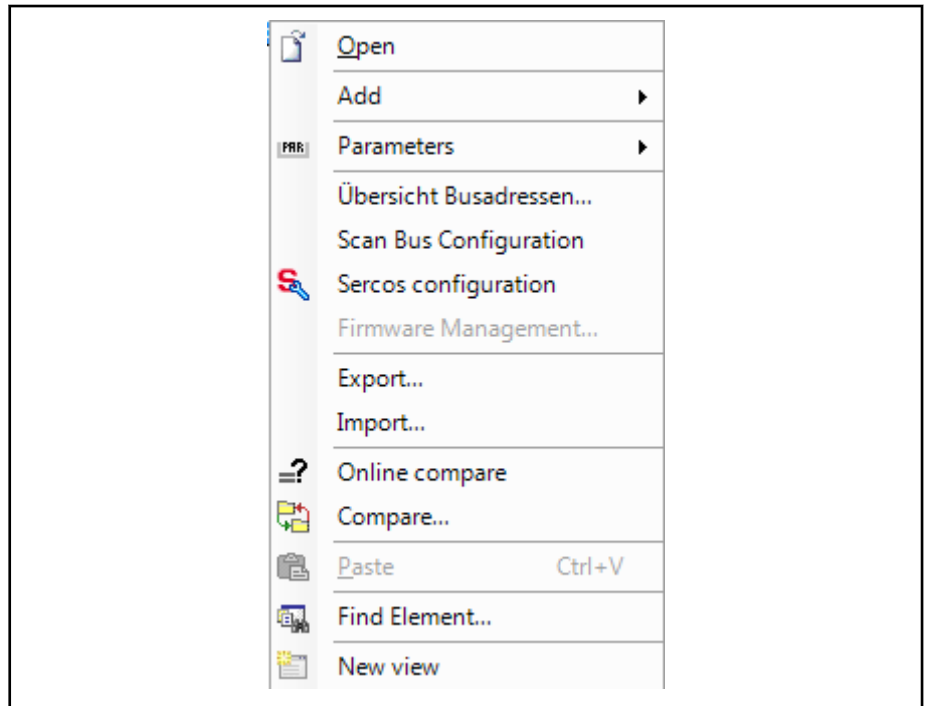


Fig. 4-26: Context menu of the Sercos node of an IndraLogic XLC

The context menu of the Sercos node contains further functions apart from the default entries:

- [chapter "Context menu item Set Device" on page 196](#) (only for IndraLogic XLC controls)
- **Parameter** - Performs the following actions:
 - Parameter Adjustment... (only in online mode)
 - Export...
 - Import...
- [chapter "Context menu item Bus Address Overview" on page 196](#)
- [chapter "Context menu item Scan Bus Configuration" on page 197](#)
- [chapter "Configuring the drive bus \(Sercos II\)" on page 203](#)
- [chapter "Sercos configuration" on page 201](#)
- [chapter "Firmware download on Sercos devices" on page 203](#)

Open (double-click)

The menu item "Open" displays the "Sercos properties" dialog. There are the following tabs:

- Bus diagnostics: Information on the connected devices
- I/O diagnostics: Information on the Sercos PLC devices
- Settings: Configuration of the Sercos interface

Bus diagnostics

This dialog provides information on the current state of the Sercos bus ("Actual state").

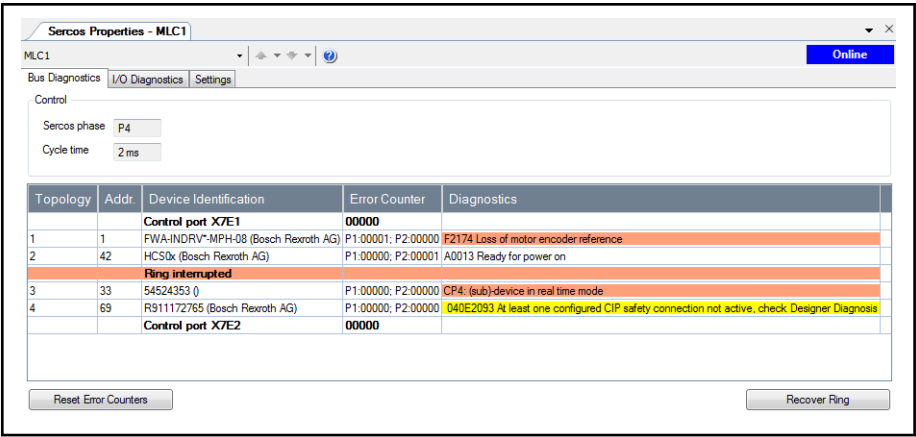


Fig. 4-27: Sercos properties – Bus diagnostics

Only devices actively participating in the communication are displayed. If a device failed with a communication error (e.g. F50B017A, Invalid AT data) or if the device was only affected in Sercos phase 2 or higher, the phase has to be switched via P0 to include the device again in the communication.

Refer to the documentation "IndraWorks 14VRS Field Buses", chapter "Configuring Sercos III" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

This dialog provides information irrespective of whether IndraWorks is "offline" or IndraLogic is "logged off".

For the Sercos bus diagnostics, there is also a PLC example program with a VI-Logic visualization and WinStudio screens. The example program is provided upon delivery as the GAT plug-in "Sercos diagnostics" in the IndraWorks installation. In GAT projects or in the AxisInterface example project, the plug-in can be easily imported using the GAT Wizard.

Perform the following steps for other projects:

- The required files are located in the folder "C:\ProgramData\Rexroth\IndraWorks\x\GatWizard\Plugins\14\SercosDiag" (x depends on the number of the installed IndraWorks versions). If required, browse for the file "SercosDiag.pdf" starting from the directory "C:\ProgramData\Rexroth\IndraWorks".
- Open the file "SercosDiag.pdf" in this directory and follow the instructions in the chapter "How to use", subchapter "Usage WITHOUT GAT or AxisInterface example".

I/O diagnostics This dialog displays diagnostics on the PLC devices.

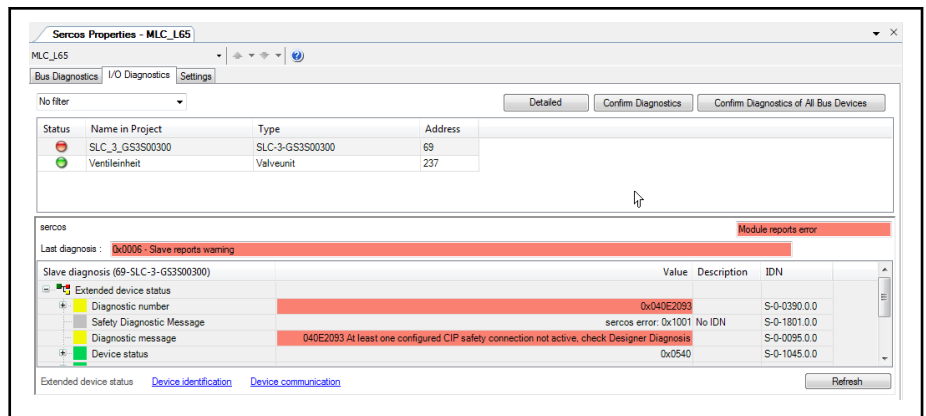


Fig. 4-28: Sercos properties – I/O diagnostics



This dialog provides only information if IndraLogic is "logged in".

Refer to the documentation "IndraWorks 14VRS Field Buses", chapter "Configuring Sercos III" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Settings

Make Sercos bus settings in this dialog.

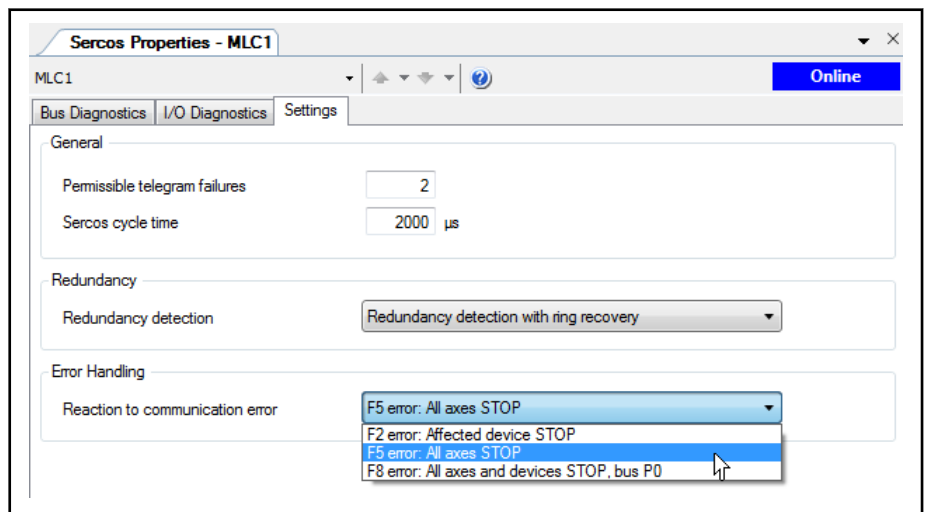


Fig. 4-29: Sercos properties – Settings



Settings in this dialog can only be made if IndraWorks is "online".

Parameters involved

- C-0-0503, sercos Master, sercos III, configuration of function modes
- C-0-0506, sercos Master, sercos III, configuration of function modes
- C-0-0507, sercos master, allowed telegram losses

To set the redundancy detection, refer to the documentation "IndraWorks 14VRS Field Buses", chapter "Configuring Sercos III" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Sercos settings to respond to communication settings

- **F8 error: All axes and devices STOP, bus P0** (default setting. Compatible to the previous versions and Sercos 2).

If there are communication errors (e.g. "F80B0016, AT-Data not valid"), an F8 error is output and the Sercos bus is thus stopped with all connected devices

- **F5 error: All axes are devices STOP.**

An F5 error (e.g. "F50B017A, AT-Data not valid") is output if there are communication errors. All motion axes and the respective device are stopped with the F5 error. The Sercos bus remains in operating or parameterization mode. PLC devices at the Sercos bus are still ready. An error reaction on a device failure might have to be implemented in the PLC program if required.



After deleting the F5 error, the axes - that are not involved - can be traversed again. Especially in case of coupled axes, implement an error reaction on a device failure in the PLC program.

- **F2 error: Affected device STOP**

An F2 error (e.g. "F20B017D, AT-Data not valid") is output if there are communication errors. This F2 error only stops the corresponding device. The Sercos bus remains in operating or parameterization mode. Motion axes and PLC devices at the Sercos bus are still ready. An error reaction on a device failure might have to be implemented in the PLC program if required.

If a real axis, which is consumed by another axis, fails, an error also occurs at the consuming axis (invalid master axis data).



When setting the "Error reaction F2" or "F5 error", the controller axes processing I/O data of one or multiple Sercos devices, to not go into an error state when an I/O device fails. Disabling the controller axis when an I/O device fails has to be executed with the application, e.g. with the function block "IL_SIIIRemoteSlaveState" from the "RIL_SercosIII" library.

The setting "Reaction on communication errors" defines the reaction to the following errors

Setting	Invalid AT data	Consumer connection failure	Producer connection failure
Generate F8 errors	F80B0016	F80B0017	F80B0018
Generate F5 errors	F50B017A	F50B017B	F50B017C
Generate F2 errors	F20B017D	F20B017E	F20B017F

Tab. 4-1: Error numbers if error reaction is set



The setting "Error reaction F2" or "F5 error" causes a change in behavior when switching from parameterization to operating mode. Even if the configuration does not match, it is tried to reach the operating mode.

- Missing devices: Switching is continued even though the error "F0140001, Error in device configuration" occurred. An F5 or F2 error is entered into the diagnostic memory for each missing device
- Additional devices: Unprojected devices obtain a default configuration. Error "F0140001, Error in device configuration" and for each additional device, an F0 error is entered
- Disabled, but physically existing device: Errors "F0140001, Error in device configuration" and "F0140002, Deactivated axis physically present" is reported to the diagnostic memory



The control mode is displayed at the control node and in the toolbar. The Sercos phase is displayed at the Sercos node and in the toolbar. Normally, they are both the same. The setting "Error reaction F2" or "F5 error" causes a change in behavior. If there are command switching errors (e.g. limit value violation), the control mode (BB) and the Sercos phase (P2) can be different. A complete failure of the Sercos communication causes that the control mode (BB) is not equal to the Sercos phase (P0). In such cases, the control mode (e.g. via the toolbar) has to be changed to also switch the Sercos phase.

To diagnose the mentioned cases, the following parameters can be automatically evaluated:

- C-0-0477, Command-actual comparison of the sercos devices
- C-0-0510, sercos master, address configuration

IndraWorks provides diagnostic information in the following locations:

- Dialog "Sercos bus diagnostics" (see [chapter "Open \(double-click\)" on page 191](#))
- "Sercos configuration" dialog (refer to [chapter "Sercos - Context menu" on page 191](#))
- Message are entered into the message window (validation) if "IndraWorks is switched online", "IndraWorks is logged in" and other operating actions
- Diagnostic log

IndraLogic provides information on Sercos and the control mode:

- The structure "ControlData[LOCAL_CNTRL].arSercos[ML_LOCAL_SERCOS_IFC]" contains information on the Sercos phase and the cable redundancy.

The control mode can be accessed via the structures "ImcStatus" and "ImcCtrl" of the IMC interface

- Function blocks for diagnostic purposes in the "RIL_SercosIII" library

IndraMotion Service Tool provides diagnostic information to the following:

- "Sercos configuration" dialog (below the "Hardware" node)
- Diagnostic log



If a device with one of the above mentioned communication errors failed, the phase has to be switched via P0 to include the device again in the communication.

Context menu item "Set Device"

Enable and disable the Sercos interface of IndraLogic MLC XM and VPx as well as XLC controls with Sercos via the menu item "Set device". The interface can have two configurations:

- Sercos master
- Not used

If the interface is configured as "Not Used", all configured Sercos devices are deleted from the project planning.



Changes in this configuration require the download of the PLC program and the Motion configuration. Additionally, a restart is required.

Context menu item "Bus Address Overview"

The "Overview on bus addresses" dialog is used for a clear representation and editing of the addresses of the Sercos devices. This dialog can be opened via the menu item "Overview on bus addresses" in the context menu of the Sercos node in the Project Explorer.

In the dialog, all Sercos devices are listed with their important properties in a table. Addresses can be edited after selecting the cell. Cells, which cannot be edited, are grayed out. The currently selected cell is highlighted in color.

Data in the table is checked for validity. Errors and warnings can result indicated by a respective icon in the first column. The tooltip on the icon shows the error and warnings. If at least one error is present, changes cannot be applied with **Apply** and the dialog cannot be closed with **OK**.

All changes are applied with **Apply** or **OK**.

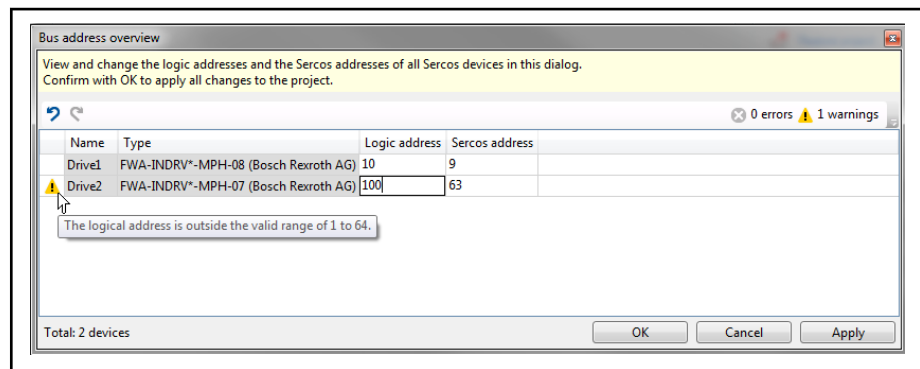


Fig. 4-30: Overview on bus addresses

There is a toolbar above the table. It provides the following functions:

Icon	Name	Hotkey	Meaning
	Undo	Ctrl+Z	If changes were made in the table, use this function to undo them step by step. This function is disabled after applying the changes with Apply
	Repeat	Ctrl+Y	If the changes were undone, they can be restored step by step using this function. This function is disabled after applying the changes with Apply
	Error		Data in the table is checked for validity. The number of errors found is displayed. The Sercos devices with errors are labeled by the same icon in the first column of the table. If at least one error is present, changes cannot be applied and the dialog cannot be closed with OK
	Warnings		Data in the table is checked for validity. The number of warnings found is displayed. The Sercos devices with warnings are labeled by the same icon in the first column of the table

Tab. 4-2: Toolbar functions

Context menu item "Scan Bus Configuration"

Use the "Scan Bus Configuration" context menu item to scan and apply drives and I/O devices connected to the Sercos bus of the control to the project. The following dialog is displayed:

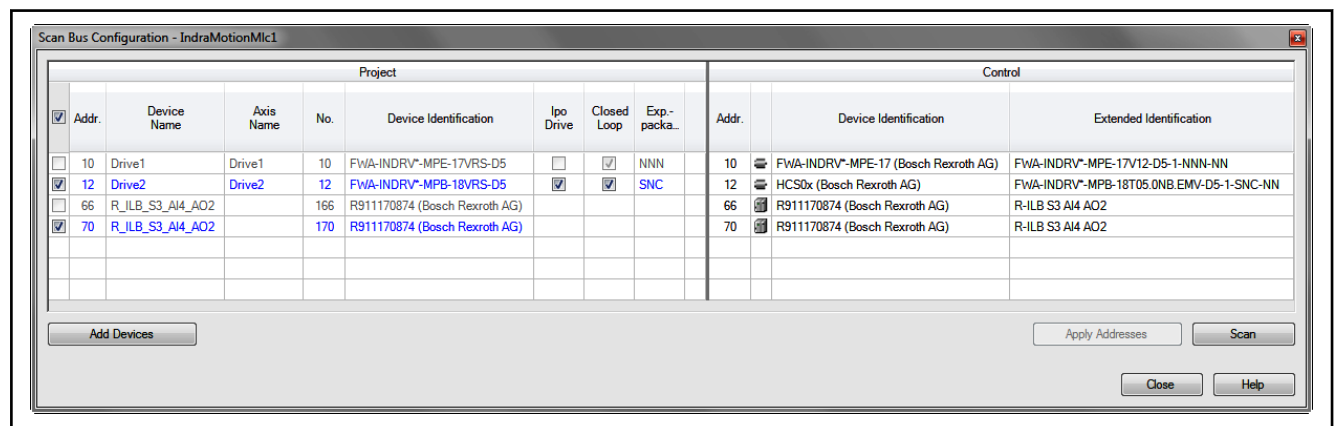


Fig. 4-31: "Scan Bus Configuration" dialog

The left part of the table displays all already projected devices and the right part displays all devices connected to the Sercos bus. The devices are assigned via the Sercos address.



To exactly identify a device in the field, let its Sercos LED flash. Therefore, go to the "Control" column and select the context menu item "Identify Device Visually (flashing)". As long as a device is visually identified, the device icon is highlighted in green. When closing the dialog, scanning the Sercos bus or switching the phase, the visual identification of the device is automatically switched off.

Note that not all Sercos devices support the command "Visual identification". In this case, the device does not respond to the command, even though the device is highlighted as "Visually identified" in the dialog.

The dialog displays the devices sorted according to their Sercos address. To change the sorting, click on the respective column header, e.g. according to the logic number or the topology address.

Use the checkbox "Display only new devices" to reduce the display of the devices and to show only those that are not yet in the project.

If several devices with the same Sercos address are connected to the Sercos bus, a corresponding error message is displayed.

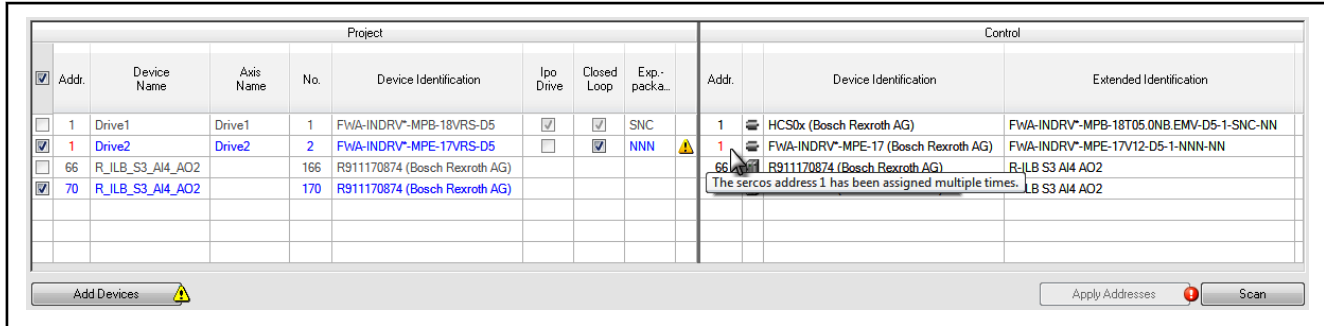


Fig. 4-32: Sercos address is assigned multiple times

In this case, assign unique addresses to these devices. The Sercos addresses of the corresponding entries (changed data is first displayed in gray) have to be changed. Apply these changes with the **Apply Addresses** button in the control (remote address allocation).

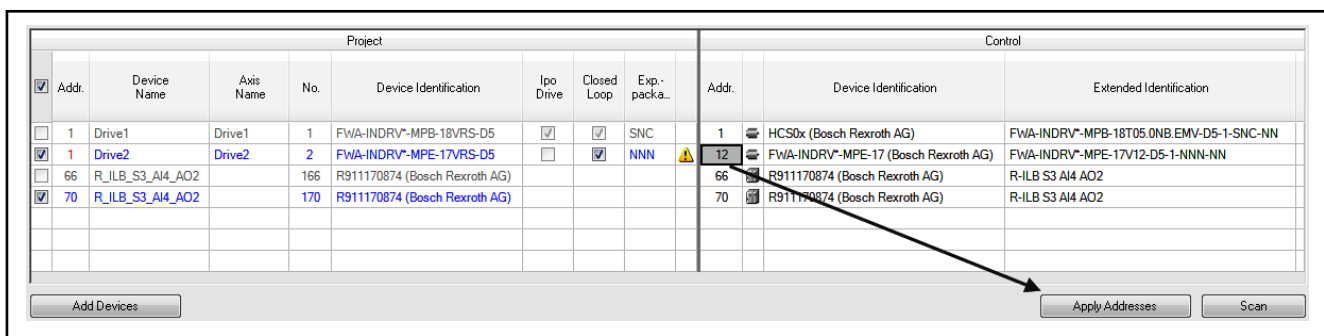


Fig. 4-33: Remote address allocation

After the changes have been applied, the bus configuration is automatically scanned again.

To add the newly found devices to the project, some properties shown on the left have to be determined. Newly found devices are highlighted in blue. Already projected devices are displayed in gray and can here not be changed.

Highlight the devices to be added to the project in the first column.

The Sercos address ("Addr.") is applied by the scanned device and cannot be changed here.

The logic number ("No.") can be changed for axes and I/O devices.

The specified device name can be changed. Since global variables have to be generated for the identifiers in the PLC program, they have to comply with the naming conventions of the IEC 61131.

Drive features

There is an additional axis name for drives. This axis name generally corresponds to the device name (except for multi-axis drives; the axis name consists of the device name and an appendix that can be changed here).

Drives (Sercos devices acc. to the drive profile "FSP_Drive", parameter S-0-1302.0.1 = 0x00020001) can be created in different variants:

- IndraDrive or HydraulicDrive

In the column "Ipo Drive", it can be determined where the axis motion (interpolation) is to be calculated. Highlight the selection to calculate the command values in the drive. Otherwise, the command values are calculated in the control (also refer to [chapter 6.3.1 "General information" on page 364](#)).

Set in the "Closed Loop" column, whether to operate the drive with encoder (Closed Loop) or without encoder (Open Loop). Enable this selection only if the corresponding function package is enabled in the drive, as, otherwise, the Sercos devices cannot be switched to the operating mode (also refer to [chapter 6.3.1 "General information" on page 364](#)).

- SercosDrive (PackProfile)

Drives of any manufacturer can be scanned as SercosDrive. The drives have to meet the requirements of the Sercos PackProfile.

- Drive as PLC device

A device description file (SDDML) has to be installed for the device to be scanned.

No axis instance is assigned to this device. Controlling has to be implemented into the PLC

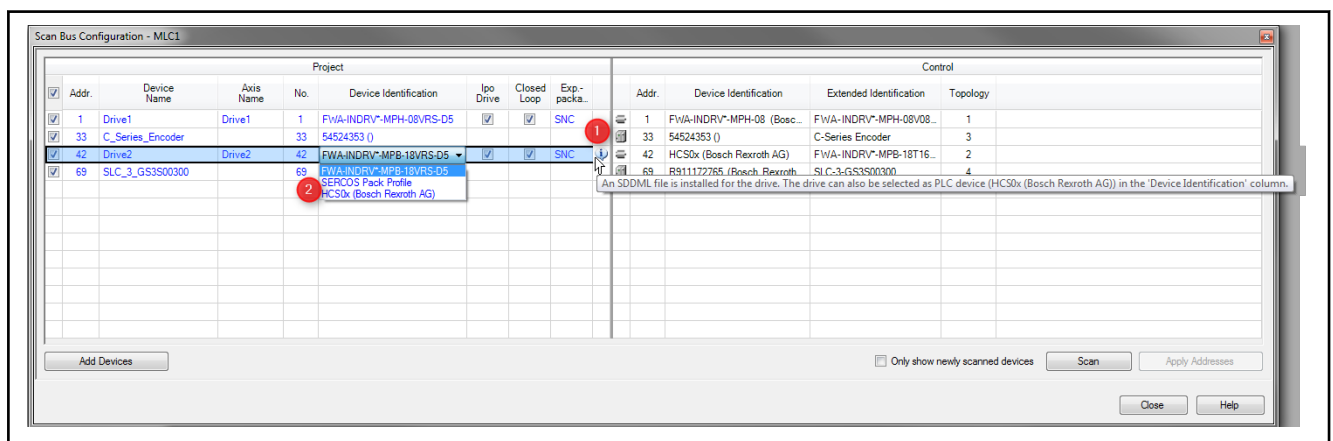


Fig. 4-34: Drive variants when scanning the bus configuration at an IndraDrive example

Depending on the information retrieved from the devices and the devices description files installed, possible drive types are available. All three variants are provided for IndraDrive and HydraulicDrive. Up to two variants are possible for other drives.

If there is more than one alternative possible, the info icon "i" is displayed in the respective line ①.

Select the device in the "Device Identification" column on the left ②.

Mass operations for drives

Right-click to select the drive variants and to select "Ipo drive" or "Closed loop" for multiple devices at the same time.

1. The lines of the respective devices are selected.
2. Right-click on the column to be used for selection.
3. Select the desired option.

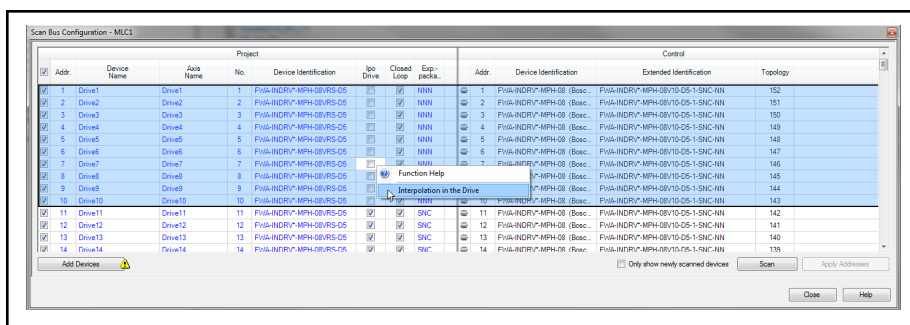


Fig. 4-35: Mass operation: Switching to "Interpolation in the drive"

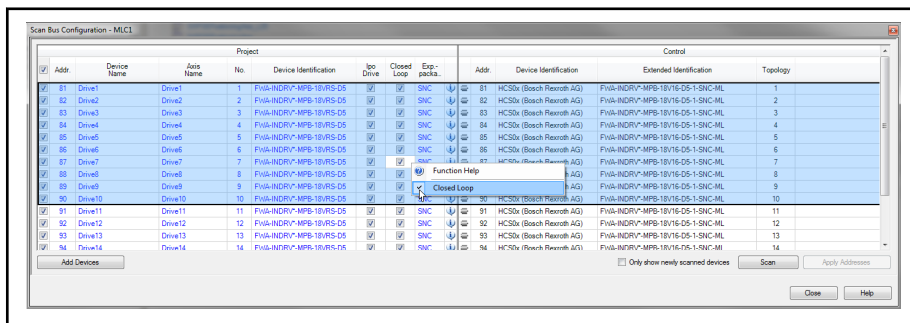


Fig. 4-36: Mass operation: Switching to "Closed-loop"

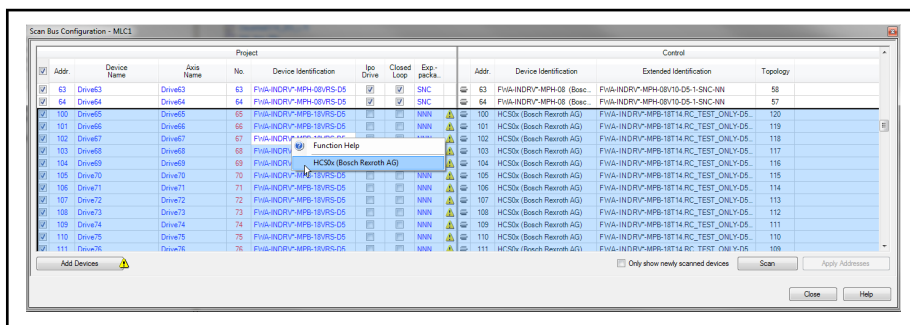


Fig. 4-37: Mass operation: Switching to "HCS0x"

I/O device features

For modularly structured bus couplers, the modules are also scanned and displayed. This is only the case if the bus coupler is not yet in the project. All of the modules have to be created with the bus coupler in the project. Individual modules cannot be excluded.

If multiple devices are installed for one I/O module, this is displayed with the info icon "i" and a corresponding tooltip. Select the matching device in the "Device Identification" column.

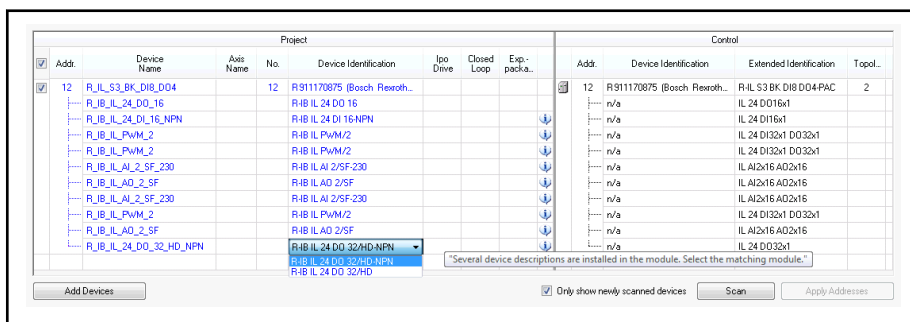


Fig. 4-38: Scan dialog with I/O modules

Use the **Add Devices** button to add the selected entries to the project located below the Sercos node of the control.

Incorrect entries such as invalid device or axis names or double axis numbers are labeled with a corresponding warning or tooltip. In most of the cases, the devices can still be created in the project. These properties can be subsequently adjusted. Before switching online, the projected data is checked again. Online switching is not possible in case of error.

If new devices were connected to the Sercos bus of the control in the meantime, click on the **Scan** button to load the bus configuration again.



For controls with a firmware $\leq$ 12VRS, creating I/O devices is not supported. The I/O devices are scanned and displayed in the right section of the dialog. However, the left section to insert the project is empty in this case.

Sercos configuration

In the control firmware version 14V06 and higher, the Sercos configuration was changed. Thus, the PLC devices are applied to the control upon login and the Motion devices while downloading the Motion configuration. They are then summarized to a total configuration in the control. It is not significant anymore, whether the connected devices match the new configuration upon transfer. Thus, a Motion configuration download is also possible if there is a misconfiguration.

If the control detects a misconfiguration, it reports this misconfiguration via the common diagnostic channels, such as the error/diagnostic memory. In addition, the dialog "Sercos Configuration" shows, whether the configuration matches the connected devices as well as the differences:

The dialog shows the Sercos devices configured in the control on the left and the Sercos devices actually connected to the control on the right. The "Status" column in the middle provides information on the matching degree of both sides. A warning icon in this column means that is a deviation, but that this deviation is not severe. Thus, the Sercos bus can still be switched to phase P4. If the Sercos bus cannot be switched to P4 anymore due to the deviation, a red error icon is displayed. In any case, a tooltip on the icon provides more detailed information on the type of deviation.

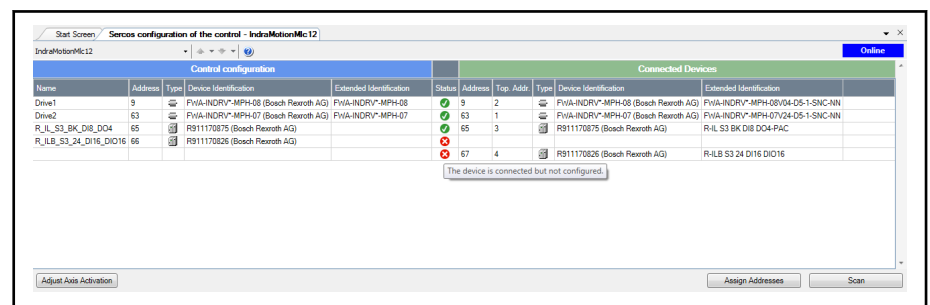


Fig. 4-39: "Sercos configuration" dialog

The columns "Device identification" and "Extended identification" contain information from the electronic type plate or the device firmware. To compare the configured device and the connected device, only the content of the "Device identification" column for PLC devices and only the content of the "Extended identification" column for drives are compared.

The deactivation of a device is displayed with a grey font color on the control configuration and can also be changed for axes via the context menu if the Sercos bus is either in phase P2 or in a lower phase. The activation of PLC devices cannot be changed in this dialog. To adjust the activation of multiple axes to ensure that they match the connected devices, press **Adjust Axis Ac-**

tivation. This function is especially a lot faster for multiple axes configured in the control than a manual adjustment for each axis.



To adjust the activation individually for multiple axes, it is recommended to switch the Sercos bus to P0 before. As a result, a change of the activation without significant delay is applied by the control.

After opening, the dialog displays all devices sorted according to their Sercos address. To change this sorting, click on the respective column header, e.g. to sort according to the topology address or the name.

All displayed data directly results from the control. There is no direct relation to the project data. To change the configuration of the Sercos devices in the control, make these changes in the Project Explorer and then apply them to the control.

To exactly identify a device in the field, let its Sercos LED flash. Therefore, go to the context menu item "Identify Device Visually (flashing)". As long as a device is visually identified, the device icon is highlighted in green. When closing the dialog, scanning the Sercos bus or switching the phase, the visual identification of the device is automatically switched off.



Note that not all Sercos devices support the command "Visual identification". In this case, the device does not respond to the command, even though the device is highlighted as "Visually identified" in the dialog.

New Sercos addresses can be assigned to the connected devices. Press **Assign addresses** and enter the address into the displayed column "New address".

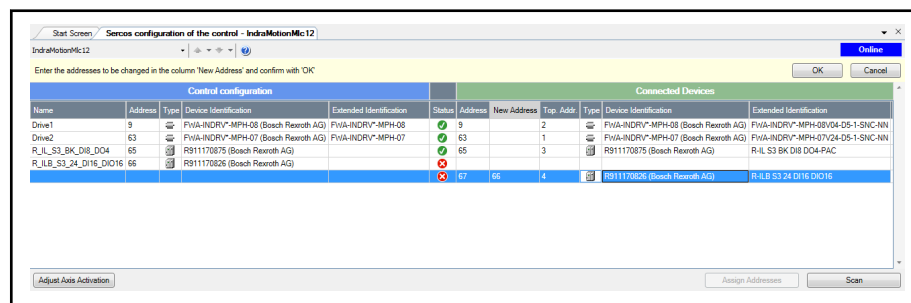


Fig. 4-40: Address allocation at the Sercos devices

Press **OK** in the upper part to assign these addresses to the connected devices.



The address can only be allocated in the Sercos phases 0 and 2.

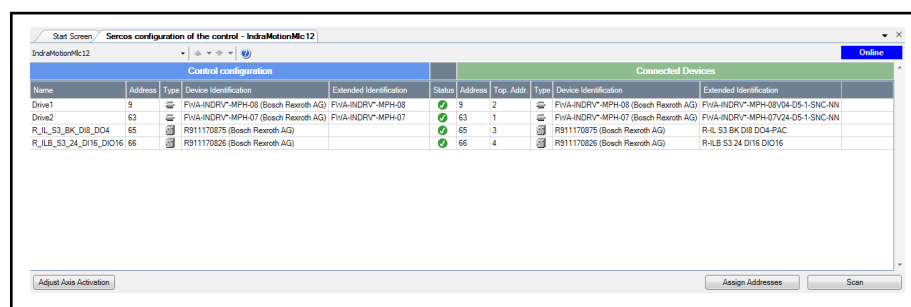


Fig. 4-41: Display after successful address allocation



For control firmware versions lower than 14V06, the adjustment dialog is displayed instead of the described dialog (see [chapter "Adjustment of command/actual configuration" on page 526](#)).

Configuring the drive bus (Sercos II)

This dialog allows setting the baud rate and the synchronization of control parameters to the drive parameters during phase switching from P2 to BB for the Sercos II master communication for an IndraMotion MLC.

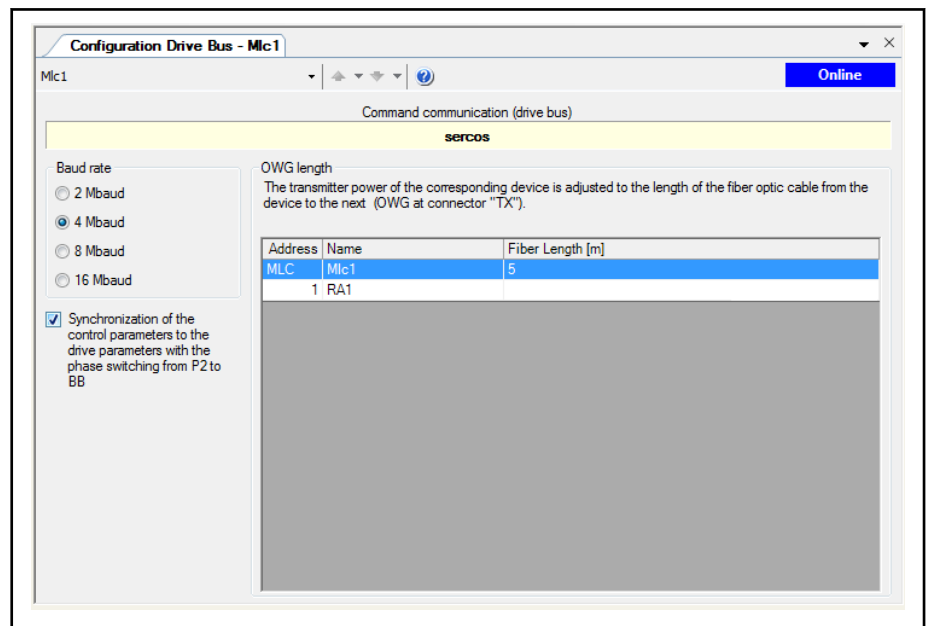


Fig. 4-42: Settings for the Sercos II bus

Firmware download on Sercos devices

Target The firmware of multiple Sercos devices is to be exchanged without loss of data.

- Prerequisites**
- It is one of the following devices:
 - Drives supporting the firmware download via TFTP (firmware $\geq$ MPx16)
 - Drives used as PLC device and supporting the firmware download via TFTP
 - Sercos III gateway for SafeLogic compact (SLC-3-GS3S00300)
 - Supplier (PowerSupply HMV0x, KMV0x)
 - From the control firmware version 14V14: All Sercos devices reporting the class "SCP_TFTP = 16#0E01" in the parameter S-0-1000 "SCP type and version". The class "SCP_NRTPC=16#1801" has to be reported additionally to specify a matching IP address
 - Only for control firmware versions $< 14V14$: The control and the computer - on which IndraWorks is installed - are located in the same subnet
 - The control is switched online
 - The devices are connected to the control and enabled

Procedure



Read the release notes for the respective firmware first.

In this example, the control runs in **BB RUN** and the axes are active.

It is recommended to follow this sequence:

1. Stop all active axes and ensure that no axes start during the firmware download.
2. Go to the context menu of the "Sercos" node to open the firmware management. The following window lists all available Sercos devices.

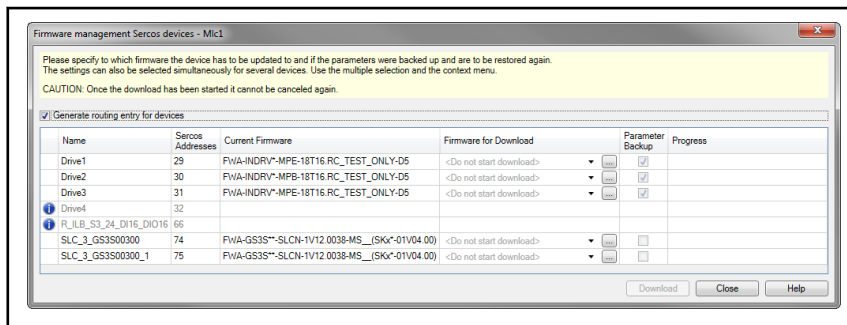


Fig. 4-43: "Firmware Management Sercos Devices" dialog

3. Only for control firmware versions < 14V14: Select whether to generate a routing entry for the devices. A routine entry is required to access the devices from the PC. If a routine entry has already been created, this options does not have to be selected.
4. Select the devices for the download. Select a firmware for the download. To select multiple devices at a time, click on these devices with the <Ctrl> key pressed and select a firmware for the download via the context menu.

Then, specify the firmware to be downloaded. Either select the firmware for each device from the drop-down list or press ... to find another firmware file. To use the same firmware for multiple devices, click on the devices with the <Ctrl> button pressed and select an already used or a new firmware via the context menu.

At the end, specify the devices for which the parameters are backed up before the download and restored after the download. The parameter backup can only be selected for devices supported for the parameter backup.

Devices, which cannot be selected for the download, are shown in grey and have an information icon with a tooltip stating why the download is not possible for this device.

5. Click on **Download** to start the process. You are then prompted whether to stop the PLC. After confirming, the download starts.

NOTICE

Once started, the process cannot be canceled.

During this process, do not switch off the control voltage of the devices or cancel their connection. This can cause irreparable damage to the devices.

6. After transferring the firmware to the devices, it is automatically tried to restart them. If this is not possible, as the device is for example not supported, restart the devices manually. A message is displayed listing the devices to be restarted. Start the devices by switching off and on the control voltage and acknowledge the message with **OK**.

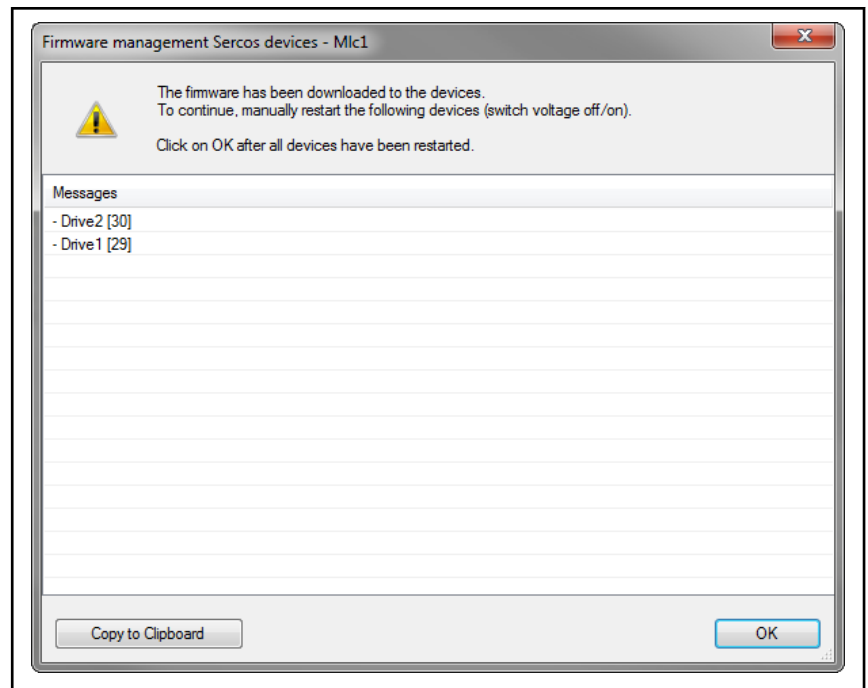


Fig. 4-44: Message to restart the Sercos devices

7. Subsequently, the function packages of the drives are restored. If might be required to restart some devices. If this restart cannot be executed automatically, a message is displayed, stating which drives have to be started again manually. Start the corresponding drives by switching off and on the control voltage and acknowledge the message with **OK**.
8. The previously archived parameters are restored. If not all parameters can be restored, a list of the parameters, which could not be restored, is displayed.



In case of another firmware, drive parameters might have been changed or even omitted.

The result of the download is displayed at the end. If errors or warnings occurred, the already archived parameters can be saved to a file. This file can be manually imported again via the parameter import (context menu of the control -> Parameters -> Import...).

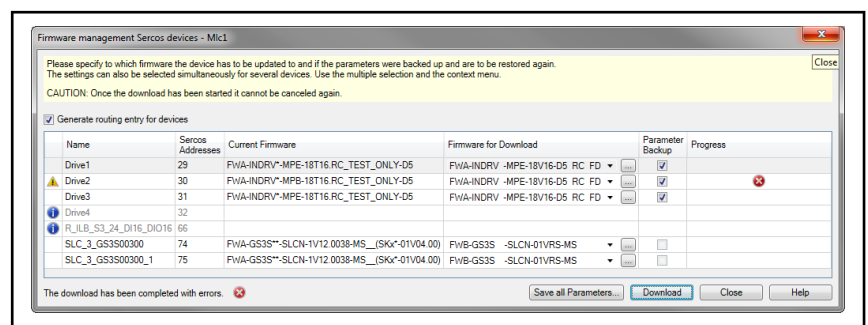


Fig. 4-45: "Firmware Management Sercos Devices" dialog – Result

Sercos - Toolbar



This toolbar is available for IndraLogic XLC controls only for the variants with Sercos interface.

The Sercos toolbar shows the current phase and provides direct access to frequently required functions. It is structured as follows:

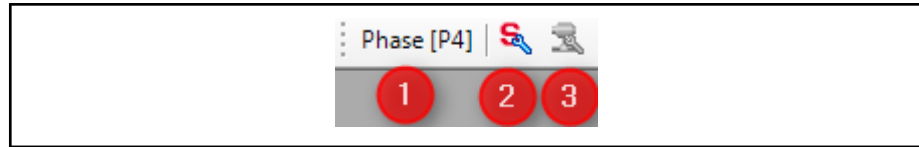


Fig. 4-46: Sercos toolbar

- Display of the current control phase ① (while a firmware download on the Sercos devices is displayed with NRT = non-real time)
- Open the dialog "Configuration of Sercos devices" (always available) ②
- Open the dialog "Configuration Drive bus" (only available online if a Sercos II master communication is projected) ③ (only for IndraMotion MLC)



The Sercos phase is displayed in the toolbar and at the Sercos node. Normally, they are both the same. Setting the response to communication errors to F2 or F5 error (see ["Settings" on page 193](#)), the control mode and the Sercos phase can be different in specific cases. The Sercos phase can only be changed via the control mode (e.g. via the toolbar).

4.4 Control – Context menu

4.4.1 Overview on menu items

The context menu of the control contains the following menu items:

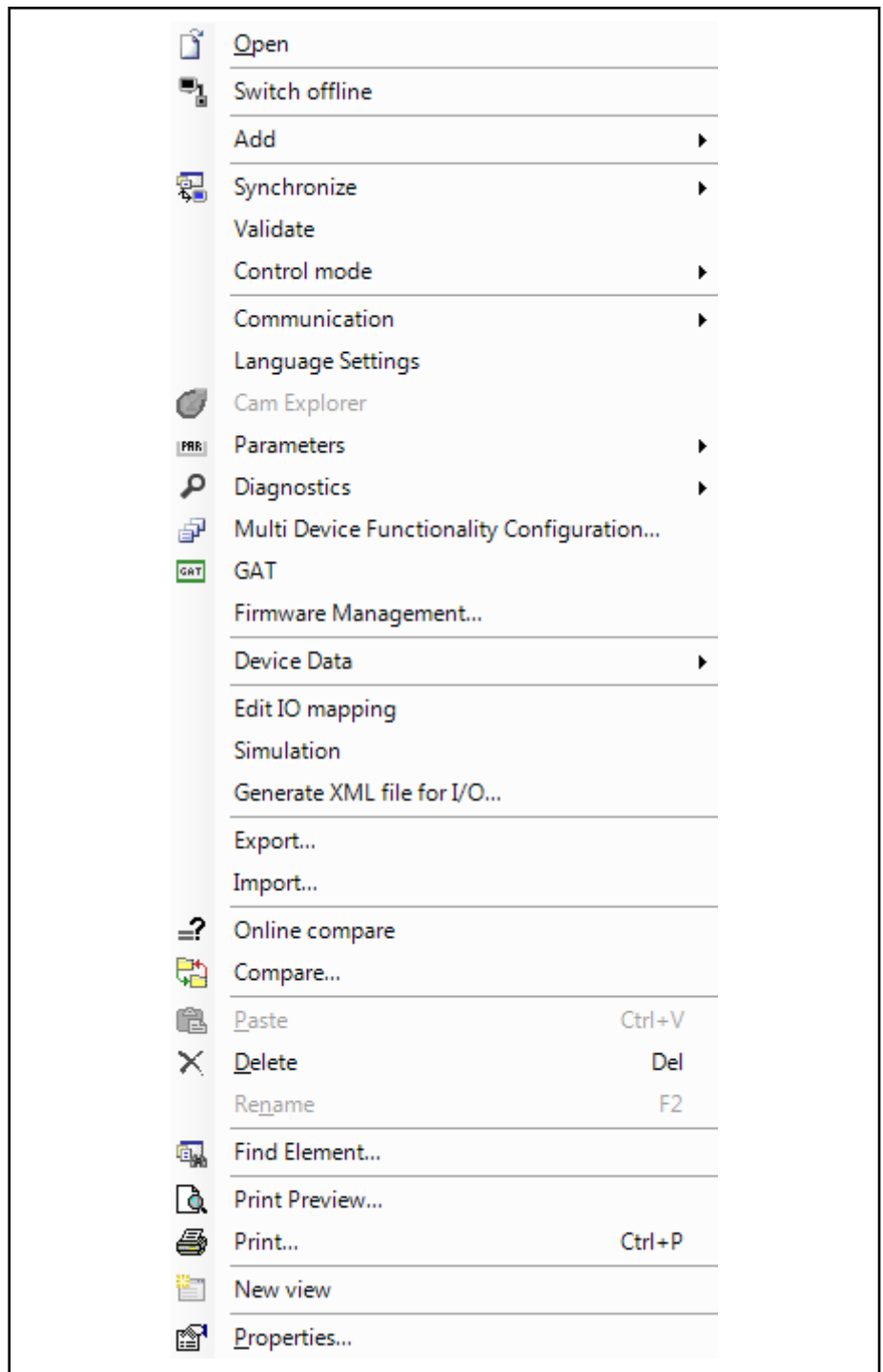


Fig. 4-47: Context menu of a control in online mode

- **Open** - See [chapter 4.4.2 "Device editor"](#) on page 209
- **Switch offline** - See [chapter 7.6 "Modes for project editing"](#) on page 523
- **Synchronize** - See [chapter 7.6 "Modes for project editing"](#) on page 523
- **Validate** - See [chapter 7.12 "Validating Motion configuration"](#) on page 560
- **Control mode** - see ["Control mode"](#) on page 163, contains the subitems

- P0 switches the control to the download mode
- P2 switches the control to the parameterization mode
- BB switches the control to the operating mode
- **Communication** - Communication parameter setting, refer to [chapter 4.4.3 "Communication" on page 213](#) or control IP communication setting or [chapter 3.14 "IP communication" on page 141](#)
- **Language settings** - Language setting of the control, see [chapter 4.4.4 "Language settings" on page 216](#)
- **Cam explorer**, See [chapter 4.4.5 "Cam explorer" on page 217](#)
- **Parameters** - See [chapter 4.4.6 "Parameters" on page 222](#)
- **Diagnostics** - Contains the subitems
 - [chapter "Device status" on page 234](#)
 - [chapter "Load" on page 236](#)
 - [chapter "Clearing errors" on page 238](#) - Deletes all control and drive errors
 - [chapter "Error/diagnostic memory" on page 238](#) - Provides an overview on the current diagnostic state of the control and its drives
 - [chapter "Invalid parameters" on page 241](#) - Displays the parameter "C-0-0626, Diagnostics" and lists all invalid parameters
 - [chapter 5.4.5 "Task list/configuration" on page 338](#) - Displays the present tasks and their priorities
 - [chapter 5.4.6 "Task viewer" on page 340](#) - Shows the chronological sequence of task processing on the control
- **Multi-device functionality configuration...** - Allows the use of an application and its parameters for several controls, see [chapter 4.4.8 "Multi-device" on page 244](#)
- **GAT - Generic Application Template** is a structured template to add and edit PLC program code (refer to GAT Generic Application Template)
- **Firmware management...** - Loads and updates the control firmware, see [chapter 4.4.9 "Firmware management" on page 253](#)
- **Device data** - Saves and restores device data or files and folders from the PC to the control and vice versa, see [chapter 4.4.11 "Device data" on page 259](#)
- **Simulation** - Simulates the control without real hardware, see [chapter 4.4.12 "Simulation" on page 268](#)
- **Add** Adds new elements below the control
- **Export...** - Saves elements from the current project to a file [chapter 4.4.14 "Exporting" on page 268](#)
- **Import...** - Imports elements from a file into the current project, see [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the control and its subfolders. **Only available offline**
- **Rename** - Renames the control. **Only available offline**
- **Find element...** - Searches for elements in the project
- **Print preview...** - Provides a preview of project and device data, see [chapter 4.4.18 "Print preview" on page 274](#)

- **Print...** - Provides a printout of the current project and device data, see [chapter 4.4.19 "Printing" on page 276](#)
- **New view** - Displays nodes in individual view
- **Properties...** - Displays and modifies control properties [chapter 4.4.20 "Control properties" on page 277](#)

4.4.2 Device editor

Device editor - General information

The device editor provides dialogs to configure a control managed in the Project Explorer.

By default, double-click on the control to open the **Devices** when it is selected in the Project Explorer. Another option is the "Open" menu item in the context menu of the control.

The title of the main dialog is the device name ("Mlc1" in the following figures) and, depending on the device type, it contains a combination of the following subdialogs:

- [chapter "Applications " on page 209](#)
- [chapter "Log " on page 210](#)
- [chapter "PLC settings" on page 211](#)
- [chapter "Information " on page 212](#)

Applications

This tab displays and, if required, deletes applications currently located on the control.

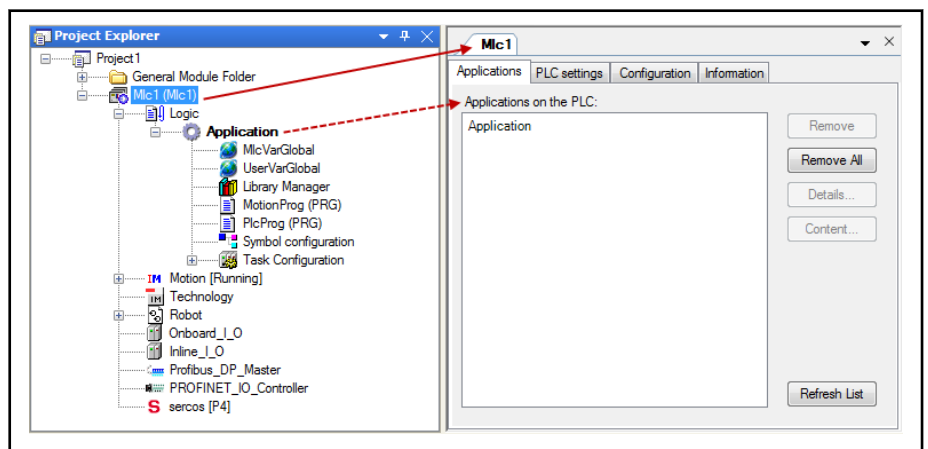


Fig. 4-48: "Devices" dialog – Applications

Applications on the control: List of the applications found on the control during the latest "scan" (with "List").

Refresh list: The control is searched for applications and the list is refreshed accordingly.

Remove or **Remove all:** The currently selected applications or all applications are deleted from the control.

Details...: Provides more information on the application.

If an application is loaded to the control, the following is checked first:

- The list of applications on the control is compared to those available in the project. If the list does not match, the corresponding dialogs are displayed either to load the applications not already present on the control or to delete other applications on the control

- The "externally implemented" function blocks in the application to be loaded are checked to see if these are also available on the control. If this is not the case, a corresponding message ("Unresolved reference(s)") is output in a message box and in the message window
- The parameters (variables) of the function blocks in the application to be loaded are compared to those in the function blocks with the same name in the application on the control (signature check). If they do not match, a corresponding message ("Invalid signature(s)") is output in a message box and in the message window

Log

The log (logger) is switched off by default. Enable it via **Tools ► Options** in the IndraWorks main menu (refer to the following figure).

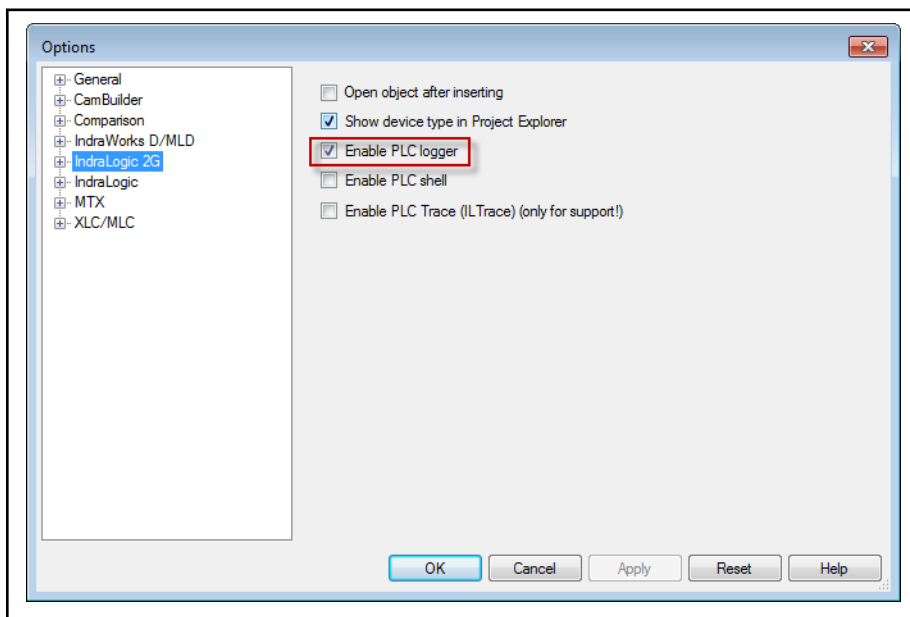


Fig. 4-49: Enable PLC logger

The events of the control are recorded via the log. These are:

- Events upon system start and shutdown (loaded components with version)
- Application download and loading of the boot project
- Customized entries
- Log entries from I/O drivers
- Log entries from the data server

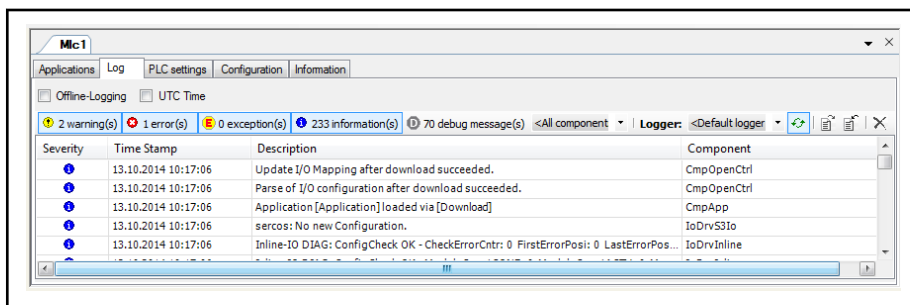


Fig. 4-50: Device editor – Log

A log entry is displayed with the following information:

Scaling (severity): There are four categories for the severity of the event: Warning(s), error(s), exception(s), information. The display of each category can be shown or hidden via the corresponding button in the bar above the list. The respective number of log entries is displayed on the button for the respective category.

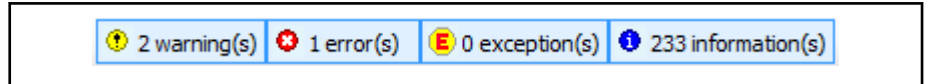


Fig. 4-51: Severity of event

Time stamp: Date and time, e.g. "16.11.2010 14:00".

Description: Describing the event, e.g. "Sercos III I/O: SetParamP4 OK".

Component: Name of the respective component.

Selection component (component name): An individual component can be selected in a drop-down list to display only related log entries. The default setting is "<All components>".

Logger: The selection list contains the available recordings. The default setting is the "<Default>" specified by the target system, currently the same as "PlcLog" for the IndraLogic runtime system.

Automatic update is enabled via .

The content of the list can be exported to an XML file. Press  to open the standard dialog to save a file. The file filter is set to "xml files" (*.xml). The log list is stored in the selected directory with the file name specified and the extension ".xls". If the "Offline Logging" option is enabled, even actions that are not related to the connection with the control are recorded (at this time it can only be implemented in the safety version of the programming system).

An already existing log list in XML format can be imported via the  icon.

Select the  icon to delete all entries in the log list.



For further diagnostic options, refer to [chapter 4.4.7 "Diagnostics" on page 234](#).

PLC settings

This tab specifies the control behavior in the "Stop" state.

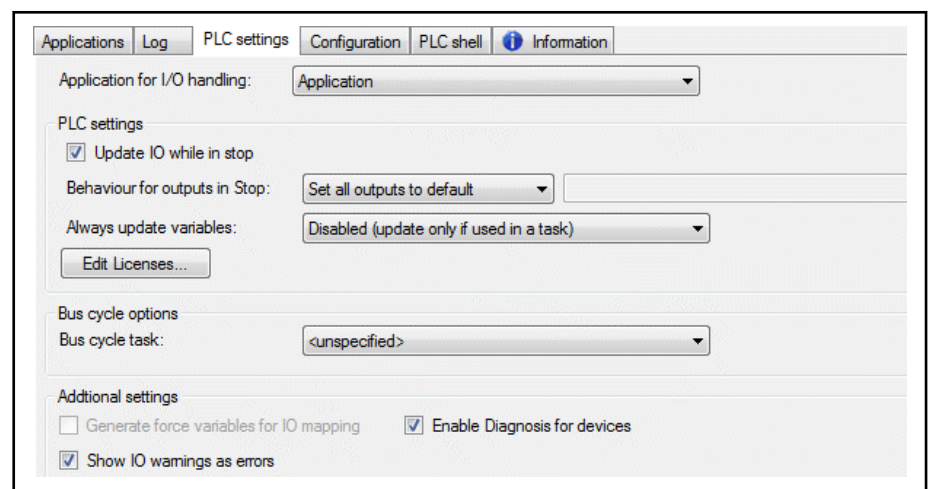


Fig. 4-52: Device editor – PLC settings

Application for I/O handling:	If several applications are available for the device, they are listed in a drop-down list. The default application, which is automatically created with a default project, is always entered first.
PLC settings	Update I/O while in stop: If this option is enabled (default), the values for input and output channels are updated if the PLC goes into "Stop" state.
Behavior of the outputs in stop	The selection list provides the following options to handle the values of the output channel when the control goes into the "Stop" state: • Retain values: The current values are retained • Set all outputs to default: The default values from the I/O mapping are assigned • Execute program: Control the handling of the output values using a program in the project. Enter this program name and it is executed when the control goes into the "Stop" state. Click on ... to open the input help to facilitate the program selection Update all variables in the devices: If the option is enabled, all variables are updated.
Bus cycle options	Bus cycle task: The drop-down list provides all tasks defined in the task configuration of the active application (e.g. "MotionTask", "PlcTask" etc.).  Check the task data of the application and enter the task! Select a specific task to control the bus cycle (I/O mapping) or select the "Unspecified" setting if the task with the shortest cycle time, i.e. the fastest task, is to be used. This setting applies to all I/O devices. However, it can be overwritten locally by every I/O device (see chapter "Profibus, Profinet and Inline I/Os" on page 343).
Additional settings	• Create force variables for the I/O mapping • Enable diagnostics for devices • Display I/O warnings as errors

Information

This tab of the **Devices** dialog displays some general information from the device description file on the currently selected device in the Project Explorer.

The following information is displayed:

- Name
- Vendor
- Categories
- Version
- Ordering number
- Description
- Figure, if present

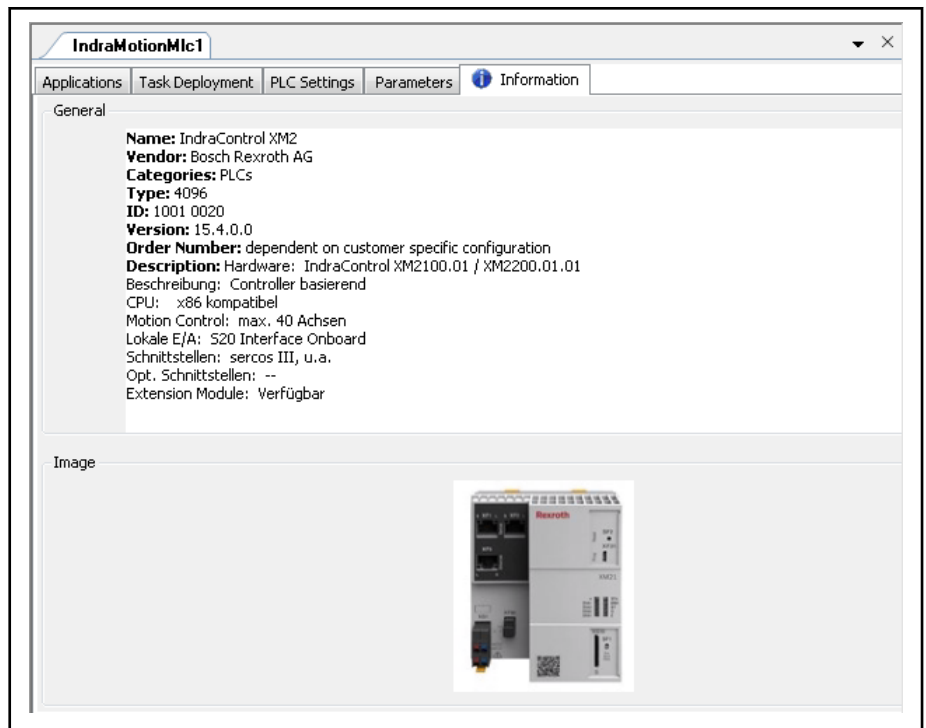


Fig. 4-53: Device editor – Information

4.4.3 Communication

TCP settings

The dialog box displays the settings for the Ethernet connection between PC and control. Some values can be adjusted.

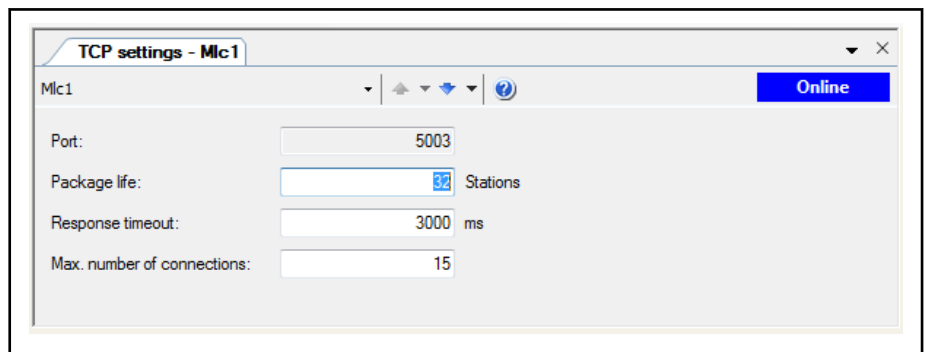


Fig. 4-54: "TCP settings" dialog

Port: Specifying the port for the TCP communication.

Package life cycle: Specifies the amount of network nodes forwarding, rejecting or discarding an IP package.

Response timeout: "Response timeout" specifies the period that is waited for the absent response until an error message is output.

Max. number of connections: Specifies the number of connections that a control can operate simultaneously. If this number is exceeded, the connection is aborted.

Parameters involved

- C-0-0208, TCP, port for acyclic channels
- C-0-0206, TCP, time to live

- C-0-0209, Sender timeout
- C-0-0210, TCP, max. number of connection

Interfaces

Use this menu item to make the settings for the IP communication. For a detailed description, refer to [chapter 3.14 "IP communication" on page 141](#).

User control ID

Overview

A user control ID can be written to the control. If a control is provided with this ID, enter it when connecting for the first time (login, switch online,...) to an IndraWorks project session.

Example

Example: A machine is provided with two controls: S1 and S2. The control S1 is provided with the (random) user control ID S1 and the control S2 is also provided with the (random) ID S2. Both controls can also obtain almost any other ID. When logging into the control S1 with IndraWorks, IndraWorks prompts to enter the control ID into a dialog. If the ID is correct, it is logged in. If the ID is incorrect, the complete action is canceled. If the entered ID is valid, it is not prompted anymore by IndraWorks at next login or when switching online within a running IndraWorks project session. Only after closing and opening the IndraWorks project again, entering the ID upon the next connection establishment is required.

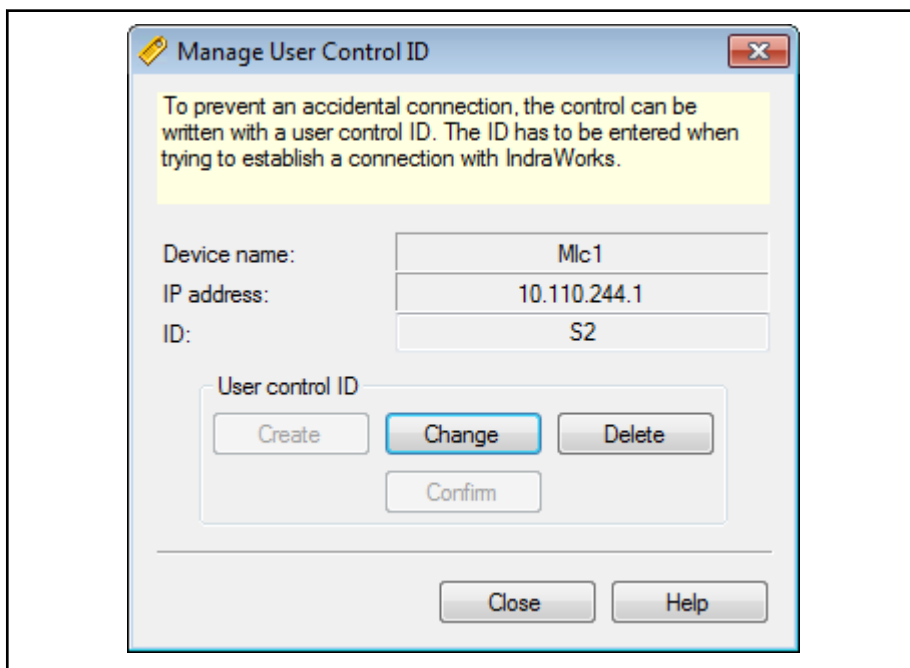


Fig. 4-55: Dialog to enter the user control ID requested by IndraWorks (in this example, it is the ID "S2")

Important

It is important that the user control ID is only saved on the control and that it is not confidential. The ID is not part of the IndraWorks project. Thus, it is not project property and not under version control. The user control ID must not be confused (with a password for example). The user control ID is used to impede a connection in IndraWorks such as, for example, a login with a wrong control. Therefore, IndraWorks prompts to enter the user control ID before establishing the connection.

This is only possible if there is a user control ID on the control. A brief explanation on how to create, rename and delete a user control ID is given in the following.

Managing user control ID

Creating an ID

To create a user control ID on a control, establish a connection with IndraWorks. Thus, either switch online or log in. Subsequently, open the dialog "Manage User Control ID" in the context menu of the control (right-click on the "Control" node) and go to the menu item "Communication".



Fig. 4-56: Dialog "Generate user control ID" – Generate

Click on **Create** in the dialog "Manage User ID Control" to open the dialog to generate an ID.

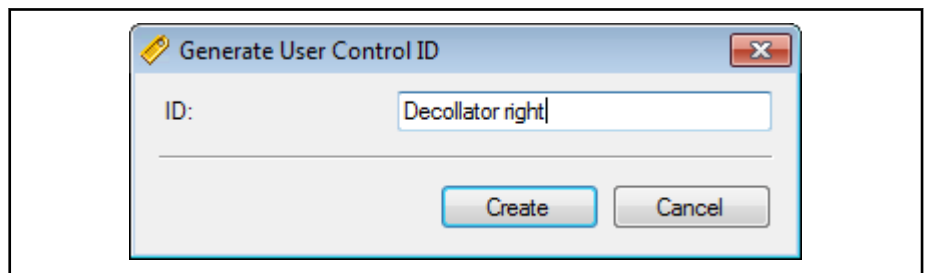


Fig. 4-57: Dialog to enter the user control ID to be generated

Enter an ID for the current control in the dialog "Generate user control ID". Click on **Create** to write the entered ID to the control.

As IndraWorks is already connected to the control and the ID was just entered, the ID is not prompted anymore during the current IndraWorks project session after closing the connection to the control and establishing it again. Only after closing and opening the IndraWorks project again, IndraWorks prompts to enter the user ID when the next connection is established.

Rename or delete ID

If a control is provided with a user control ID, the dialog "Manage User Control ID" can be used to rename or delete the ID.

Exchanging hardware

When exchanging the control, and the CF card of the old control is used in the new one, IndraWorks detects that CF card when establishing a connection between IndraWorks and the new control. This also applies if the content of the CF card of the old control is copied to the CF card of the new control. IndraWorks provides that information in the following dialog:

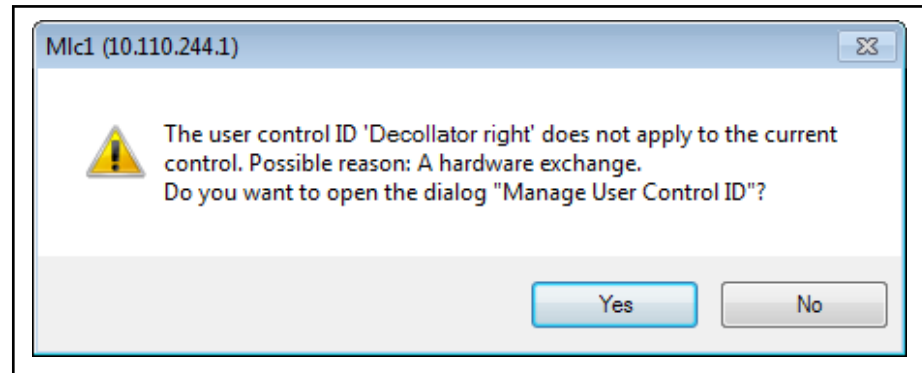


Fig. 4-58: Information after detecting an invalid control ID

Click on **Yes** and the "Manage user control ID" dialog opens. Use this dialog to validate the user control ID for the new control or to delete the ID on the new control.

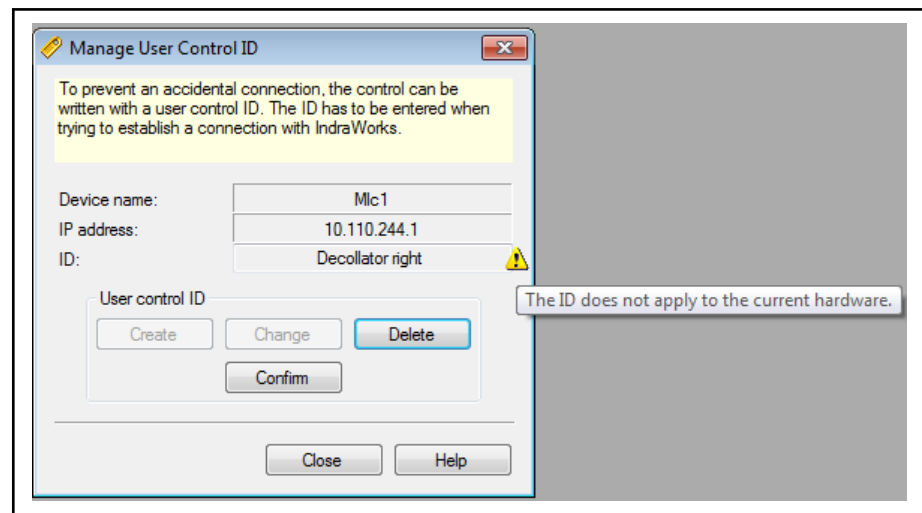


Fig. 4-59: Dialog "Manage user control ID" – ID does not apply to the current hardware

If the user control ID does not apply for a syntactically correct identifier (here: "Decollator right") for the current control, the ID including the identifier can be validated or deleted.

Protocols

Refer to [chapter 3.18 "Protocols - System security"](#) on page 155.

4.4.4 Language settings

Call Context menu of the control: **Language settings**.

Target Use this dialog to set the language of the control and of all connected devices (IndraDrive/HydraulicDrive).

Language of the control The control supports the languages "German" and "English". Additionally, a user-defined language can be selected. The user-defined language can load

language files for the parameter names, the diagnostic messages and the display texts to the control. If a language file is loaded to the control, the texts from this file are used subsequently. The default user-defined language is "English".

Language of the drives

Every language supported by the drive can be selected. This language is immediately transferred to all connected devices. A drive has to be **online** and **active** to transfer a language. If the number of connected active drives changes, click on "Rewrite" to apply the language again.

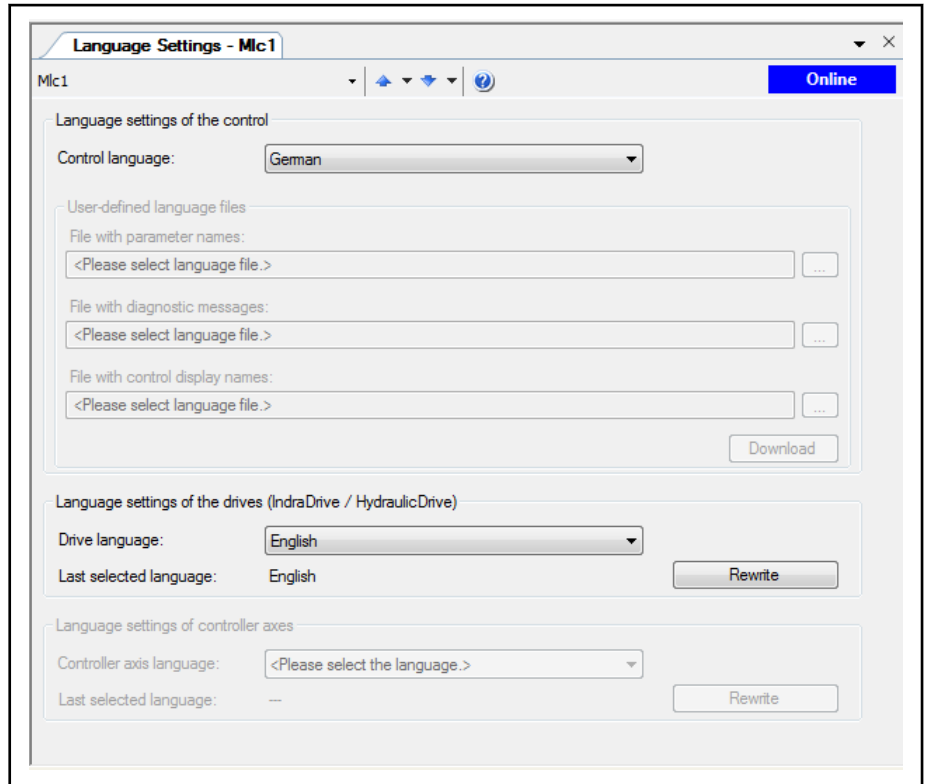


Fig. 4-60: Language settings

For more information on the language setting, refer to [chapter 12 "User-defined languages for parameter names, units, diagnostics and menu texts"](#) on page 671.

Parameters involved

- C-0-0001, Language selection
- C-0-0002, Name of parameter file
- C-0-0003, Name of diagnostic file
- C-0-0004, Name of menu file
- S-0-0265, Language selection

4.4.5 Cam explorer

The "Cam Explorer" dialog provides access to three sections:

- Cam Pool
- Compact Flash
- Control

The "Cam Explorer" can copy cams to each of these sections (via drag&drop or arrow keys) and retrieve them.

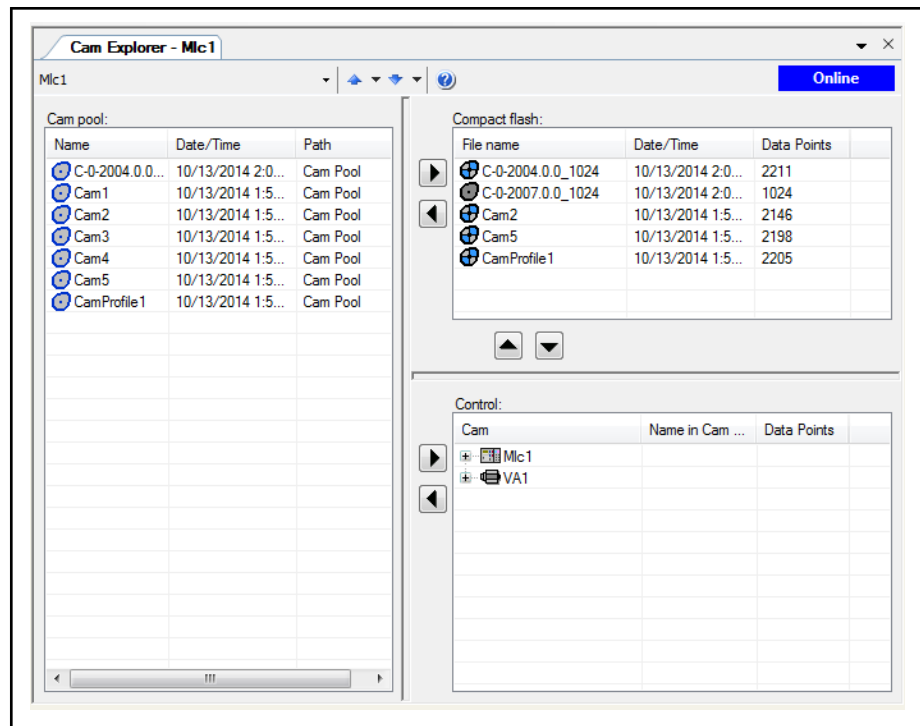


Fig. 4-61: "Cam Explorer" dialog

The cam stock is displayed in the left of the dialog below "Cam Pool". In general, they can be generated with the CamBuilder. The cams can also be retrieved from the CF card, control or an axis.



To use the CamBuilder, a license is required. The license has to be entered under **Tools ▶ Options ▶ General ▶ Software Licenses ▶ CamBuilder**.



Cam tables and MotionProfiles or FlexProfiles are generated almost identically using the CamBuilder. Principally, each cam table is also a MotionProfile or a FlexProfile, i.e. it consists of segments with certain mathematical properties (= profile).

While applying a cam to the control or the Compact Flash card, a cam table with the desired number of points is always generated. The respective parameters (C-0-2001 ... C-0-2099) are listed parameters that only contain the points. Retrieving a cam table from one parameter always leads to a new cam that only contains data points and that no longer indicates any segments or their mathematical description.

MotionProfiles or FlexProfiles are stored in the control as a description of individual segments and can usually be retrieved the same way.

In general, a MotionProfile or FlexProfile requires less storage area, but more computing power for the execution. Due to the kept segmentation, it is also possible to modify existing segments at runtime (e.g. program-controlled fine adjustment). When modifying cam tables, the complete cam table has to be applied.

In the dialog on the upper right, all cam table files and MotionProfile or Flex-Profile files - stored on the Compact Flash Card - are displayed. Cam tables, MotionProfiles and FlexProfiles are displayed with the corresponding icon in

each line. For cam tables, the number of data points in the cam table is displayed in the third column. For MotionProfiles and FlexProfiles, the file size is displayed in bytes.

In the dialog on the right bottom, all cam tables, MotionProfiles and FlexProfiles - stored in the parameters of the control or the axes - are displayed. The following applies: Cam tables can only be stored in the parameters C-0-2001...C-0-2099 of the control. MotionProfiles and FlexProfiles can only be stored in the A-parameters of the respective axes. For cam table parameters, the number of data points in the cam table is displayed in the third column. For MotionProfiles and FlexProfiles, the number of segments used is displayed.



MotionProfiles and FlexProfiles exist in axes interpolated in the control. This applies for virtual axes, real axis with interpolation on the control and Sercos axes.

Cams (cam tables, MotionProfiles or FlexProfiles) can be copied from any of the three partial windows to the other. There are three options:

- Arrow keys between the partial windows
- Via a command in the context menu
- Drag&drop



If the arrow keys are used, select at least the element to be copied (single click). If the elements are copied to parameters, select the copy target as well.

When copying a cam from the CamPool to the Compact Flash card, select the target format via the dialog first.

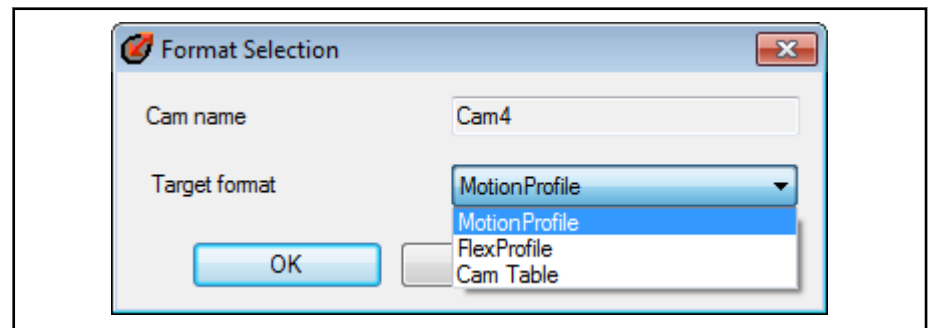


Fig. 4-62: Selecting the target format on the CF card

If the target format is a cam table, it is always converted into a cam table. Another dialog, displaying the number of data points and the file names on the CF card, is shown.

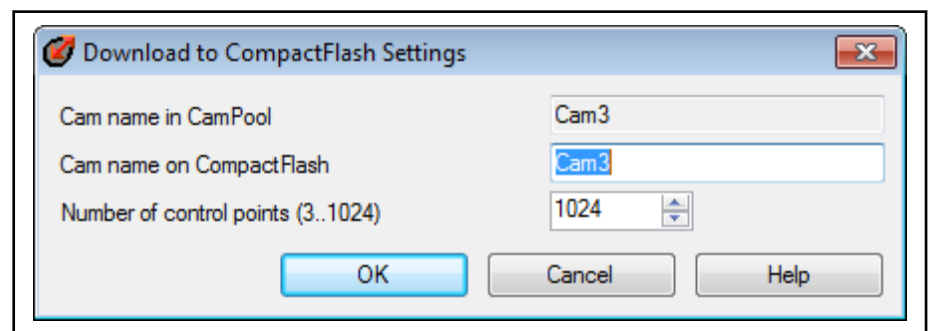


Fig. 4-63: Specifying name and number of data points

When copying from the CF card to the control, the number of data points can no longer be changed. The input field is then disabled.

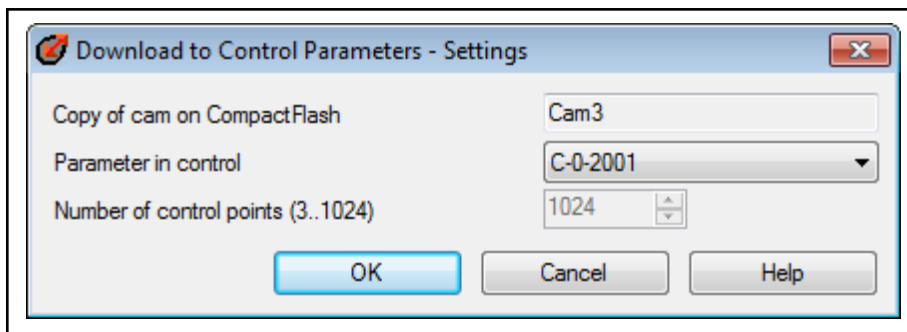


Fig. 4-64: Settings to copy a cam table from the CF card to the control



Cam tables copied to the CF card are stored so that they can be copied to cam table parameters without being converted. No mathematical segment description, but a cam table is stored on the Compact Flash card.

In the PLC program, suitable function blocks can be used to access stored files.

MotionProfiles or FlexProfiles are also stored on the CF card to copy them into the parameters involved with reasonable effort.

Cam tables stored on the CF card have the file extension ".cam", MotionProfiles ".cpf" and FlexProfiles ".xml".

MotionProfiles or FlexProfiles can also contain cam tables in individual segments. While copying these profiles to an axis parameter, the storage location of the cam tables has to be queried. The following window is opened for selection:

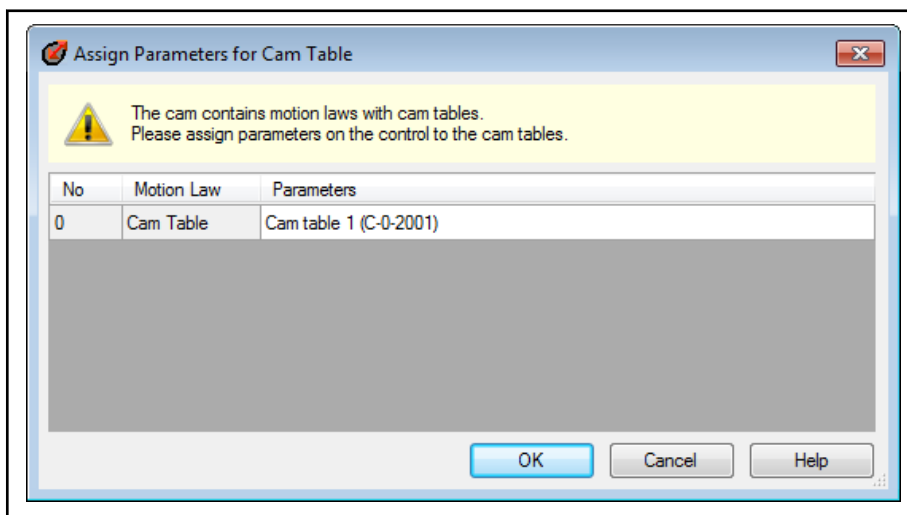


Fig. 4-65: Selecting cam table parameter while downloading a MotionProfile or FlexProfile to an axis

Parameters involved:

Cam tables

- C-0-2001 ... 2099, control cam tables

MotionProfile

- A-0-2910/A-0-2920, MotionProfile 0-1, number of motion steps

- A-0-2911/A-0-2921, MotionProfile 0-1, master axis velocity
- A-0-2912/A-0-2922, MotionProfile 0-1, list of initial master axis positions
- A-0-2913/A-0-2923, MotionProfile 0-1, list of motion laws
- A-0-2914/A-0-2924, MotionProfile 0-1, list of distances
- A-0-2915/A-0-2925, MotionProfile 0-1, list of slave axis velocities

FlexProfile

- A-0-3000, FlexProfile, current set
- A-0-3001, FlexProfile, current step
- A-0-3002, FlexProfile, master axis switching position
- A-0-3003, FlexProfile, slave axis, additive command position value
- A-0-3004, FlexProfile, master axis, additive command position value
- A-0-3009, FlexProfile, control word
- A-0-3010, FlexProfile, status word
- A-0-3011, FlexProfile, conditions: control variables
- A-0-3012, FlexProfile, conditions: status variables
- A-0-3013, FlexProfile, value, current time-master
- A-0-3020/A-0-3050/A-0-3080/A-0-3110, FlexProfile 0-3, master axis velocity
- A-0-3021/A-0-3051/A-0-3081/A-0-3111, FlexProfile 0-3, list of master axis sources
- A-0-3022/A-0-3052/A-0-3082/A-0-3112, FlexProfile 0-3, list of slave axis distances
- A-0-3023/A-0-3053/A-0-3083/A-0-3113, FlexProfile 0-3, list of master axis ranges
- A-0-3024/A-0-3054/A-0-3084/A-0-3114, FlexProfile 0-3, list of master axis ranges, units
- A-0-3025/A-0-3055/A-0-3085/A-0-3115, FlexProfile 0-3, list of motion laws
- A-0-3026/A-0-3056/A-0-3086/A-0-3116, FlexProfile 0-3, list of motion step types
- A-0-3027/A-0-3057/A-0-3087/A-0-3117, FlexProfile 0-3, list of slave axis starting velocities
- A-0-3028/A-0-3058/A-0-3088/A-0-3118, FlexProfile 0-3, list of slave axis starting accelerations
- A-0-3029/A-0-3059/A-0-3089/A-0-3119, FlexProfile 0-3, list of slave axis starting jerks
- A-0-3030/A-0-3060/A-0-3090/A-0-3120, FlexProfile 0-3, list of slave axis end velocities
- A-0-3031/A-0-3061/A-0-3091/A-0-3121, FlexProfile 0-3, list of slave axis end accelerations
- A-0-3032/A-0-3062/A-0-3092/A-0-3122, FlexProfile 0-3, list of slave axis end jerks
- A-0-3033/A-0-3063/A-0-3093/A-0-3123, FlexProfile 0-3, list of slave axis travel velocities
- A-0-3034/A-0-3064/A-0-3094/A-0-3124, FlexProfile 0-3, list of slave axis travel accelerations

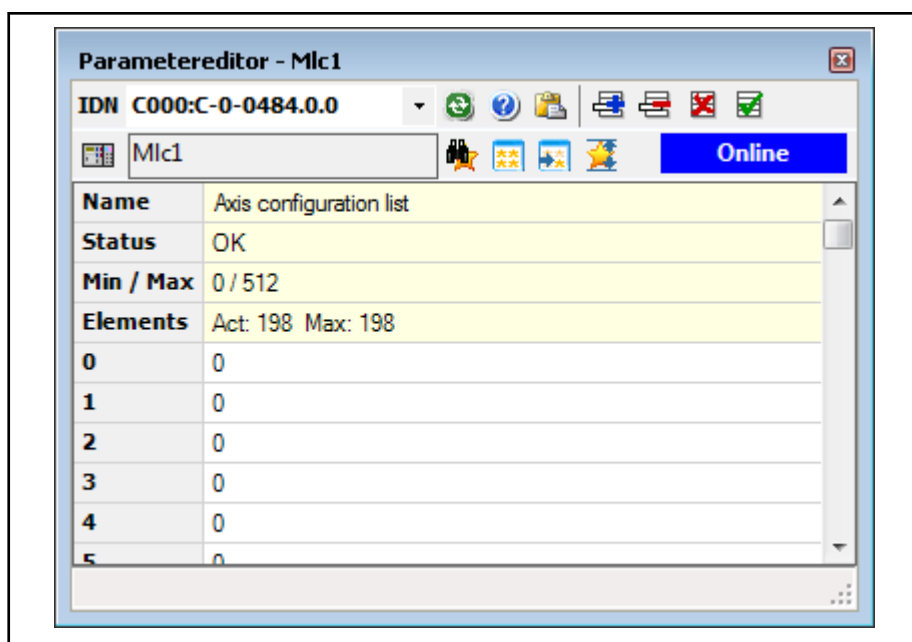
- A-0-3035/A-0-3065/A-0-3095/A-0-3125, FlexProfile 0-3, list of slave axis limit jerks
- A-0-3036/A-0-3066/A-0-3096/A-0-3126, FlexProfile 0-3, list of turning point displacements
- A-0-3040/A-0-3070/A-0-3100/A-0-3130, FlexProfile 0-3, events, list of motion step assignments
- A-0-3041/A-0-3071/A-0-3101/A-0-3131, FlexProfile 0-3, events, list of trigger modes
- A-0-3042/A-0-3072/A-0-3102/A-0-3132, FlexProfile 0-3, events, list of action modes
- A-0-3043/A-0-3073/A-0-3103/A-0-3133, FlexProfile 0-3, events, list of trigger values
- A-0-3044/A-0-3074/A-0-3104/A-0-3134, FlexProfile 0-3, events, list of trigger values, units
- A-0-3046/A-0-3076/A-0-3106/A-0-3136, FlexProfile 0-3, Command: Check and apply event
- A-0-3047/A-0-3077/A-0-3107/A-0-3137, FlexProfile 0-3, Diagnostics
- A-0-3048/A-0-3078/A-0-3108/A-0-3138, FlexProfile 0-3, Command: Check and apply profile
- A-0-3049/A-0-3079/A-0-3109/A-0-3139, FlexProfile 0-3, checksum

4.4.6 Parameters

Parameter editor

The parameter editor allows an individual parameter to be displayed and changed. Opening the parameter editor is context sensitive, that is, it provides C-parameters in the control and for each axis the A-, S- and P-parameters of the respective axis or the S- and P-parameters for drives.

Availability	This function is enabled in the following modes: • Online mode - Access to the real parameters of the control, axes or drives • Offline mode - Access to the parameters of the control, axes or drives
Structure	Open the parameter editor in the context menu of control, axes and drives and right-click on a parameter in any dialog:



Name Parameter name
Status Query status (transfer)
Min Possible minimum value of the parameter
Max Possible maximum value of the parameter
Elements Value or list of values

Fig. 4-66: Parameter editor call

Actual parameters are entered taking the source into account:

In the figure above, the number of the control "C000", local control, is placed in the front.

For the parameter "C-0-0484, Axis configuration list", the complete name "C000:C-0-0484" results.

The A-, S- and P-parameters can be retrieved for an actual axis.

The parameter name is extended with the axis number (A001...A016):

A001: A-0-0002

for "A-0-0002, Axis name" of the axis "1".

If it is accessed from the **local axis**, the axis number can be omitted.



If the parameter can be written in the current mode, the values can be changed and applied with <ENTER>.

Toolbar of the parameter editor

For the following functionalities, go to the toolbar above the tabular parameter display:

Icon	Description
	Opens the "Parameter selection list" on page 224
	Opens the parameter group
	Applies the parameters to the parameter group
	Adjusts window size to content

Icon	Description
	New loading, updates the display
	The parameter help opens the .chm help file
	Copies the parameter values to the clipboard
	Inserts a list element into an actual position (list is not immediately updated) in case of list parameters
	Deletes a list element at an actual position (list is not immediately updated) in case of list parameters
	Deletes list elements
	Writes the list to the corresponding parameter
Online/offline	Indicates, whether the control is in online or offline mode ("Online" in the example)

Tab. 4-3: Toolbar of the parameter editor

Parameter selection list

The parameter selection list provides a complete overview on the currently available parameters and allows the desired parameter to be selected for display and editing in the parameter editor and in the parameter group (depending on the location of the call).

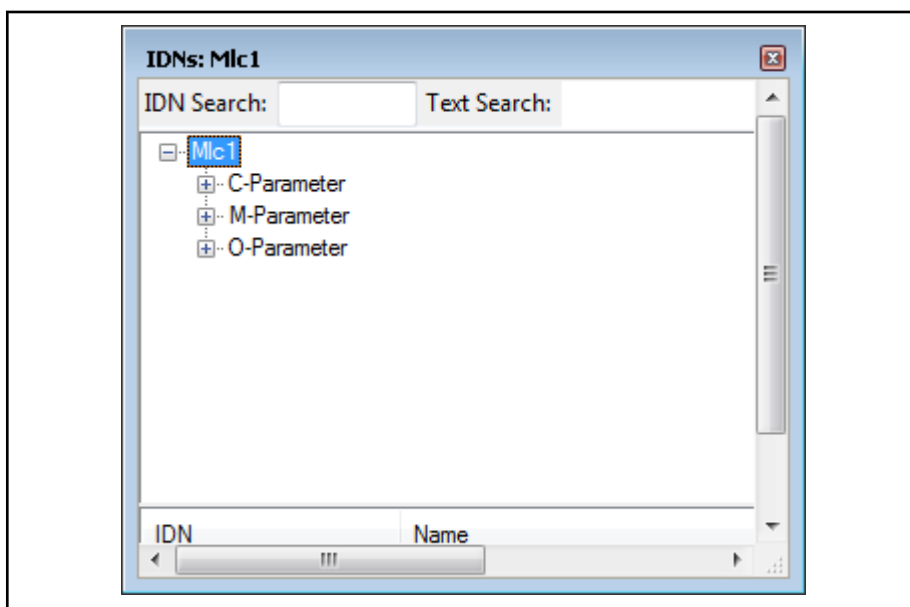


Fig. 4-67: Opening the parameter list in the parameter editor

Parameter group

Based on the individual parameter displayed in [chapter "Parameter editor" on page 222](#), the user can create a list of parameters, whose values can be evaluated and changed.

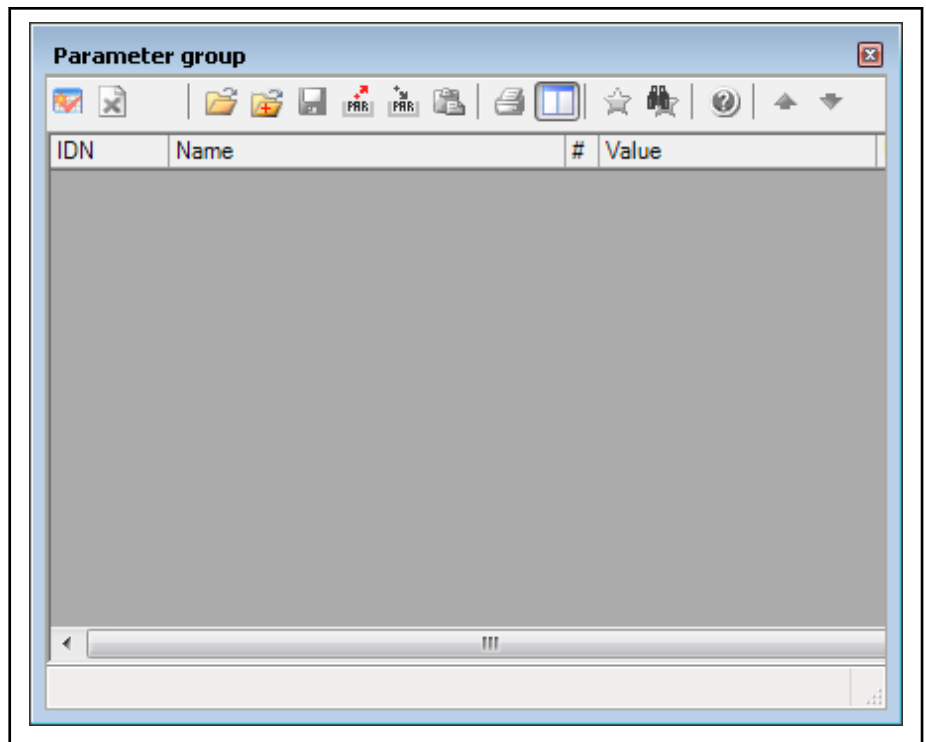


Fig. 4-68: Editor for parameter group

Availability

This function is enabled in the following modes:

- Online mode - Access to the real parameters of the control, axes or drives
- Offline mode - Access to the parameters of the control, axes or drives

Toolbar of the parameter group

For the following functionalities, go to the toolbar above the tabular parameter display:

Icon	Description
	Inserts a new line to enter parameters (selection dialog)
	Deletes the current line
	Loads the parameter list
	Loading and opening a parameter configuration
	Saves the parameter list
	Imports a parameter file (*.par)
	Exports a parameter file (*.par)
	Copies the content to the clipboard as text
	Prints the parameter group

Icon	Description
	Displays the parameter source
	Opening chapter "Parameter editor" on page 222
	Parameter selection (selection dialog), see also chapter "Parameter editor" on page 222
	Parameter description, opens the help file
	Moves the line up/down

Tab. 4-4: *Toolbar of the parameter group*

Finding parameters

The "Find Parameters" window searches for parameters using Ident numbers or parts of the name. All parameters currently available on the axis can be selected.

Parameter adjustment

General information

The project parameters are not taken into consideration when downloading the Motion configuration from the PC to the control.

The parameter adjustment synchronizes the parameters of project and control and can be opened at the following nodes in the Project Explorer:

- Control
- Motion
- Real axes
- Virtual axes
- Encoder axes
- Link axes
- Controller axes
- Axes
- Robot
- Kinematics
- Sercos
- Drive
- Drive axis

Prerequisites

To use the complete functional scope of the parameter adjustment, the following prerequisites have to be met:

- Online connection to the control
- The Motion configuration in the project and the control are synchronized, refer to [chapter "Online mode" on page 524](#)
- For the S-/P-parameter adjustment, the option "Offline parameterization for drives":

- has to be enabled in the control properties, refer to "[Tab Extended settings](#)" on page 280
- has to be supported by the drive firmware (exceptions, e.g. Sercos Drive, MPx21)

Adjusting parameters The parameters can be adjusted for all drives or for individual drives.

Call:

- To synchronize all drives, start the parameter adjustment in the Project Explorer via the context menu of the "Motion" node: **Parameters** ► **Parameter adjustment...**
- To adjust a single drive, open the parameter adjustment via the context menu of the respective drive node: **Parameters** ► **Parameter adjustment...**

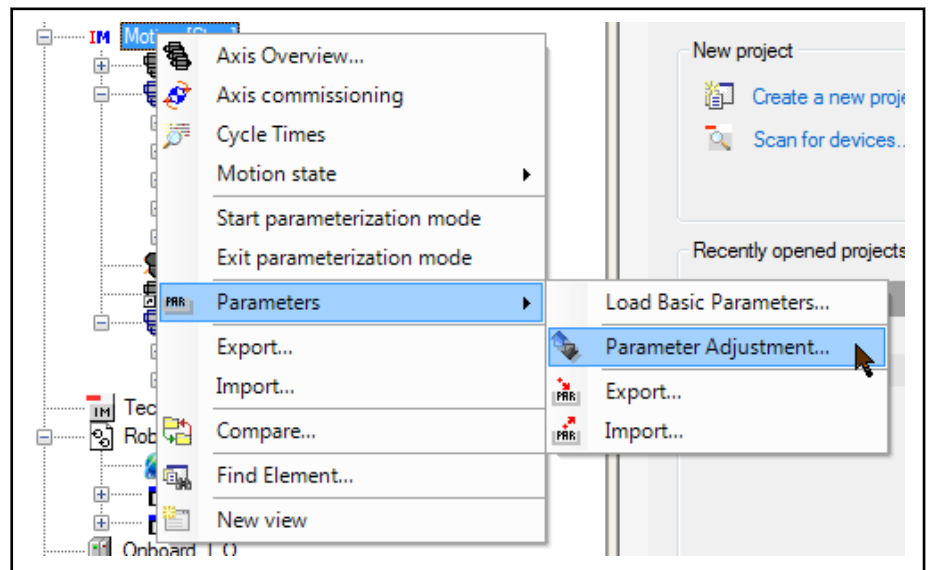


Fig. 4-69: Parameter adjustment

After the function has been called, the "A-drive parameters" of the project are compared to the parameters of the control. the "Parameter adjustment - Motion" dialog is opened.

This might take some seconds depending on the current control state and the number of configured axes and kinematics.

If no differences can be detected as result of the parameter adjustment, the following is displayed:

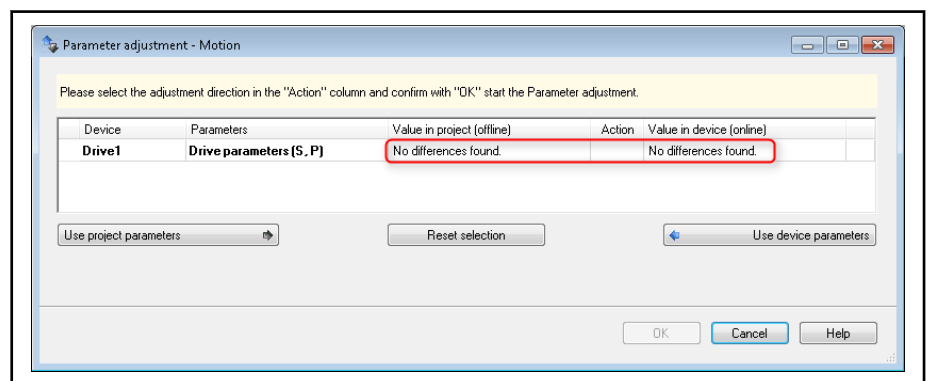


Fig. 4-70:

The following information is shown in the dialog:

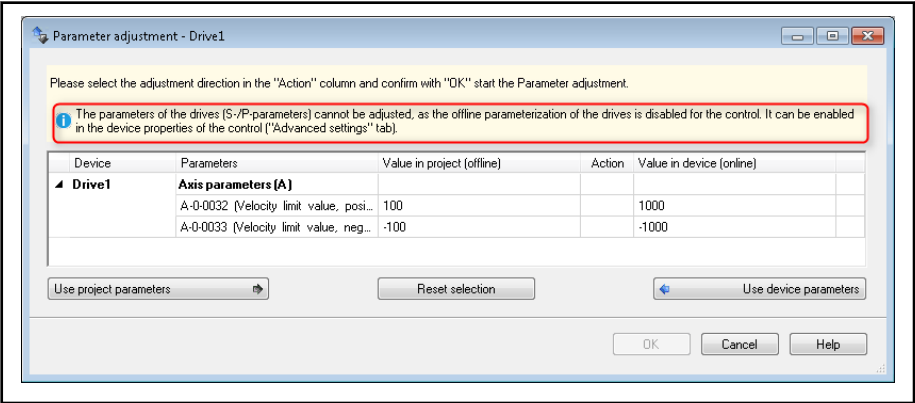


Fig. 4-72: Dialog "Parameter adjustment" - Message: "S-/P-parameters cannot be adjusted"

If no differences are identified when comparing the parameters, the following information is shown:

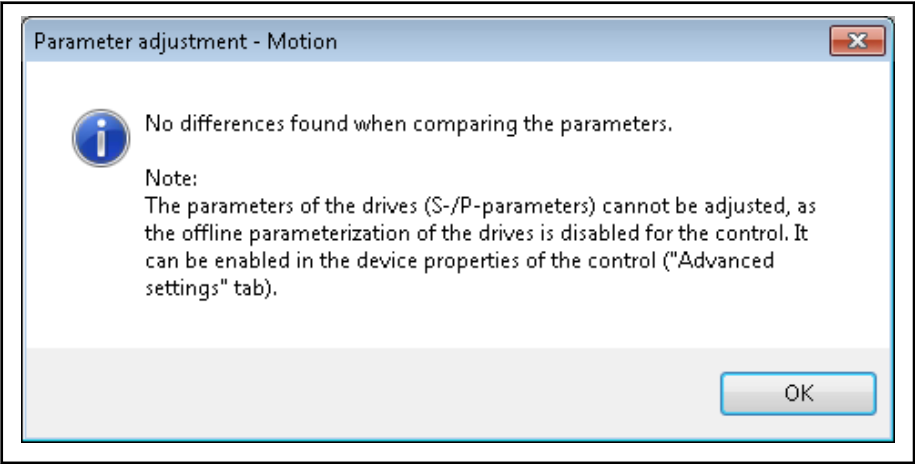


Fig. 4-73:

The control option "Offline parameterization for drives" can be selected in the control properties, see "Tab Extended settings" on page 280

Parameter adjustment - Dialog elements and shortcuts

Parameter adjustment - Dialog elements

	Opens the "Devices" node
Device	Drive name in the project
Parameters	Parameter type: • Drive parameters (A) • Drive parameters (S/P)
Value in the project (off-line)	Current parameter value in the project deviating from the parameter value in the drive.

Action	In this case, the "Action" field specifies whether a parameter is transferred as well as the transfer direction: [blank]: This parameter is not transferred : Transfer from the project to the control : Transfer from the control to the project
Value in the device (online)	Current parameter value in the drive deviating from the parameter value in the project.

Commands

Use project parameters 	Sets the transfer direction in the "Action" field to "from project to control" for all parameters
Reset selection	Resetting the settings in "Action" column
Use control parameters 	Sets the transfer direction in the "Action" field to "from control to project" for all parameters
OK	Starts the parameter transfer as per the setting selected in the "Action" field

Shortcuts

The dialog supports the following shortcuts:

Shortcuts	Function
[*]	All devices expand
[Shift] + [*]	All devices collapse
[+]	Expands the currently selected device
[-]	Collapses the currently selected device
[Pos1]	Jump to the beginning of the currently selected line
[Ctrl] + [Pos1]	Jump to the beginning of the table
[End]	Jump to the end of the currently selected line
[Ctrl] + [End]	Jump to the end of the table
[Esc]	Cancel

Saving parameters in drives

This function is used to explicitly save parameters in Sercos to the drive. This is necessary as the drives can only perform parameter changes in the working memory.

Availability This function is enabled in

- Online mode; saving refers to the real parameters of the control, axes or drives
- Offline; saving refers to the parameters of the control, axes or drives in the project

Parameters - Export

With the export function, the parameters can either be completely or individually saved from a control to a file.

Open the export function via the context menu of the respective device node in the project tree.

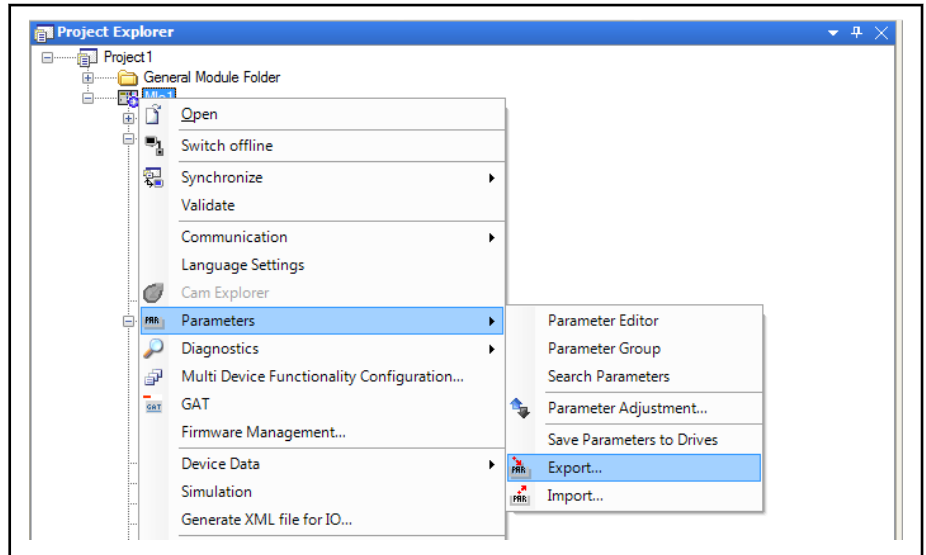


Fig. 4-74: Context menu item "Export Parameters" of the control

Availability

This function is enabled in the following modes:

- Online mode, the parameter export refers to the real parameters of the control or axes/drives
- Offline mode, the parameter export refers to the parameters of the control or axes/drives in the project

Structure

Depending on the node called for the parameter export in the dialog, the devices/axes in the online project are displayed.

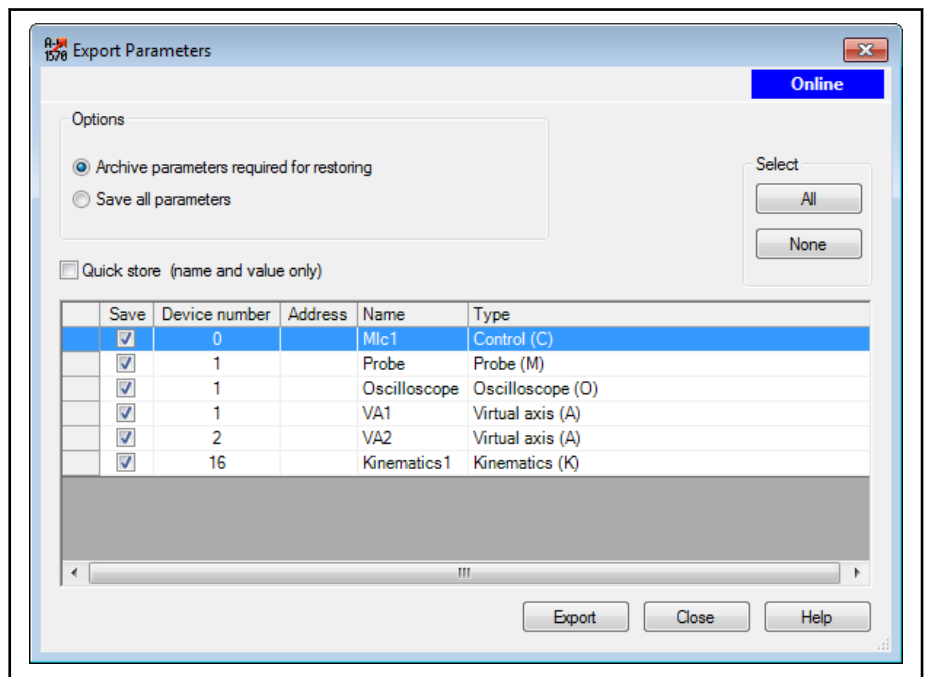


Fig. 4-75: Parameter export, selecting parameters

Column"Save":

By default, all entries are selected in this column. Deselect the checkbox to exclude the parameters of the respective device from export.

"Device number" column:

The logic device number is displayed in the "Device number" column. The device address is displayed for a control, the axis address is displayed for a drive (S- and P-parameters) or an axis (A-parameter).

"Address" column:

The Sercos address is displayed in the "Address" column for a drive (S- and P-parameters) or an axis (A-parameters).

"Name" column:

Displays the device name or the axis name.

"Type" column:

Displays the device type or the axis type.

Select or deselect via **All** or **None**.

Export options

The export can be modified using the following options:

1. "Archive parameters required for restoring"
Saves all parameters that can be written again to the respective object.
2. "Save all parameters"
Saves the complete data record of the object, even the parameter data that cannot be written again such as actual values.
3. "Quick store"
Only name, value and attribute as well as placeholder for min./max. values and unit are saved.

The **Export** button starts the parameter export.

Parameters - Import

Saved parameters can be reloaded to the control or drives using the parameter import.

Open the import function via the context menu of the respective device node in the project tree.

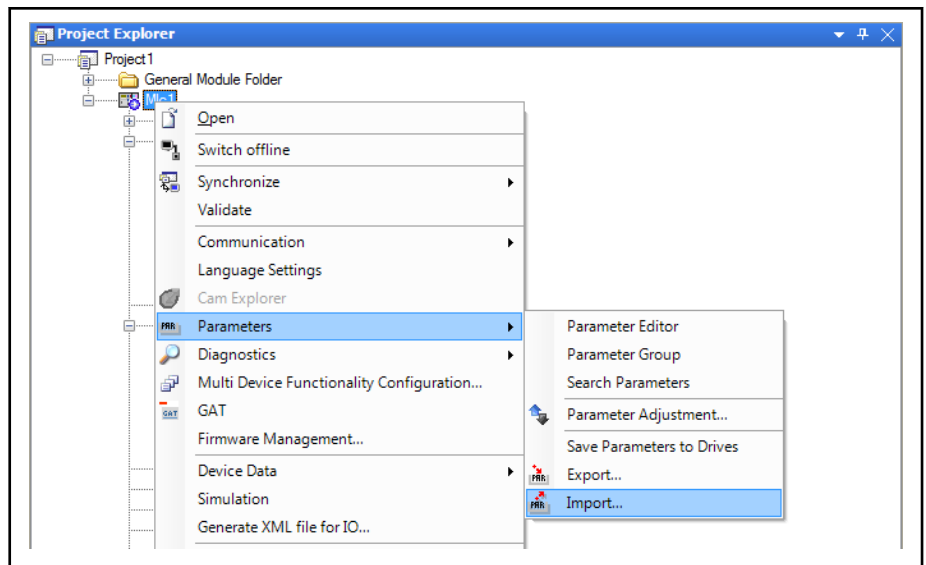


Fig. 4-76: Context menu items "Import Parameters" of the control

Availability

This function is enabled in the following modes:

- Online mode, the parameter import refers to the real parameters of the control or axes/drives
- Offline mode, the parameter import refers to the parameters of the control or axes/drives in the project

Structure

Settings for the parameter import can be made in the import dialog.

Depending on the node opened for the parameter import, the devices/axes in the parameter file are displayed.

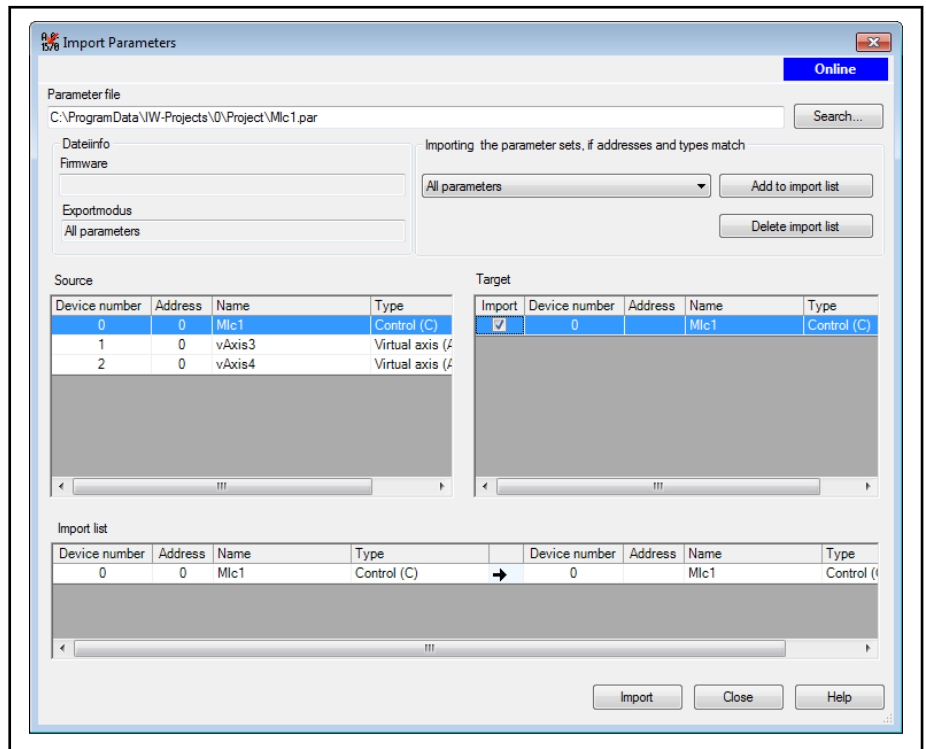


Fig. 4-77: Import settings

Parameter file:

The current parameter file, previously selected when the import function was opened via the "Open File" dialog, is displayed.

Press **Search** to load another parameter file.

File info:

- **Firmware**

The firmware release, which was on the device at the time of export, is displayed for the device selected in the source window

- **Export mode**

Provides the user with information on the export option used to save the parameters

Source:

This table lists all objects from the parameter file.

Target:

This table lists all objects that are available online with regard to the selected source line.

Import list:

By selecting one or several objects in the "Target" table, these are included in the table "Import list".



Axes of different types (e.g. from real to virtual) can also imported at once. However, only the parameters present for both types are loaded.

For deactivated axes, only the A-parameters can be reached. The S-parameters and P-parameters cannot be reached.

Control and axis names are not overwritten by the parameter import to also parameterize identical system components occurring multiple times in one system. Control and axis names are refreshed each time from the project when going online.

Modify the parameter import using the following function:

- "Importing parameters if address and type match"
Use a respective selection and click on **Add to Import List** to automatically create an import list including address and type.
- Delete the complete import list via **Delete Import List** button
- Start the parameter import via **Import**

4.4.7 Diagnostics

Device status

The dialog box provides an overview on the essential properties of the current control.

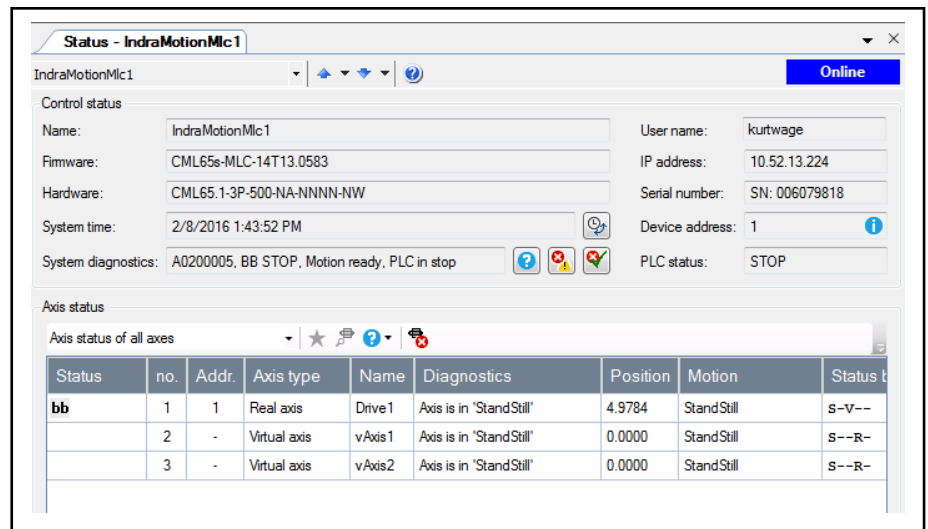


Fig. 4-78: Example: "Device status" dialog of an IndraMotion MLC

Click on  to delete all present errors of the control. The current status is displayed in the "System diagnostics" field.

The display shows events according to the priority of the events, i.e. if several events are present, the event with the highest priority is displayed. Therefore, the following rule applies (descending priority):

- Error class 9 ...⇒ ... Error class 0 ⇒ Warnings ⇒ Messages

Double-click on the display field of the current system diagnostics or click on  and the dialog [chapter "Error/diagnostic memory" on page 238](#) opens.

Click on  to apply the system time of the PC to the control.

The list of all defined axes provides an overview on the current status of these axes.

The axis number is displayed in the "Axis number" column.

The "Addr" column indicates the address of the drive set in the drive ring (e.g. Sercos) or, for link axes, the link address is indicated.

In the "Status bits" column, the most important feedbacks of the axis are indicated in a compressed manner. The letters have the following meaning:

- S - At standstill
- P - In position
- V - In velocity
- R - In reference, homed
- Y - Synchronized

If the mouse pointer is moved across several lines and columns of the axis list, tooltips are displayed to provide further explanations.

Right-click into the axis list and a context menu with additional functions opens:

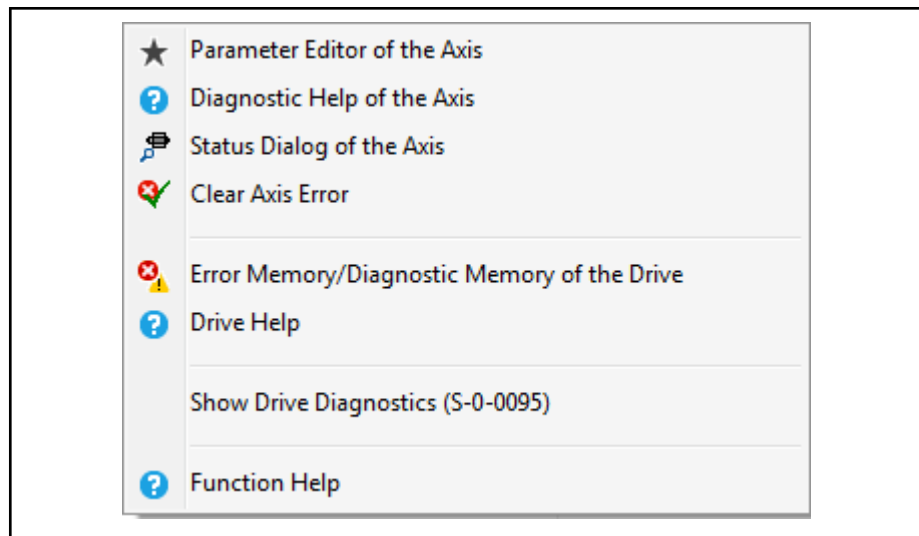


Fig. 4-79: Context menu with additional functions

Parameters involved:

- C-0-0010, Version number, hardware
- C-0-0012, Version number, firmware
- C-0-0023, System status
- C-0-0030, Control name
- C-0-0031, Control address
- C-0-0050, System time
- C-0-0203, Engineering, user name
- C-0-0626, Diagnostics

In the axis list, further parameters are used for each configured axis:

- A-0-0002, Axis name
- A-0-0020, Axis diagnostic message
- A-0-0021, Axis status
- A-0-0022, Extended axis status
- A-0-0023, Axis diagnostic number
- A-0-0100, Actual position value
- S-0-0095, Drive diagnostics (only for real axes and encoder axes)
- S-0-0390, Diagnostic number (only for real axes and encoder axes)

Load

The "Load" dialog contains additional details on the hardware and firmware of the control. This data is particularly required for the support:

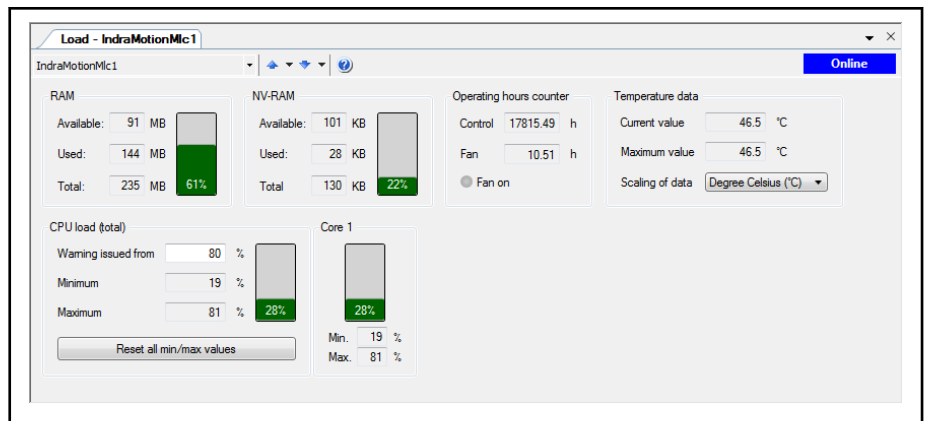


Fig. 4-80: Example: "Load" dialog of an IndraMotion MLC L65

In this dialog, some additional state values of the control are displayed. The user memory (RAM) and NV-RAM of the Motion display the memory load of the control.

For an IndraLogic XLC/IndraMotion MLC, the temperature warning is switched on when exceeding the maximum temperature and switched off when falling below. The "Maximum temperature" value refers to the measuring period since the last reset or the last switch-on of the control.

The values arithmetically averaged using the existing CPU cores is displayed below "CPU load (total)". The threshold value for the CPU load warning affects each CPU core separately, i.e. the warning is triggered when a CPU core exceeds the entered value. To reset the displayed minimum and maximum values (total and all CPU cores), press **Reset all min./max. values**.



The visualization of the CPU load depends on the number of available CPU cores of the respective IndraLogic XLC or IndraMotion MLC control.

Parameters involved

- C-0-0010, Version number, hardware
- C-0-0011, Version number, PLC firmware
- C-0-0012, Version number, firmware
- C-0-0013, Version number, BSP
- C-0-0021, Hardware, details
- C-0-0023, System status
- C-0-0031, Control address
- C-0-0032, Serial number of control
- C-0-0051, Operating hour counter
- C-0-0415, CPU load, current
- C-0-0416, CPU load, maximum
- C-0-0417, CPU load, minimum
- C-0-0418, CPU load, threshold value for warning
- C-0-0465, CPU load per core, current
- C-0-0466, CPU load per core, maximum
- C-0-0467, CPU load per core, minimum
- C-0-1051, Command: Reset C-0-0416, C-0-0417, C-0-0466, C-0-0467

Clearing errors

The command "C-0-1030, Command: Clear all control errors" is executed. All errors in the drives are also deleted.



If this command is executed, the pending warnings of the control are deleted. Thus, these warnings are reported again.

Clear Error can be opened from different locations:

- In the context menu of the control via **Clear Diagnostics/Error**
- In the dialog [chapter "Device status" on page 234](#)
- In the dialog [chapter "Error/diagnostic memory" on page 238](#) and
- In the [chapter 4.2 "Toolbar of the control" on page 162](#)

Error/diagnostic memory

Overview

The "Error/diagnostic memory" dialog provides an overview on all diagnostic messages of the control and the connected devices. The diagnostic messages are sorted automatically. The latest messages are on top of the list.

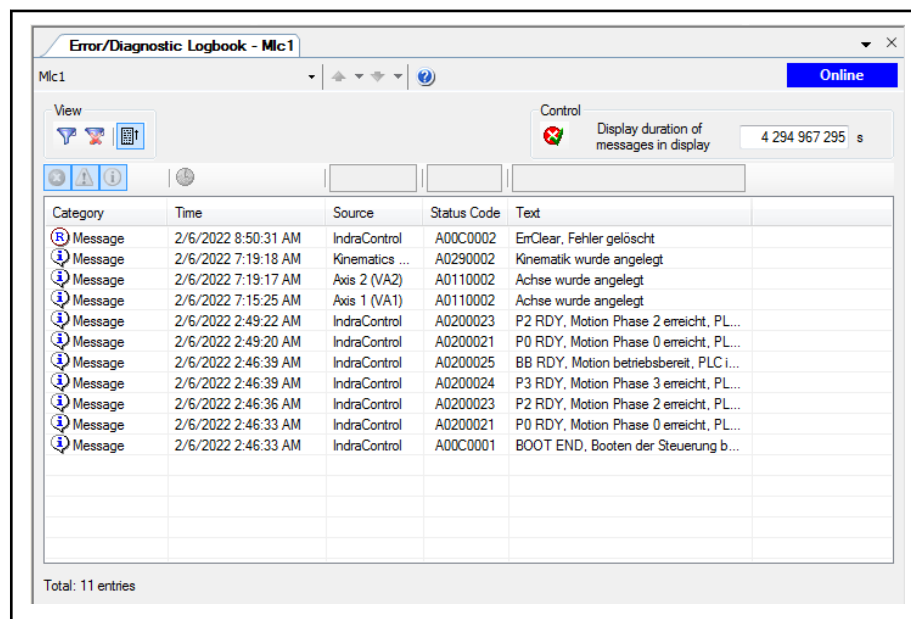


Fig. 4-81: Exemplary representation of the IndraMotion MLC error/diagnostic memory



A maximum of the latest 1,000 messages is saved in the control. Older messages are automatically deleted.

The dialog can be opened online and offline. In offline mode, some functions are disabled (the value "Display duration of messages in the display" can neither been seen nor changed for example). For older controls, apply that the message list is only displayed online.

Messages

The biggest dialog section presents the message list. Each message obtains the following information:

Category: The category indicates the severity of the message (whether it is an error or a warning). Each diagnostic message belongs to one of the following categories:

Category	Description
 Message	This is a general information (on a new operating state of the control for example)
 Error	This error has not yet been acknowledged with the "Clear Error" function
 Error	This error was acknowledged with the "Clear Error" function. The error date indicates when the error occurred
 Error	This specifies that the error was acknowledged with the "Clear Error" function. The date indicates when the error was acknowledged
 Warning	Yellow icon: This is an active warning (the warning cause is still present)
 Warning	Grey icon: This is an inactive warning (the warning cause is not present anymore). The warning date indicates when this warning occurred
 Warning	This specifies when the warning was not present anymore. In contrast to errors, warnings cannot be acknowledged manually. They are carried out automatically

Tab. 4-5: Message categories

Time: The time when message was received.

Source: The device or the logical unit that created the message. The following sources are defined:

- **IndraControl:** The control itself
- **Function block:** A function block processed in the PLC program. If this function block operates on an axis, number and name are specified
- **Axis:** One axis. Its number and name are additionally specified
- **Device:** A Sercos device. Its Sercos address and name are additionally specified
- **Kinematics:** One kinematics. Its number and name are additionally specified



The source name is determined using its logical number or the Sercos address and the current project data. If the projected elements have changed since the error occurred, the current and not the old name are displayed.

Status code: This is a unique code used to identify the message, for example to look for more information on the cause or troubleshooting in the online help.

Text: This is the message text. The language of the message text does not depend on IndraWorks, but on the language set in the control.

Filters

There is the filter bar right above the error list. Enter a criterion into the filter bar to specify how to filter the list. A criterion can be entered into every col-

umn. The individual filter criteria of the columns are combined in an AND operation and used to filter the message list. The individual filter criteria:

- **Category:** Filters for errors, warnings or messages in this list. Filters individual categories with an OR operation
- **Time:** Enter the starting and end time of the messages to be displayed. If at least one "time" was entered, the corresponding button is displayed as pressed and the selected time range is displayed as tooltip
- **Source:** Enter the text used for filtering
- **Status code:** Enter the text used for filtering
- **Text:** Enter the text used for filtering

If a text is entered into a text field of the filter bar, it is immediately filtered in the respective column. It is sufficient if the entered text is anywhere in the column. Enter the value "20" into the "Status code" column for example and the codes "A0200010" and "F2004002" are displayed. A preceding exclamation mark (negation) ensures that only messages **not** containing the searched term are displayed. The value "!A02000" thus causes most of the messages to be hidden at phase switching.

The wildcards "*" and "?" can be used additionally. The "?" is a placeholder for any character. The "*" is a placeholder for any number of characters (usually a word).

Example:

Using wildcards

- The filter "PLC in *" finds the texts "PLC in Init", "PLC in Ready" and "PLC in Run"
 - The filter "A020002?" finds all status codes from "A0200020" to "A0200029"
-

"View" Area

The area includes control elements (from left to right) used to influence the representation in the diagnostic list.

- **Filters On/Off:** Use this button to enable and disable the filter. Thus, fast switching between the filtered and unfiltered view is possible
- **Clear Filter:** Use this button to delete the filter to quickly enter a new filter for example
- **Automatic Scrolling On/Off:** Use this button to set whether moving to the most upper line is to be performed automatically when there is a new message. Enable this button to display the latest message without any further operating actions. To analyze an error in detail without seeing the new messages, disable the button

"Control" Area

The area includes control elements used to influence the control response.

- **Clear Error:** This button functions like the error deletion button via the context menu of the control. See also [chapter "Clearing errors" on page 238](#)
- **Display duration of messages in display:** Set additionally how long the messages (e.g. A0110002 "Axis was created") are shown on the display of the control. This setting does not refer to the display period of warnings and errors. The warnings or errors are displayed until they are acknowledged. Note that this field can only be changed if the control is online. Otherwise, the field is disabled

Context menu of the diagnostic list

Right-click on the message list and a context menu with the following entries is displayed:

- **Function Help:** This menu item opens the help on the dialog "Error/diagnostic memory"
- **Help on the message:** This menu item calls the help for the currently selected message. Alternatively, double-click on a message in the list
- **Copy Selected Line:** This menu item copies the content of the currently selected message to the Windows clipboard. With the set format for clipboard, the message can be directly inserted into a spreadsheet (e.g. MS Excel)
- **Copy Complete Table:** This menu item copies the content of all messages to the Windows clipboard. With the set format for clipboard, the messages can be directly inserted into a spreadsheet (e.g. MS Excel)

Invalid parameters

The dialog box displays the current system diagnostics of the control and lists all invalid parameters:

- For the control, the parameters included in "C-0-0111, List of all invalid C-parameters"
- For each axis, the parameters included in "A-0-0011, List of all invalid A-parameters", or "A-0-0014, List of incorrect synchronized A-parameters"
- For real axes and encoder axes, the parameters included in "S-0-0021, IDN list of invalid operating data for phase 2" and "S-0-0022, IDN list of invalid operating data for phase 3" are also evaluated

The use of the dialog is explained using an example:

The "positive velocity limit value" is to be increased. The permitted maximum input value is exceeded.

The current mode is the operating mode **BB**. The input is immediately applied to the drive that responds with an error message.

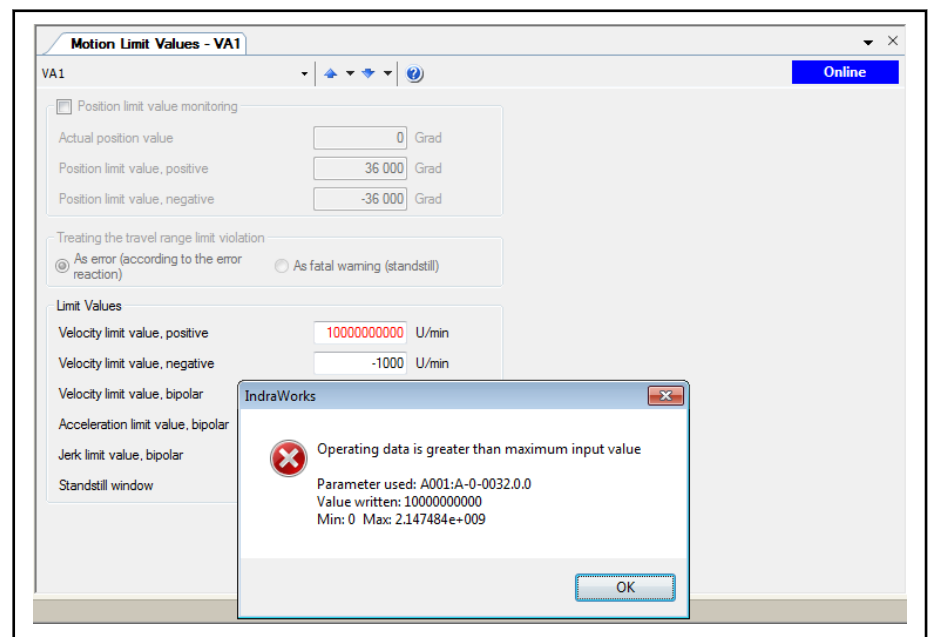


Fig. 4-82: Incorrect entry, value not within the valid value range

If the change is made in the parameterization mode **P2**, it is only applied when switching from **P2** to **BB**. Since several incorrect entries might have been made, it is advisable to list all these errors. Therefore, the "Invalid Parameters" window opens automatically.

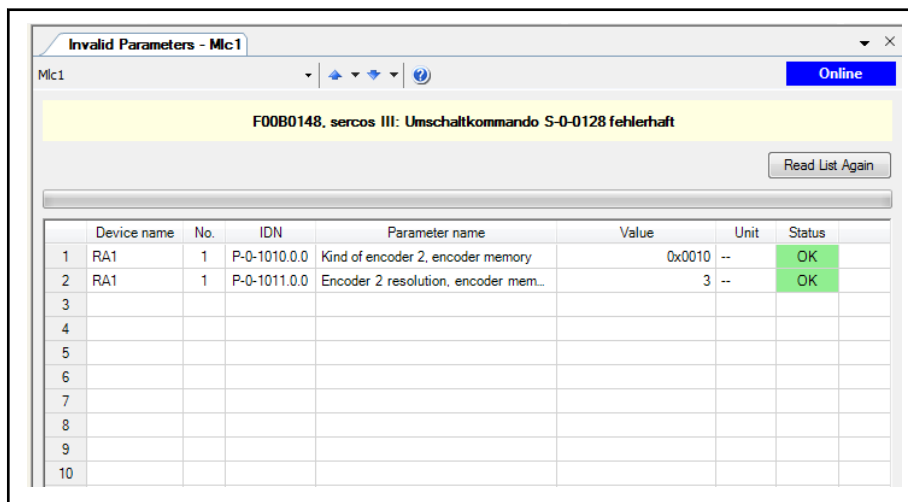


Fig. 4-83: Invalid parameters when switching from **P2** to **BB**

Now, make the appropriate corrections and repeat the attempt to switch from **P2** to **BB**.



Frequently, lines, which seem to be identical at first glance, are listed. The reason is that the S- and P-parameters determined as invalid are often overwritten with A-parameters. In this case, it is necessary to write to the corresponding A-parameter. Writing to the S- or P-parameter has no effect. Therefore, the parameters to be changed are highlighted in red. In the "Comment" column, this is described for each case.

Parameters involved

- C-0-0111, List of all invalid C-parameters
- C-0-0626, Diagnostics

and the parameters required for each axis

- A-0-0011, List of all invalid A-parameters
- A-0-0014, List of incorrect synchronized A-parameters

and the parameters required for each real axis and for each encoder axis

- S-0-0021, IDN list of invalid operating data for phase 2
- S-0-0022, IDN list of invalid operating data for phase 3
- S-0-0390, Diagnostic number

Task list/configuration

The data of all tasks can be seen in the task list. The task list can also be used to prioritize the tasks.

This dialog is described in [chapter 5.4.5 "Task list/configuration" on page 338](#).

Task viewer

The "Task Viewer" displays the activity of tasks in a task-time diagram.

This dialog is described in [chapter 5.4.6 "Task viewer" on page 340](#).

MLPI connections

Use this dialog to display the properties of all active MLPI connections of the control. This information is useful when diagnosing MLPI connection problems (e.g. due to open MLPI connections). This dialog is not required if there is no communication via MLPI.

[illegible]

Fig. 4-84: Example: MLPI connection overview with three connections

The following information is displayed for each connection:

- **User:** User name which the client uses to create the MLPI connection
- **Uri:** Complete address of the client establishing the MLPI connection to the control
- **Name:** Name which the client specified for the MLPI connection
- **Creation Date:** Time when the MLPI connection was established
- **Number of queries:** The number of MLPI queries the control processed, since the MLPI connection was established
- **Last Response Time:** Time required to process the last MLPI query on the control. This value provides information on the performance. For connections not used for sending any requests over a long period, the time increases slowly

To sort the table in the header, click on the column. This facilitates finding the connections of a certain client or the connections with the highest response time for example.

Use the button on the right to delete a selected connection, e.g. as a client is not connected anymore to the control, but the connections is still active.



This dialog also uses an MLPI connection displayed in the list. This connection cannot be deleted. Thus, the corresponding button becomes grey when selecting this connection.

⚠ WARNING

Deleting MLPI connection has unknown consequences for the client establishing this connection. Depending on the programming, the reaction of the client can be between new connection establishment and complete crash.

Delete only the connections that are not used anymore.

4.4.8 Multi-device Introduction

For "big machines" with several machine modules of the same type, the controls often have similar tasks within the complete machine. Apart from identical or comparable hardware connected to one single control, the PLC programs executed on the control are often identical except for the initial values minus the PLC variables - or they can theoretically be replaced by exactly one PLC program with control-specific initial values. The project planning of these controls is often very similar.

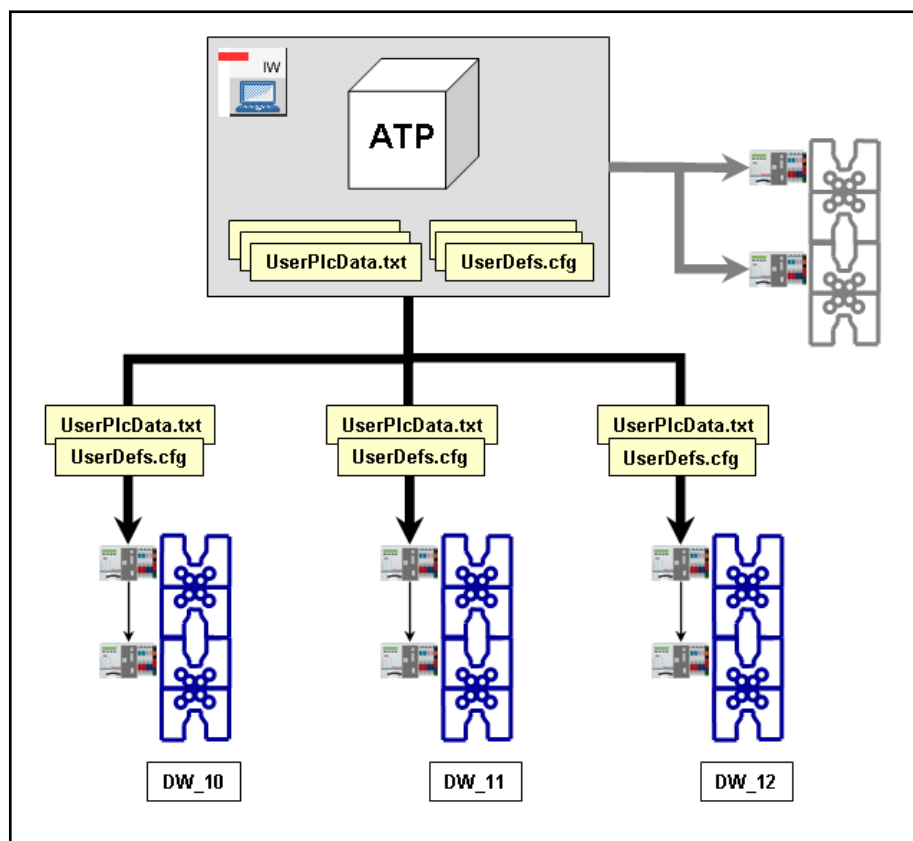


Fig. 4-85: Example: An IndraWorks project ("ATP") downloaded together with device-specific files to several controls

To use an application and their parameters for several physical controls, further controls can be added to the IndraWorks project in IndraWorks via the context menu item "Configure Multi-Device Functionality" of the control node and the **multi-device table** described in the following. These controls are in the multi-device table and can be individually selected and enabled to go on-line (Motion) or to log in (PLC).

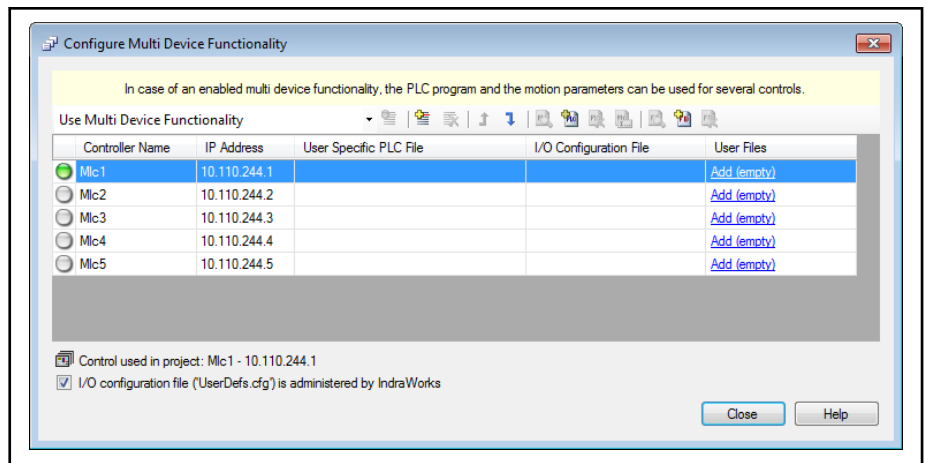


Fig. 4-86: The "Configure multi-device functionality..." dialog with the activated multi-device functionality and the multi-device table

Multi-device functionality with SafeLogic

The multi-device functionality with SafeLogic is supported by the XLC/MLC system from version 14V22 (path 1).



For a control change in the multi-device table or to change the settings via the multi-device table, the following conditions have to be met:

1. The standard application is logged out
2. The Safety application is logged out
3. The control is offline (Motion)

Related documentation

IndraWorks 14VRS SafeLogic Project Configuration

DOK-IWORKS-SL**PRJ*V14-APRS-EN-P, R911341694

Available in the Rexroth media directory → [Link](#)

Brief description of the multi-device table

Opening the multi-device table

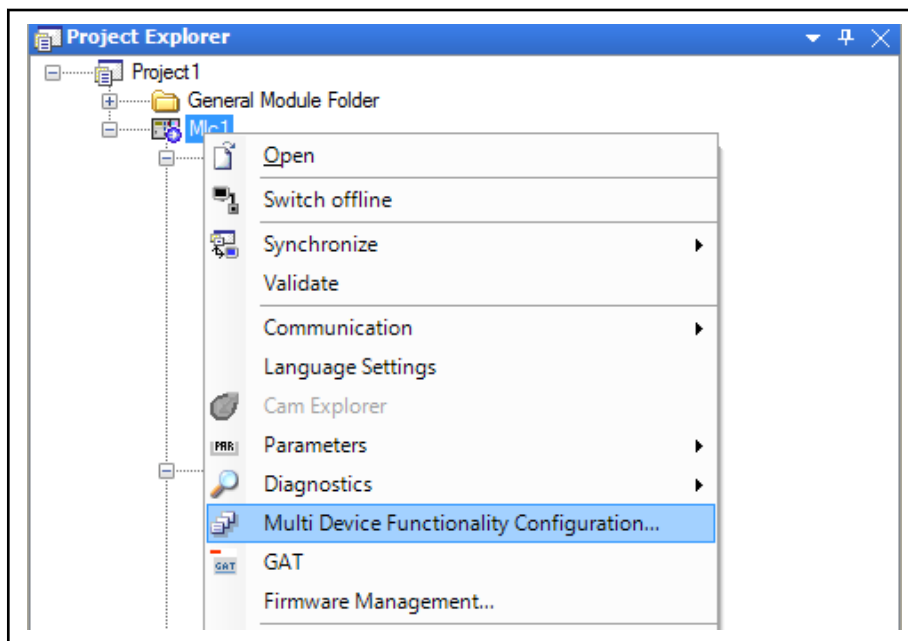


Fig. 4-87: Opening the dialog with the multi-device table

In IndraWorks, exactly one multi-device table can be assigned to each control and it can be edited using the "Configure multi-device functionality..." dialog. This dialog is opened via the context menu of the control (right-click on the control node in the Project Explorer). Click on "Multi-Device Functionality Configuration..." and the dialog with the identical name opens with the multi-device table. To edit the table, the IndraWorks project may neither be online (Motion) nor logged in (PLC). Furthermore, the multi-device functionality has to be enabled in the dialog "Configure Multi-Device Functionality..."

Activating/deactivating the multi-device functionality

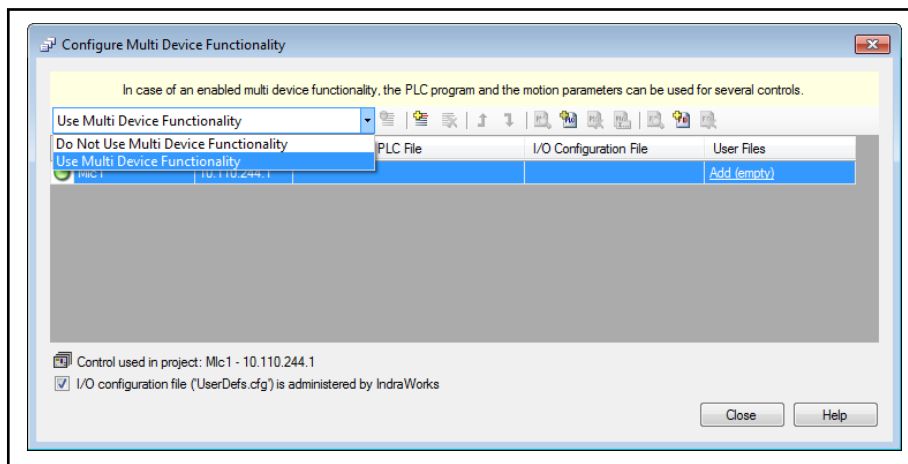


Fig. 4-88: Activating the multi-device functionality

Use the combo box in the toolbar of the "Multi-Device Configuration" dialog, to enable or disable the multi-device functionality ("Use multi-device functionality" or "Do not use multi-device functionality").

As long as the multi-device functionality has not been activated, the multi-device table is empty. When the multi-device functionality is activated for the first time, a device with the name and IP address of the current control is added once to the multi-device table. If the multi-device table has been activated once, it always contains at least one device.

Adding/deleting more controls

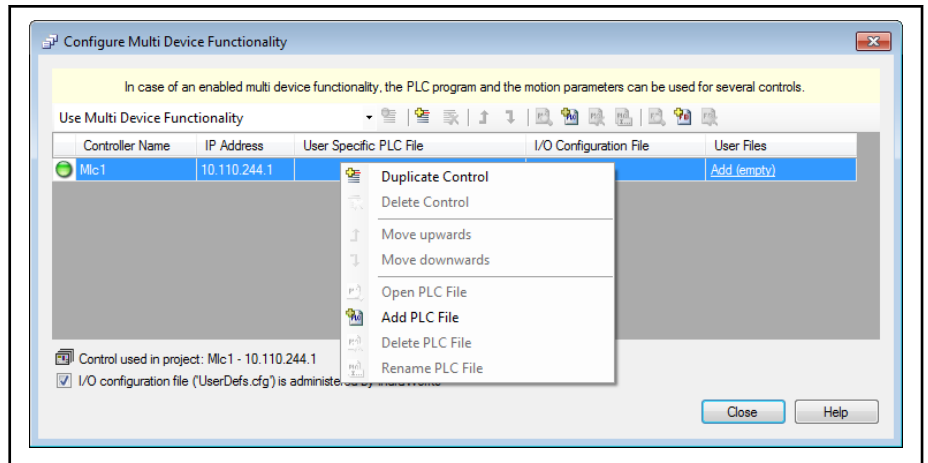


Fig. 4-89: Adding another control based on the selected control (duplicating)

More controls with individual device names, individual IP address, etc. can be added to the multi-device table via the context menu (right-click). Of all the controls in the multi-device table, only one control is active at a time (indicated by a green LED). Its properties are used in IndraWorks.

Apart from adding controls, they can also be deleted from the multi-device table. The active device cannot be deleted. Thus, if the multi-device table has been activated once, it contains at least one device.

Multi-device functionality in detail

Version control system (VCS)

The data of the multi-device table is part of the "Control" node in IndraWorks. If the IndraWorks project including the "Control" node is version-controlled, the data in the multi-device table is also version-controlled.

Difference: Multi-device disabled ⇔ enabled

Multi-device disabled

If the multi-device functionality is disabled, the IP address of the control is not version-controlled. That means that if the IndraWorks project is under version control and the multi-device functionality is disabled, the IP address of the control can be changed without checking out the control.

Furthermore, if the multi-device functionality is disabled when logging into the PLC, no "user-specific PLC data" and no "user data" are applied.

Multi-device enabled

If the multi-device functionality is enabled, the IP address of the control is part of the multi-device table data. Since the multi-device table as part of control data is under version control, the IP address is also version-controlled. This means that if the IndraWorks project is under version control and the IP address of the control is to be changed, the control node has to be checked out.

At each login to the PLC, the following data is transferred to the Compact Flash card of the control (user partition, directory "/ata0b"):

- User-specific PLC data file (if available)
- Configuration file to disable the Profibus DP slaves (if available)
- User files (if available)

Additionally, the parameter "C-0-0030, Control name" is write-protected during a parameter import.

If a function module is used for the cross communication in an MLC control, the parameter "C-0-0031, Control address" is also write-protected.

If the function module used for the cross communication is of type "Cross-Comm Sercos III", the following parameters are additionally read-only:

- C-0-0700, C2C, cycle time (Tcyc), command value
- C-0-0701, C2C, configuration of function modes
- C-0-0778, C2C, command configuration

Basic behavior of the multi-device table

Editing the table

To edit the cells of the multi-device table, click or double-click.

If there is an invalid entry in a cell, a small exclamation mark and a note are displayed in the cell with the incorrect entry after leaving the cell. Only if there is no error in a line, the data of this line is internally applied to IndraWorks.

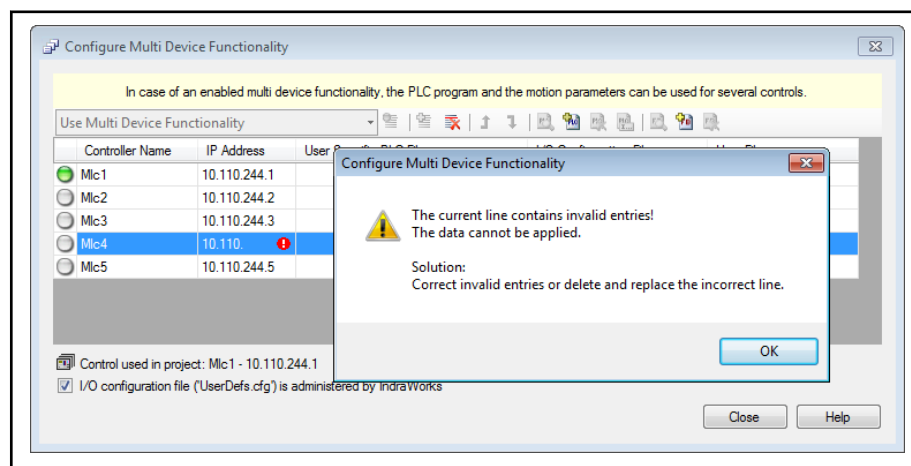


Fig. 4-90: Note on invalid entry

Commands via toolbar or context menu

The commands of a multi-device table like adding a new device for example, shifting a line within the table etc., can be opened via the toolbar buttons of the multi-device dialog or via the context menu of the table.

The functionality of the individual columns of the multi-device table is described in detail in the following.

Describing columns of the multi-device table

Column "Control name"

IEC-compliant control name

This column contains the control names. Only IEC-compliant names are accepted.

Column "IP address"

This column contains the IP addresses of the individual controls. In contrast to the control names, the same IP address can be used multiple times. Thus, different user-defined data files (see [chapter "Column User-specific PLC data" on page 249](#)) can be used for one physical device for example.

Column "Addr."

Sercos III cross communication, device address

This column is only available if a "CrossComm Sercos III" function module is used for cross communication of different controls. The cells of the column contain the cross communication address of the respective control. The address can be directly changed in the cell.

The command "Sercos III cross communication" can also be opened via the context menu of this column. This command can open the "Properties" dialog of the "CrossComm Sercos III" function module.

Column "Function"

Sercos III cross communication, master/slave

This column is only available if a "CrossComm Sercos III" function module is used for cross communication of different controls. These cells specify whether the current control responds like a cross communication master or slave.

The command "Sercos III cross communication" can be opened via the context menu of this column. This command can open the "Properties" dialog of the "CrossComm Sercos III" function module.

Column "User-specific PLC data"

A PLC program - n user-specific PLC data files

All controls in the multi-device table use the same PLC program. Once compiled, the program can be downloaded to the respective active control if the multi-device functionality is active when logging into the PLC.

If specific data - such as initialization values - is to be used for the individual controls in the multi-device table, this data can be provided using the user-specific PLC data file. Exactly one individual user-specific PLC data file can be assigned to each control in the multi-device table. The task of the PLC program is to analyze this user-specific PLC data file at runtime. The IndraLogic XLC/IndraMotion MLC firmware or IndraWorks do not analyze the user-specific PLC data files.

"UserPlcData.txt"

The user-specific PLC data file is added via the context menu of this column. The default file name is "UserPlcData.txt". The name of the file can be changed or the file can be deleted via the context menu. The user-specific PLC file data is saved internally in IndraWorks in different directories depending on the device. Thus, the same file name can be used multiple times in the multi-device table. The file opens with the editor registered for text files on the target system when clicking on the file name in the cell.

Transfer at login to the PLC

The user-specific PLC data file is transferred to the Compact Flash card during each login to the PLC (user partition "/ata0b") irrespective of whether the PLC program is loaded or an online change is executed. An existing file of the same name is overwritten. The file is not transferred if the login is aborted in IndraWorks by the user.



The user-specific PLC data file on the Compact Flash card of the control is never actively deleted. This also applies if the file is renamed or deleted in the multi-device table and thus in the IndraWorks project.

Column "Field bus devices"

Same hardware configuration, exception: Sercos drives and Profibus DP slaves

Devices connected to or used by the controls in the multi-device table have to be identical to the projected devices with regard to type, number and eventually the plug position. This applies especially to S20-I/O, function modules, field bus interfaces, etc.

The drives at the Sercos bus and the Profibus DP slaves are an exception. A project with the maximum number of features can be used for these drives. That means that the maximum stage of expansion can be projected in IndraWorks.

Projected, but not physically existing Sercos drives are automatically detected when switching to online mode in IndraWorks and can be permanently deactivated by the user if requested once.

"UserDefs.cfg"

Projected, but not physically existing Profibus DP slaves can be individually deactivated for each control in the multi-device table during the PLC startup

using the configuration file "UserDefs.cfg". This file is automatically read and analyzed by the runtime of the PLC when the PLC program is started.

To further illustrate this, see the two following figures of the IndraWorks interface.

Project planning

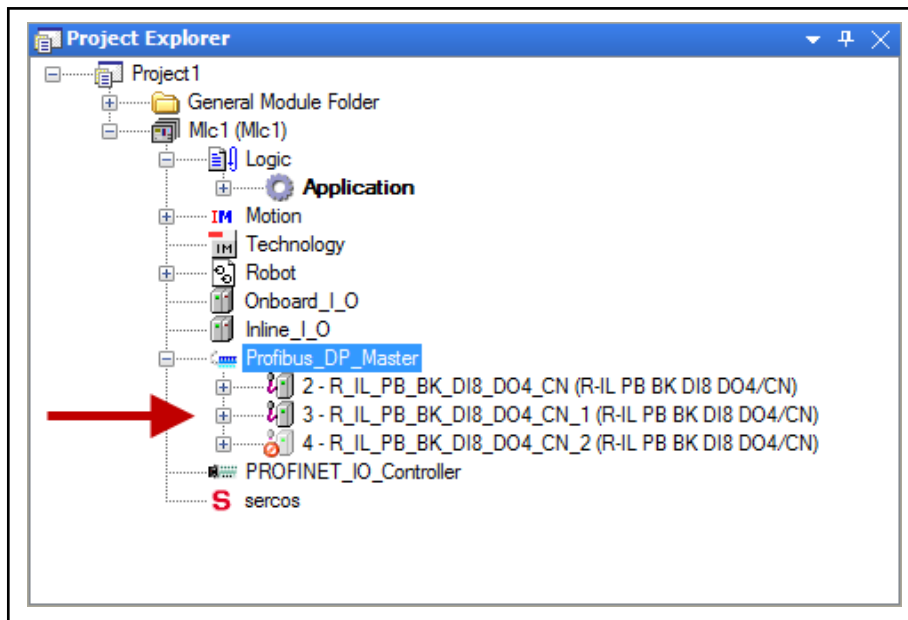


Fig. 4-91: Projected Profibus DP slaves

It is logged off, the multi-device is activated and the Profibus DP slave 4 is deactivated in the IndraWorks project. The slaves 2 and 3 are projected as active, but are to be deactivated during the PLC startup via the configuration file "UserDefs.cfg".

After login and PLC startup

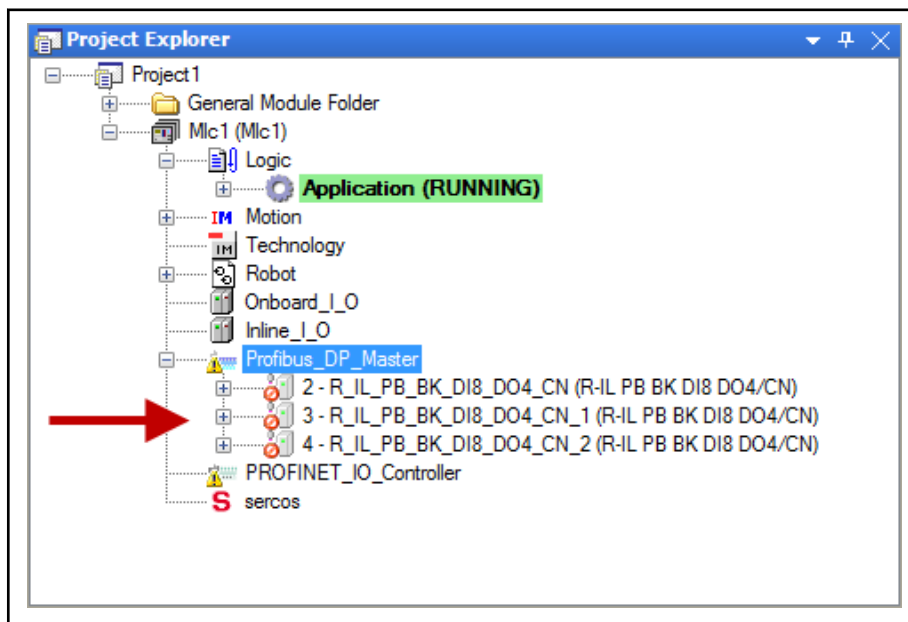


Fig. 4-92: Projected Profibus DP slaves disabled

It is logged in and the PLC program was started. Profibus DP slave 4 remains deactivated, but the slaves 2 and 3 were automatically deactivated after the PLC startup and the analysis of the "UserDefs.cfg" file.

Adding "UserDefs.cfg" The configuration file for a selective deactivation of Profibus DP slaves ("UserDefs.cfg") can be added to each control in the multi-device table via the context menu of the "Field bus devices" column. The configuration files are stored in different directories in the IndraWorks project and thus independent from each other. As it is the case for the user-specific PLC data file, an individual configuration file can be deleted. Click on the file name to edit the file with the standard editor for text files.

Transfer at login The configuration file to deactivate Profibus DP slaves is transferred as it is the case for the user-specific PLC data file at each login to the PLC (user partition "/ata0b") irrespective of whether the PLC program is loaded or an online change is executed. An existing file of the same name is overwritten. The file is not transferred if the login is aborted.

Differences Differences for a user-specific PLC data file:

- The configuration file to deactivate Profibus DP slaves cannot be renamed
- If a control in the multi-device table is not provided with a configuration file, a possibly existing file with the name "UserDefs.cfg" on the user partition ("/ata0b") of the file system might be deleted when logging into the PLC of this control
- If the multi-device functionality is deactivated, a possibly existing file with the name "UserDefs.cfg" on the CF card ("/ata0b") might also be deleted when logging in to the PLC

Column "User files"

To operate a system, unit-specific information as files to other units (controls) such as special configuration files for field bus devices are often required. These files are named "user files" in the following.

The following files can be assigned to each individual control in the multi-device table:

- exactly one user-specific PLC data file
- exactly one configuration file "UserDefs.cfg"
- several user files (described here)

The PLC program has to use these "user files" properly. The IndraLogic XLC/ IndraMotion MLC firmware or IndraWorks do not use the user file or do not analyze the files.

Transfer at login to the directory "MD_UserFiles"

The user files are transferred to the user partition "/ata0b" of the Compact Flash card of the control to the directory "MD_UserFiles" at each login to the PLC. Existing files with the same name in the directory are overwritten. If the directory "MD_UserFiles" does not exist, it is created during login. The files are not transferred if the login is aborted.



The user files in the directory "MD_UserFiles" on the Compact Flash card of the control are never actively deleted by IndraWorks. This also applies if the user files in the "User files" dialog - and thus in the IndraWorks project - are renamed or deleted.

The dialog "User files" to add, delete,... user files

The user files are added to the IndraWorks project using the "User files" dialog. Furthermore, user files can also be deleted, renamed or opened in this dialog. Click on a cell in the "User files" column and the "User files" dialog opens. Individual "user files" can be added to each device in the multi-device tables.

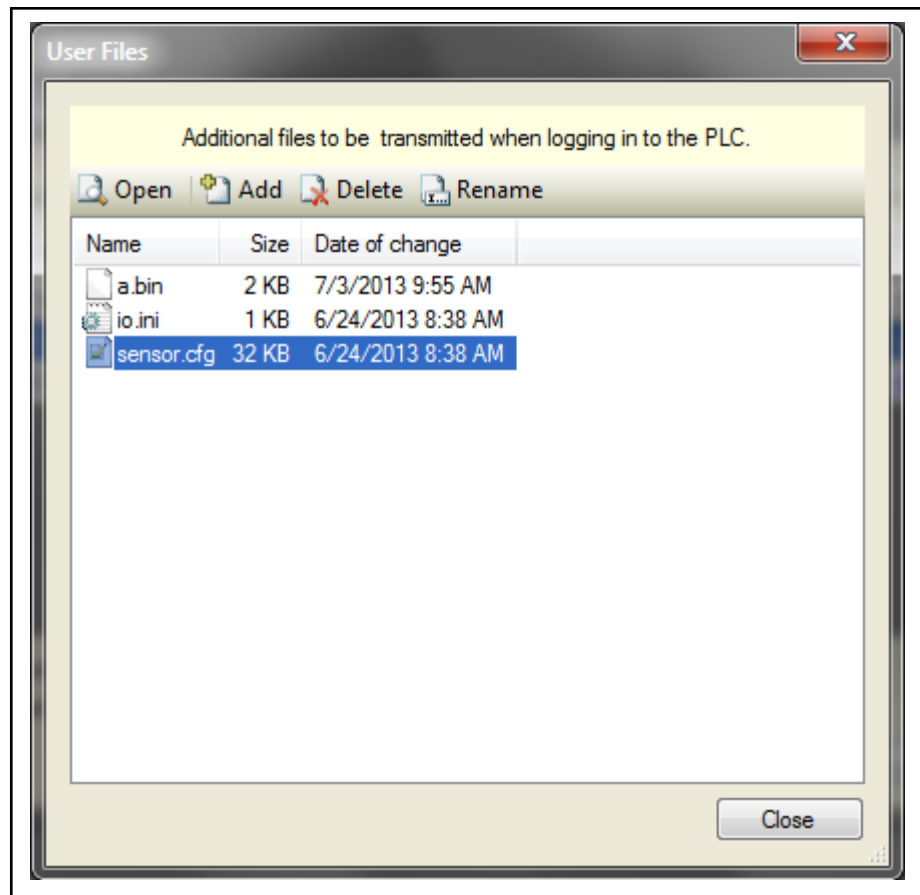


Fig. 4-93: "User files" dialog

I/O configuration file to disable field bus slaves

Disabling slaves of different field buses

The configuration file "UserDefs.cfg" to disable field bus slaves can be used to deactivate field bus slaves projected in IndraWorks. The deactivation is performed via a file on the Compact Flash card of the control.

Thus, diagnostic messages are impeded for slaves projected in IndraWorks, but that do not really exist.

For detailed information on

- Sercos III slave deactivation
- Profibus DP, slave deactivation
- S20-I/O, module deactivation

refer to the documentation "IndraWorks 14VRS Field Buses" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Managing the configuration file "UserDefs.cfg"

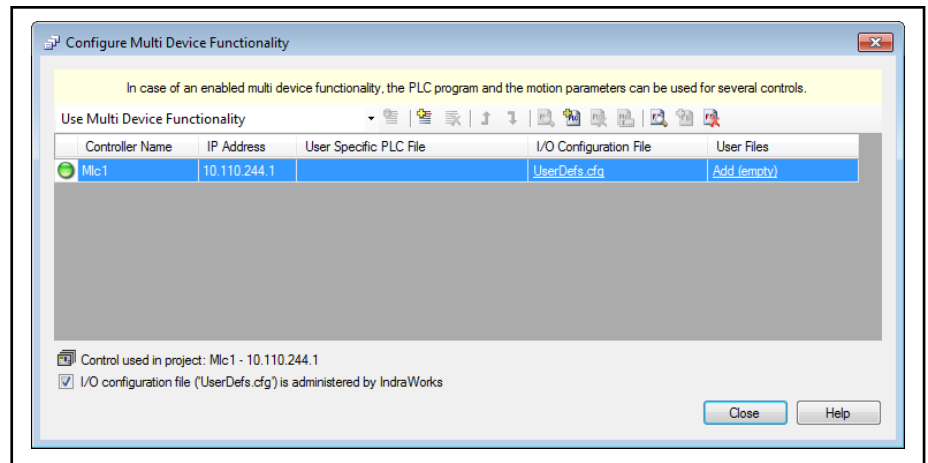


Fig. 4-94: Either IndraWorks or the user can manage the I/O configuration file "UserDefs.cfg" in the compatibility mode 13V04 and higher

Compatibility mode up to 13V02

To disable field bus devices, use the I/O configuration file "UserDefs.cfg". If the current IndraWorks project is used in the compatibility mode 13V02, IndraWorks manages the file "UserDefs.cfg". Thus, if multi-device is used and if the file "UserDefs.cfg" is in the multi-device table in the line of the control used, this file is written to the PLC upon each login and upon each PLC program download to the user partition of the CF card of the control.

If the file "UserDefs.cfg" is not available in the multi-device table in the line of the control used, the file - if present - "UserDefs.cfg" is deleted on the user partition of the CF card of the control upon each login to the PLC as well as upon each PLC program download. If multi-device is not used, the file - if present - "UserDefs.cfg" is deleted on the user partition of the CF card of the control upon each login to the PLC as well as upon each PLC program download.

This behavior cannot be changed in the compatibility mode 13V02.

Compatibility mode from 13V04

The behavior was changed for the compatibility mode 13V04 and higher. If multi-device is not used in this mode, the file "UserDefs.cfg" - if present - on the user partition of the CF card of the IndraLogic XLC/IndraMotion MLC is not deleted (new). If multi-device is used, the user decides whether to manage the file himself (new) or whether IndraWorks keeps managing the file (as up to compatibility mode 13V02).

If the user manages the file, the file "UserDefs.cfg" is neither written to the CF card of the control nor a present file with the same name is deleted on the CF card when logging into the PLC or during PLC program download.

4.4.9 Firmware management

Target	The firmware in the control is to be exchanged without loss of data.
Prerequisites	• The control is switched on • The network settings are correct on the control • IndraWorks has started and a project containing the control was loaded • The IP address of the control in the project has to match the IP address of the connected control
Procedure	



Read the release notes for the new firmware first.

To be on safe side, export all parameters first (except for S- and P-parameters) (see [chapter "Parameters - Export" on page 231](#)). The control can contain old program components, parameterizations and PLC data from previous use. These are removed by clearing the memory (see [chapter 3.4.7 "BOOTSTOP menu " on page 53](#)).

It is assumed that the control runs in **BB RUN** with active axes.

It is recommended to follow this sequence:

1. PLC: Stop PLC, log out.
Inconsistent data caused by the PLC can thus be excluded.
2. Switch control offline.
3. Download the firmware via the "Firmware Management" context menu item at the node of the control in the IndraWorks project tree.
The "Firmware Management" dialog is opened.

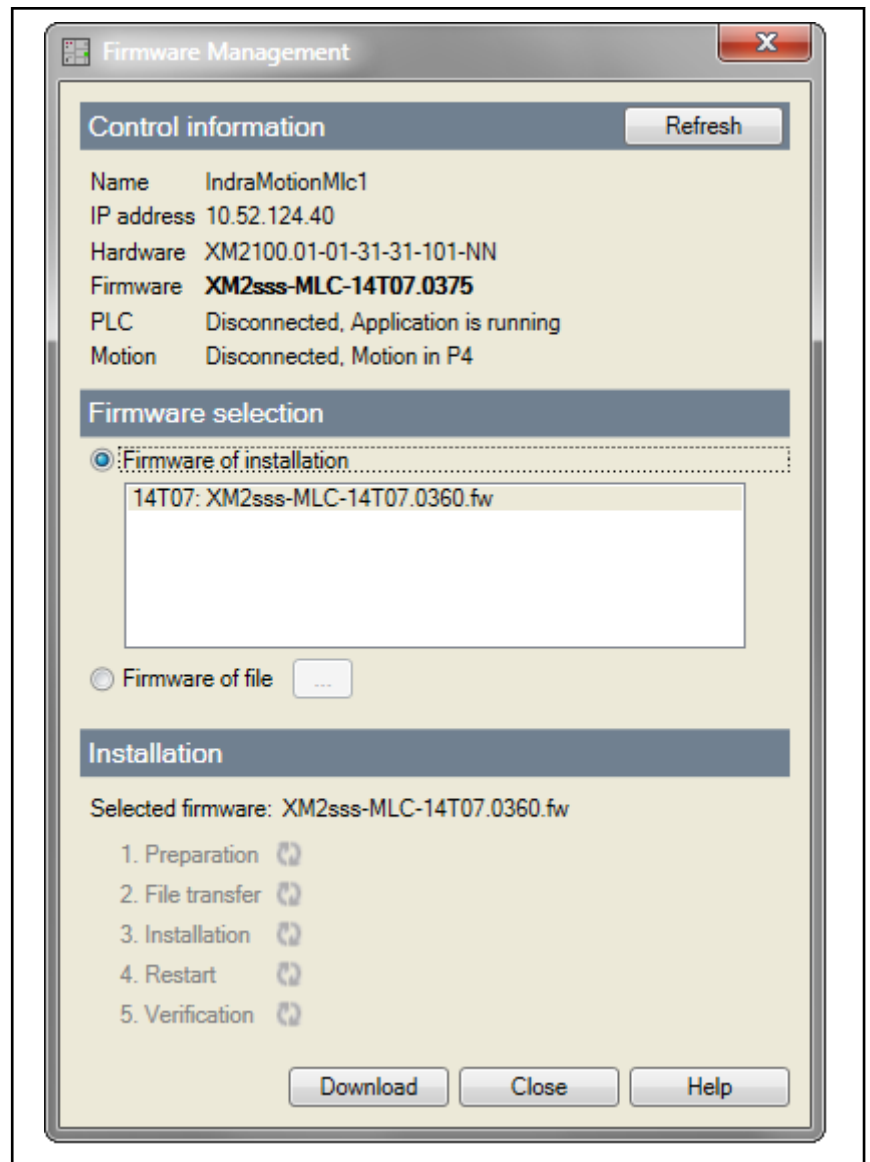


Fig. 4-95: Example: Firmware Management for an XM2 control

Device-specific data as well as online information is displayed in the "Control information" section. Click on **Refresh** to update the data display at runtime.

Select the firmware version in the "Firmware selection" section. It can be chosen between the versions or releases in IndraWorks or a firmware file available in any directory.

The versions available for selection are located under:

<Drive>:\All Programs\Rexroth\IndraWorks\<Control>\Firmware.

<Control>: "XLC" or "MLC".

Then, click on **Download...** to start the download of the selected firmware. The installation steps are displayed in the "Installation" section after startup.

Click on **Close** to close the dialog after the download.

4. Completing the system firmware download.



The new firmware is only applied after the control restart. Please observe the system diagnostics if the system firmware download was not successful.

5. Rebooting the control after firmware download



The control is generally rebooted automatically. However, in some cases, the control has to be restarted manually. In this case, "HW_INIT" is shown in the display of the control. Internal updates are executed in this state. In the meantime, the control may not be disconnected by the supply voltage. After the update, "PWRCYCLE" is shown on the display. Disconnect the supply voltage for a short period and then restart the control.

After the restart, the control runs up to **P2 Stop** or **BB Stop** depending on the setting of "C-0-0450, startup target mode of the control".

4.4.10 Drive firmware management

Target Exchanging drive firmware without loss of data.

- Prerequisites**
- The drive is either an IndraDrive or a HydraulicDrive
 - The control and the computer - on which IndraWorks is installed - are located in the same subnet
 - The control is switched online
 - The drive is connected to the control and enabled

Procedure



Read the release notes for the new firmware first.

The following is assumed: It is an IndraDrive drive, the control runs in **BB RUN** and the axes are active.

It is recommended to follow this sequence:

1. Stop all active axes and ensure that no axes start during the firmware download.
2. Open the firmware download wizard of the corresponding drive below the Sercos node via the context menu item "Firmware Management..." of the drive.
3. Select whether a routing entry to the drive is to be generated and whether the drive parameters and the function package of the drive are to be backed up and restored after a firmware download. Click on **Next>>**.

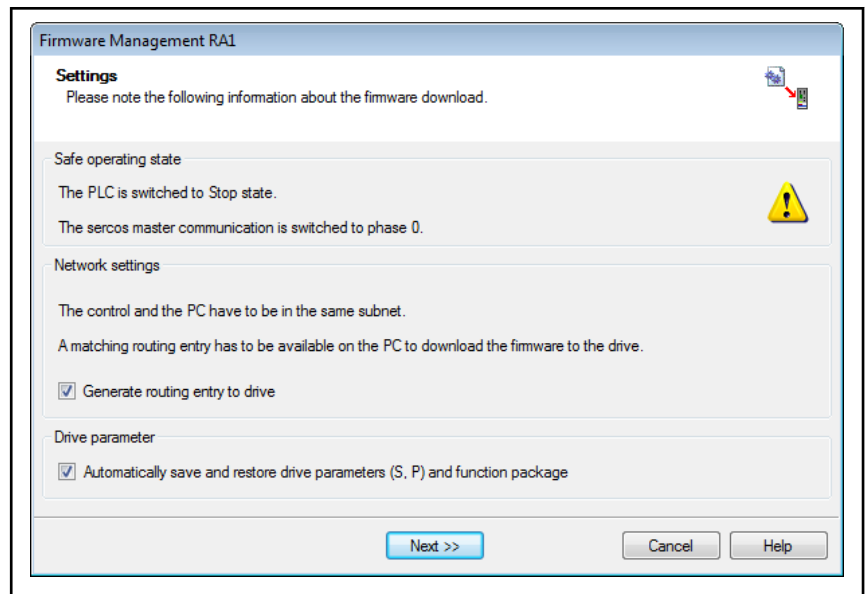


Fig. 4-96: Select the settings for the firmware download

4. Confirm the safety prompts that the control is to be stopped.
5. If selected, the routing entry to the drive is subsequently generated and the drive parameters and the selected function package are backed up.
6. A window is displayed to select the firmware to be loaded to the drive. Select the firmware file via ... and click on **Download...** to download the firmware to the drive. The progress is displayed during download.

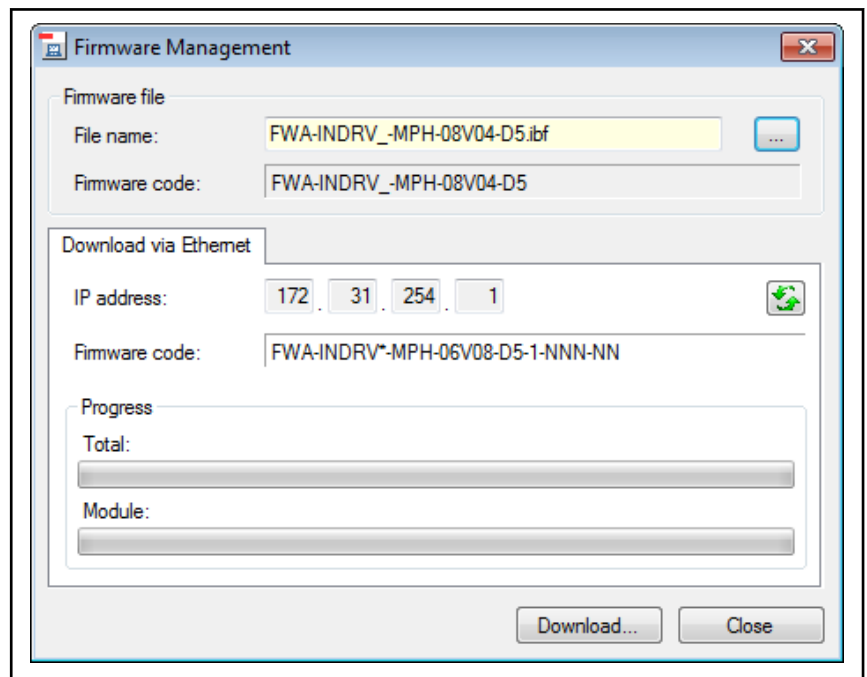


Fig. 4-97: Selecting firmware file for download

7. After the successful firmware download, a message to restart the drive is displayed. Depending on the drive type used, it can be either restarted automatically or manually by switching off and on. The messages displays whether there is an automatic restart or whether a manual restart is required.

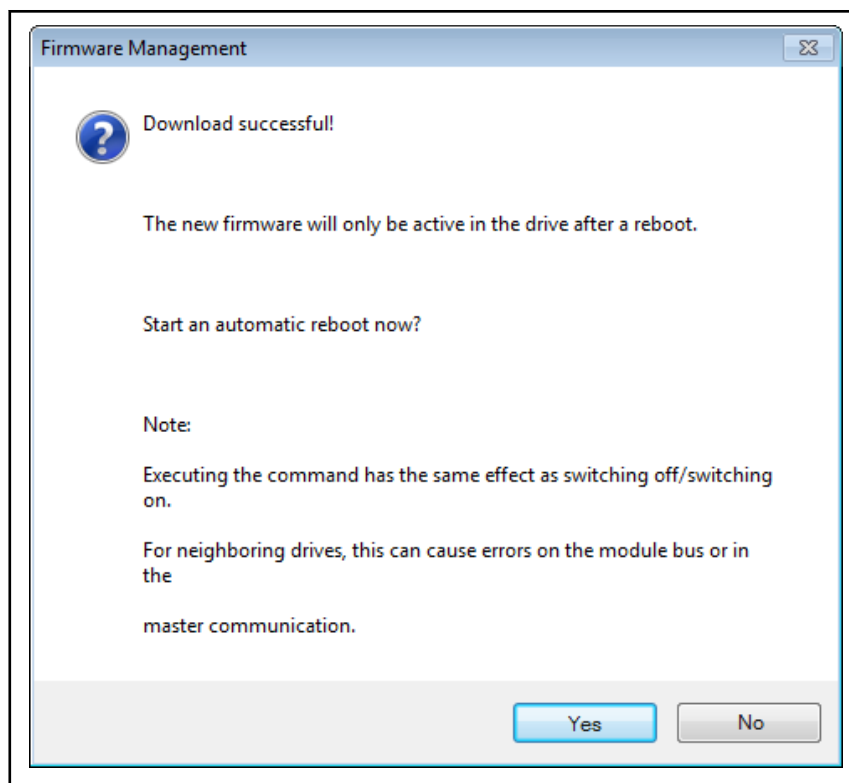


Fig. 4-98: Message displayed if the download was successful and if the drive supports an automatic restart

8. Start the automatic restart with **Yes**.

The progress of the automatic restart is displayed in the following window:

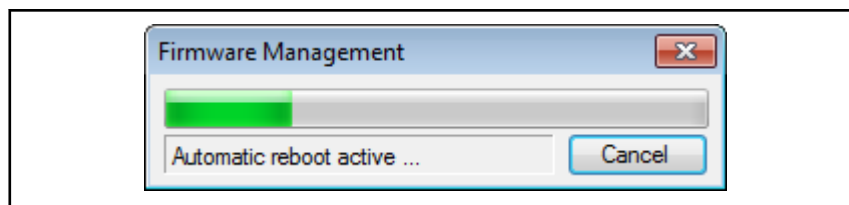


Fig. 4-99: Progress bar "Automatic restart"

9. The drive parameters are restored and the new drive firmware is automatically applied to the IndraWorks project.
10. The result of the firmware download is displayed at the end.

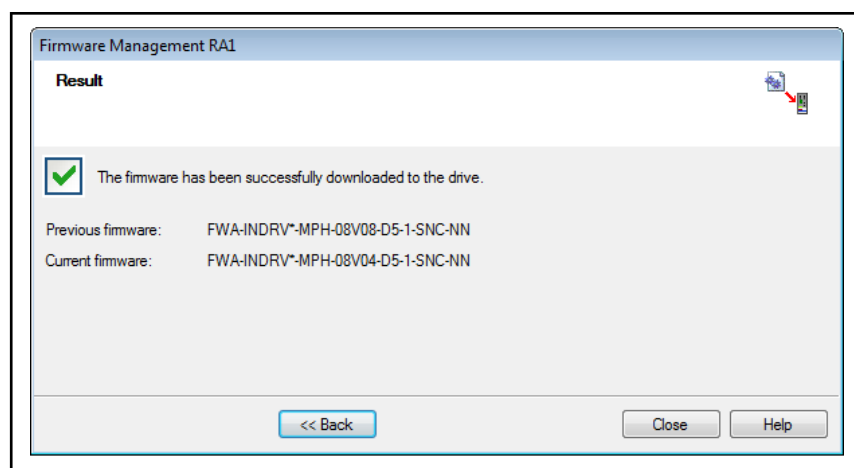


Fig. 4-100: Firmware download result

4.4.11 Device data Archiving

This menu item can be used to backup the control data (parameters, kinematic data) and the CF partitions of the control in the project to restore them on a control with the same firmware version. This function is only available if there is an online connection to the server.

Data types There are three data types. The project has to be online for archiving. The following overview shows which data types are supported:

Data type	Control data	Data userpartition	Data OEMpartition	System partition data
Archives stored on the device			X	
Firmware				X
Control parameters	X			
Drive parameters	X			
PLC retain data			X ¹⁾	X ²⁾
Compiled PLC programs			X	
Kinematic parameters*	X			
RCL program* applied to the control	X			
RCL build* applied to the control	X			
Cam tables applied to the control		X		

Data type	Control data	Data userpartition	Data OEMpartition	System partition data
Cam tables loaded to the drive	X			
MotionProfiles applied to the control		X		

* only for MLC

- 1) In firmware version 14VRS and higher, the PLC retain data is located on the OEM partition of the control.
- 2) Up to the firmware version 13VRS, the PLC retain data is located on the system partition of the control.

Tab. 4-6: Overview on data types

User interface

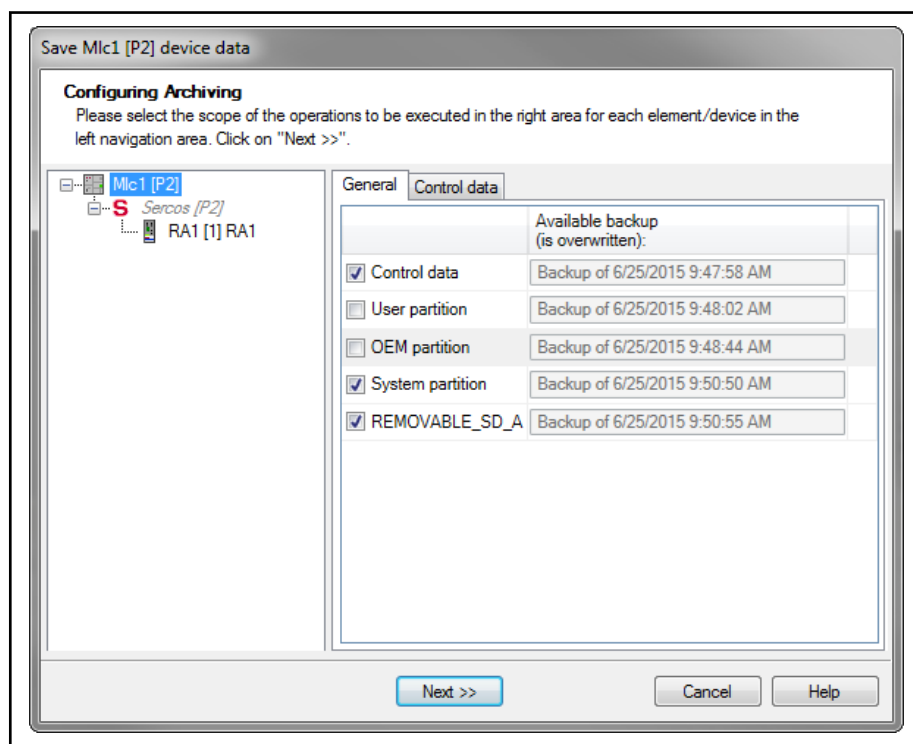


Fig. 4-101: Dialog to configure the control

Specify the data type to be archived in the "General" tab. If a data type is already in the project, the archiving date is displayed in the "Available backup" area.



If a data type is already in the project, it is overwritten during archiving.

If a backup of the control data was selected, it is possible to set the parameters to be archived and whether the kinematic data is to be archived in the "Control data" tab (only for MLC). The "Other data" group is only available if at least one kinematics of the version "Robot_Control V2" is configured in the project.

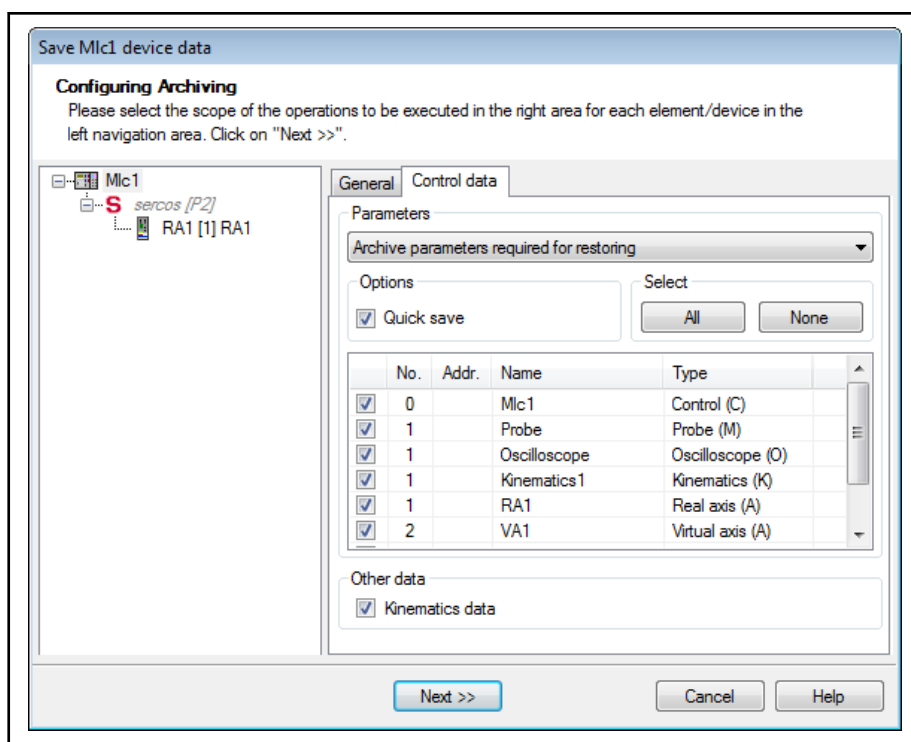


Fig. 4-102: Dialog to select the control data to be archived

Data to be archived is subsequently displayed for confirmation purposes.

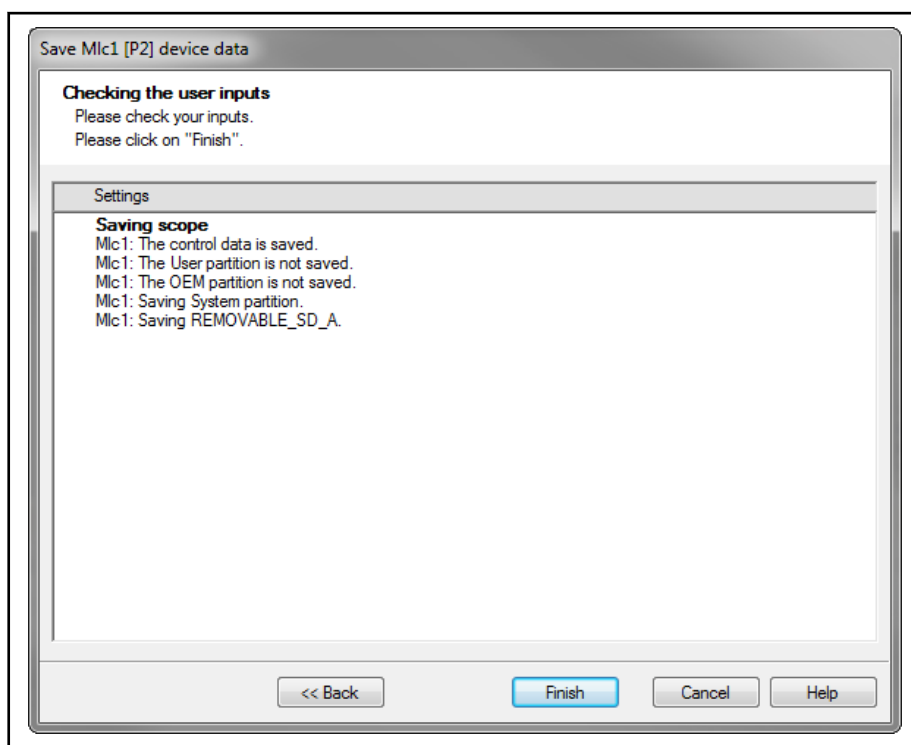


Fig. 4-103: Checking user inputs

Press **Finish** to start the archiving. The total progress is then displayed.

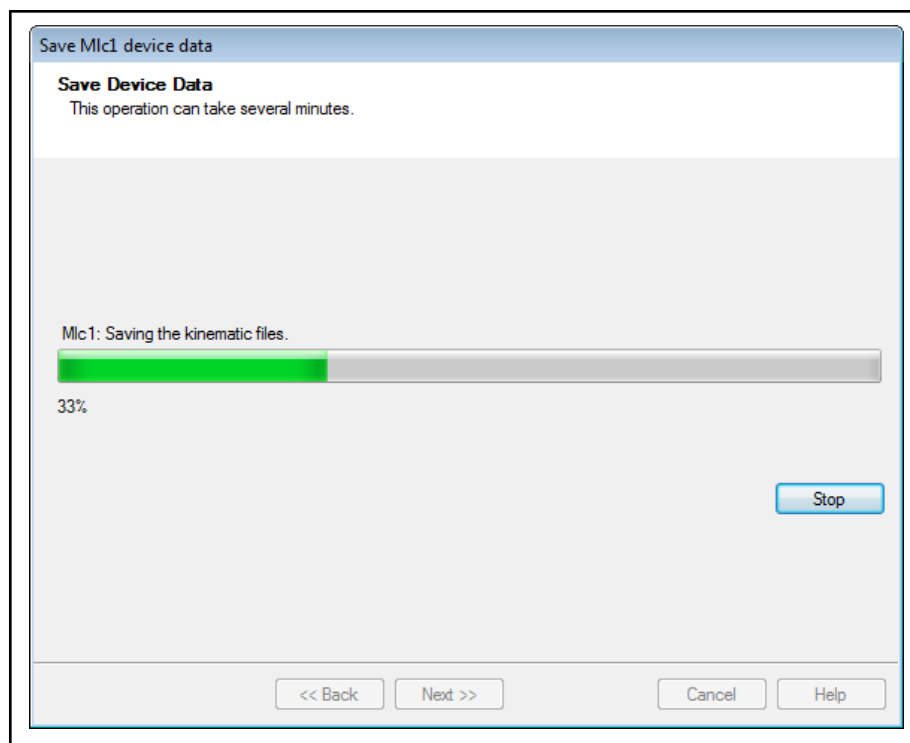


Fig. 4-104: Progress bar of the archiving

At the end, a summary of the archiving results is output.

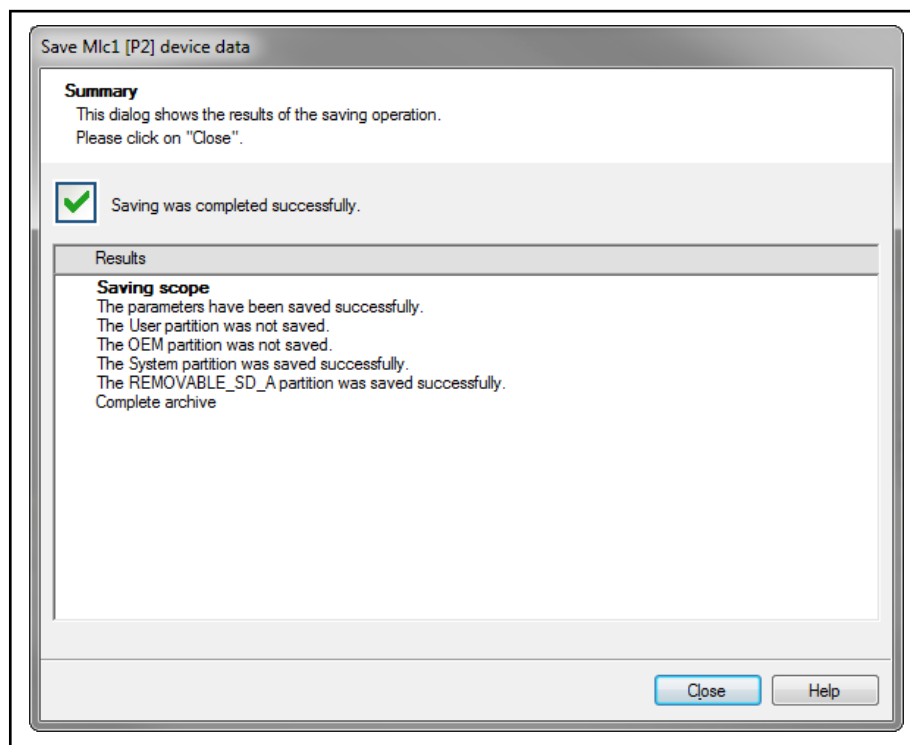


Fig. 4-105: Summary of the archived device data

Complete the archiving dialog with **Close**.

Storage location

The archived data is saved under:

- <Project Directory>\<NameOfControl>\ArchivedData

The individual files are named as follows:

- Parameter: Params.par
- Kinematic data: RoCo_Data.zip (only for MLC)
- User partition data: CF_User.zip
- OEM partition data: CF_OEM.zip
- System partition data: CF_System.zip
- Data of the external memory media: <PARTITIONSNAME>.additional.zip

Restoring

User interface

This menu item restores control data [parameters, kinematic data (only MLC)], the Compact Flash partitions and data of external memories on the control. This function is only available if there is an online connection to the server.

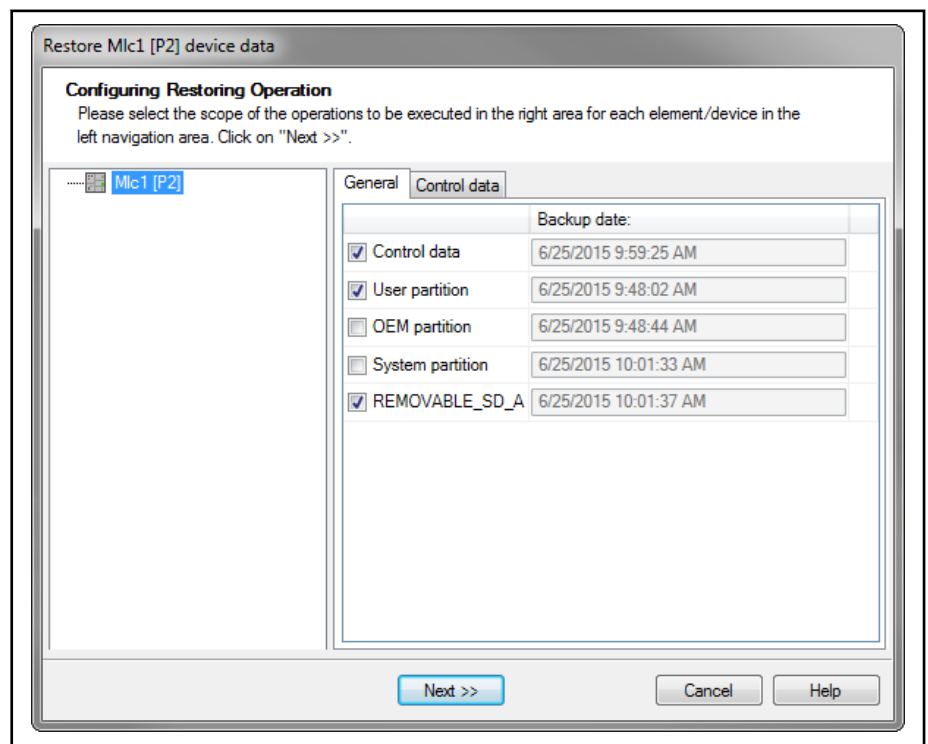


Fig. 4-106: Dialog to restore device data

The data types to be restored can be specified in the "General" tab. If a data type is in the project, the last backup data is displayed and the data type can be selected. Data types, which are not located in the project, cannot be selected.



Restoring the system partition overwrites the current firmware on the control. All data and firmware settings are lost. The process may **not** be canceled. While restoring the OEM (from firmware version 14VRS) or the system partition, the control is restarted once.

If control data restoration was selected, the parameters to be restored and whether the kinematic data (only for MLC) is to be restored can be set on the "Control data" tab. The "Other data" group is only available if at least one kinematics of the version "Robot_Control V2" is configured in the project.

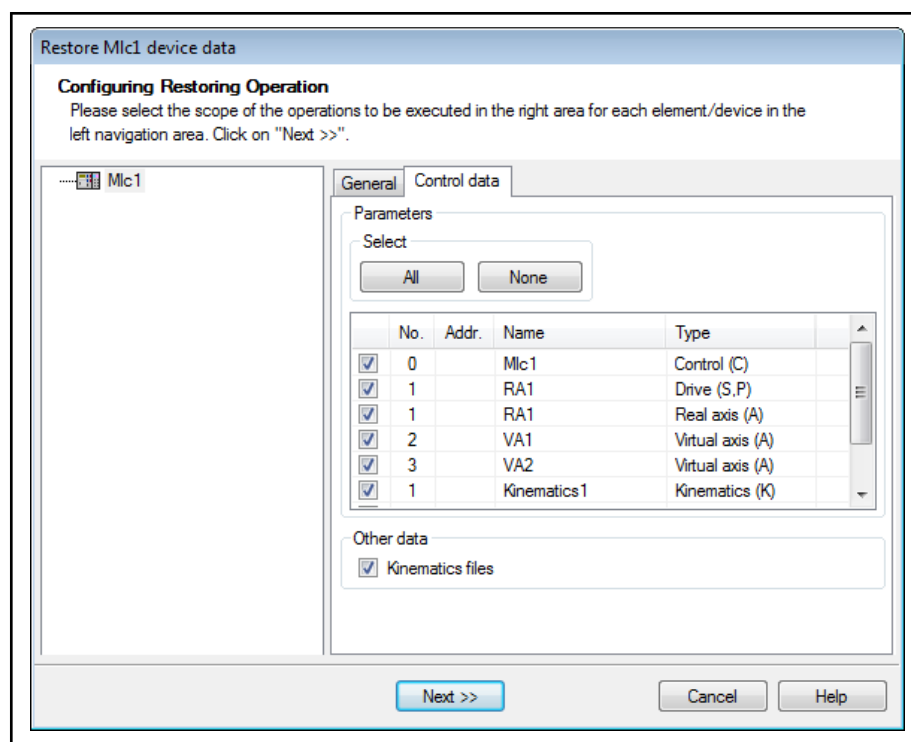


Fig. 4-107: Selecting data to be restored

Finally, the data to be restored is displayed for confirmation purposes.

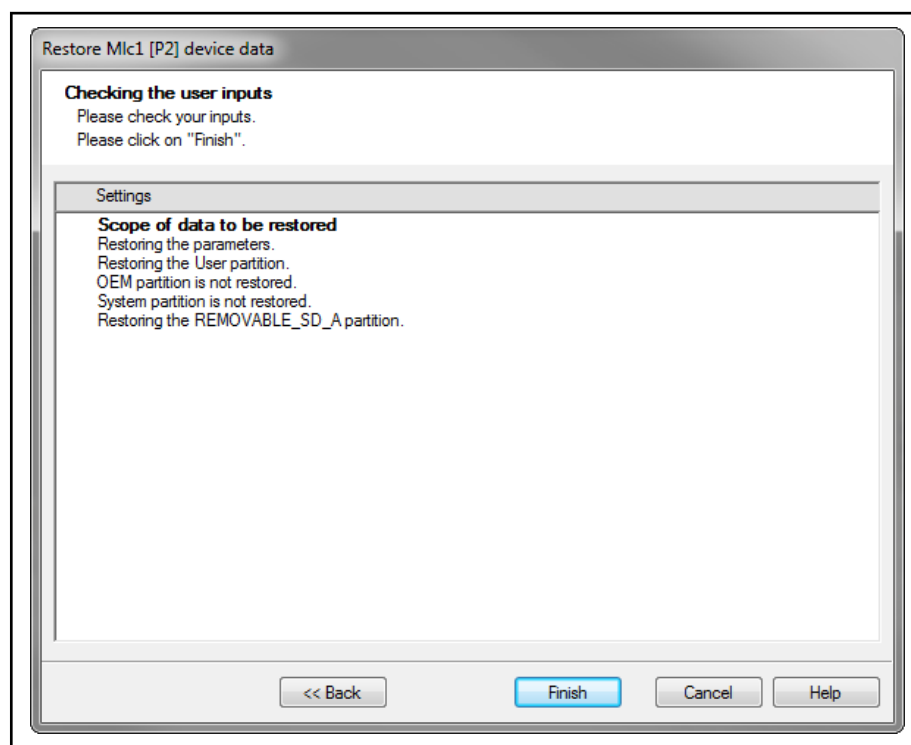


Fig. 4-108: Checking user inputs

Click on **Finish** to start the restoration. The total progress is then displayed.

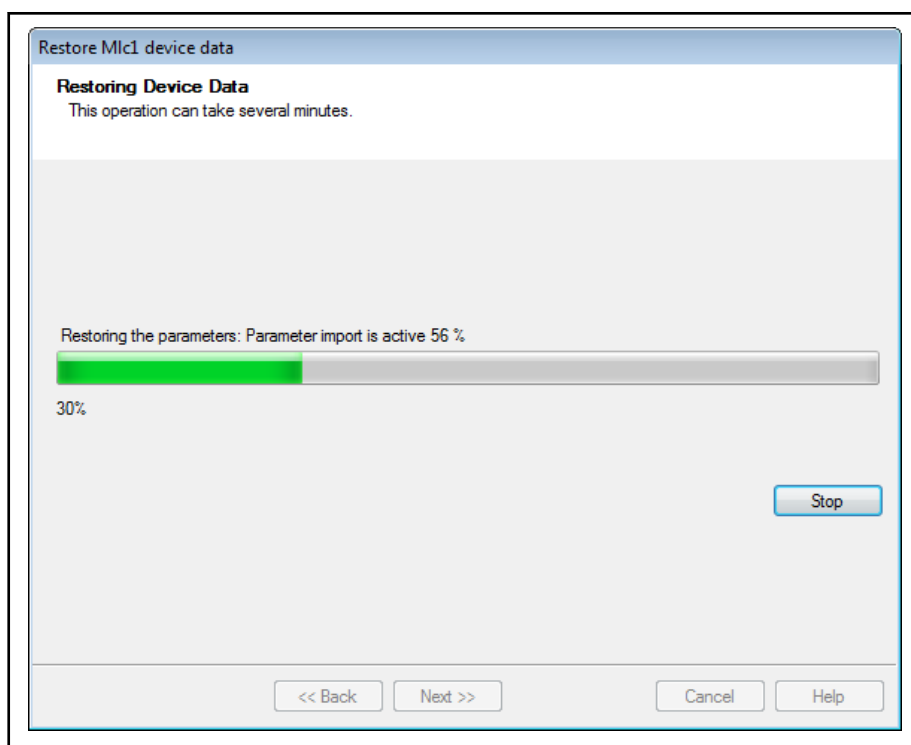


Fig. 4-109: Restoring...

At the end, a summary with the restoration result is output.

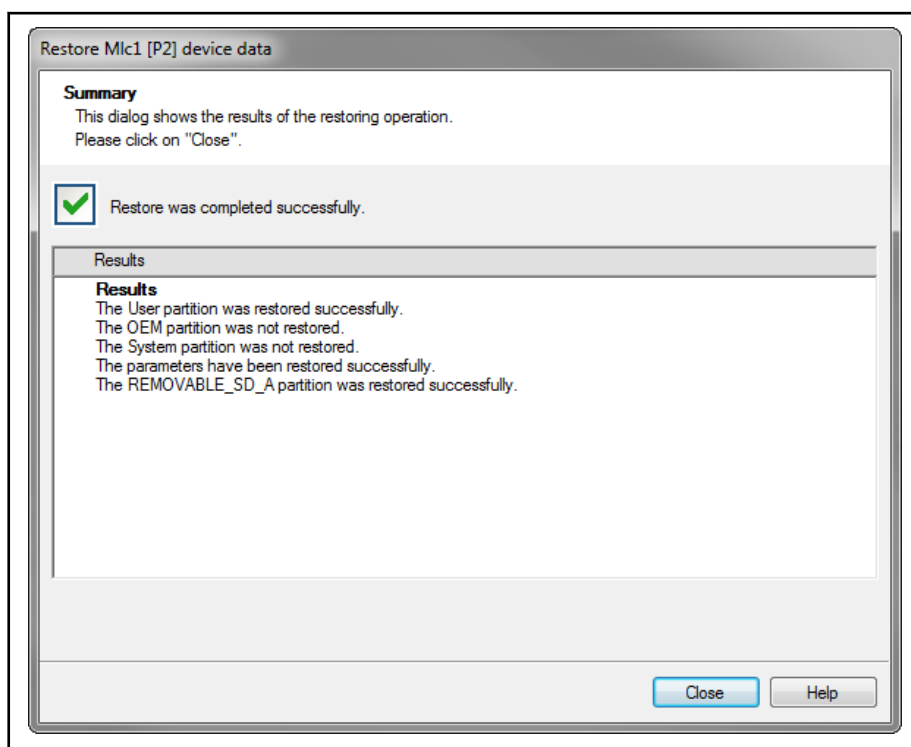


Fig. 4-110: Restoration summary

Explorer

To transfer file and folders between PC and control, use the Explorer. The Explorer allows to access the OEM and USER partition of the control as well

as the external memory media connected to the control (e.g. SD card, USB stick)..

Opening the Explorer

1. Right-click to open the context menu of the control and select **Device data ► Explorer**.

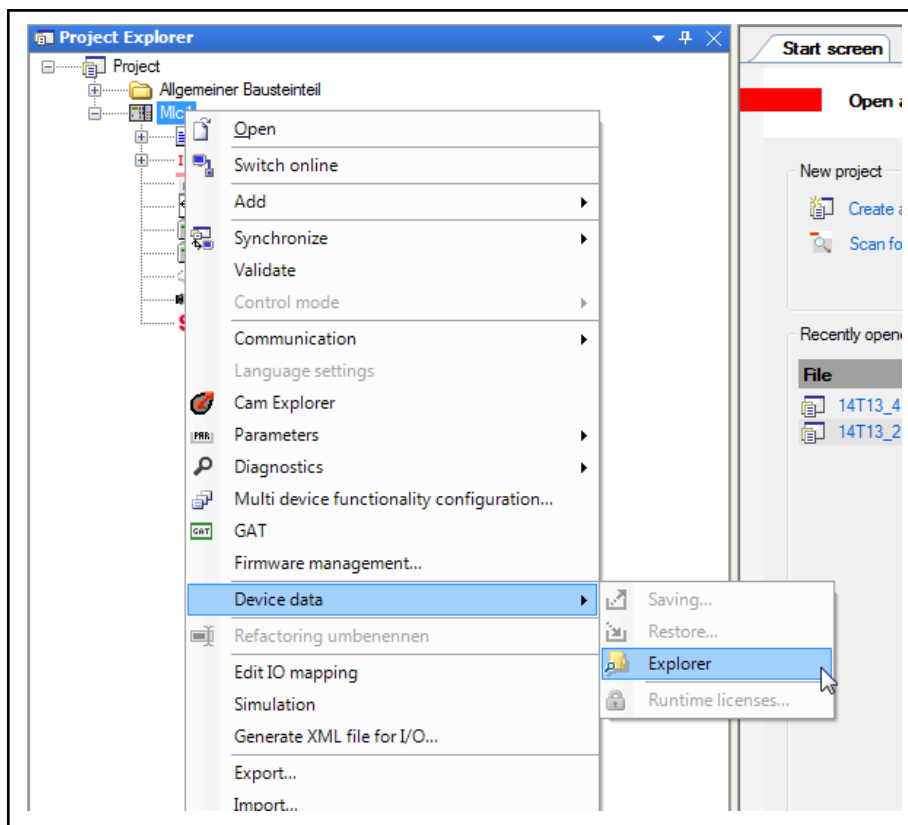


Fig. 4-111: Selecting FTP Explorer

Main window of the Explorer

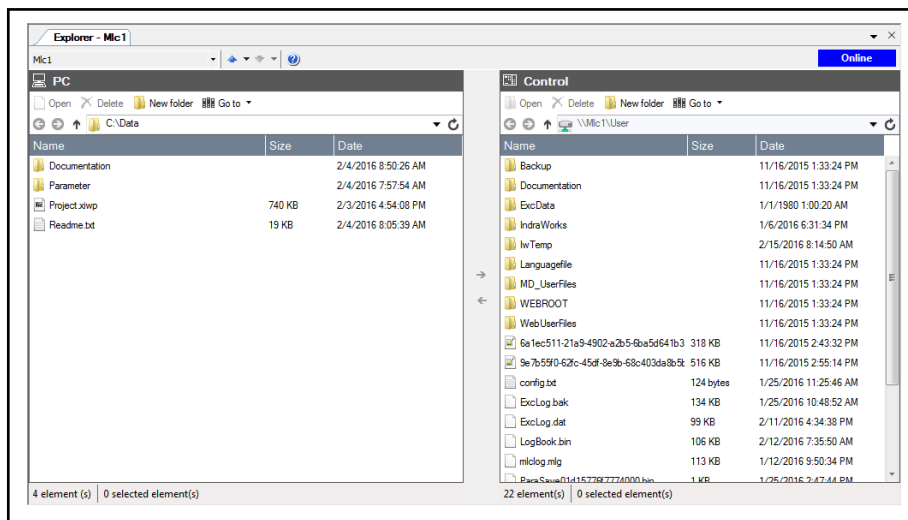


Fig. 4-112: Main window of the Explorer

The files and folders of the PC are displayed in the left section. The files and folders of the control are displayed in the right section.

FTP Explorer functions

There are two options to transfer data and folders between PC and control:

1. Select the files and folders in the left list and click on → to apply the selected data to the control. Select the files and folders in the right list and click on ← to apply the selected data from the control to the PC.
2. Select files and folders and drag them to the other list.

Additional functions

- **Open file or folder:**

Select element and press <Enter>

or

Select the element and click on the icon  **Open** in the toolbar

or

right-click on the file and select the following menu item **Open** from the context menu

- **Delete files and folders:**

Select the files and folders to be deleted and click on

Click on  **Delete** in the toolbar

or

press <DEL>

or

right-click to open the context menu and select the menu item **Delete**

- **Create new folder:**

To create a new folder, click on  **New folder** in the toolbar

- **Go to:**

Click here on important locations on the PC and control to select them

- **Back and forward**

Click on the   icons in the address line

or

Select view and press <BACKSPACE> or <Shift + BACKSPACE>

- **Return to previous level:**

Click on the icon  in the address line

or

Select view and press <Alt + Up>

- **Open directory from history:**

To see the latest open directories, click on  in the address line and then on the respective entry

- **Update view:**

Click on  in the address line

or

select the view (PC or control) and press <F5>

- **Rename file or folder:**

Select file or folder and press <F2>

or

right-click on the file or on the folder and select the context menu item **Rename**

4.4.12 Simulation

The simulation is available as context menu at the "Device" node and is used to switch on and off the PLC simulation mode of the programming system. In the PLC simulation mode, the active application can be loaded, started and tested on a "simulated target device". As a simulated device is always integrated into the programming system, no real target device is required to test the runtime behavior of an application.

When the active application is logged in for the first time, a request is generated whether the application "Sim.<DeviceName>.<ApplicationName>" is to be created and loaded. No communication settings have to be entered for the simulated device. Following a successful login, the further online commands (Start, Stop, Breakpoints etc.) can be used to test the application.

To switch off the simulation mode again, first log off the control and then call the **Simulation** command again. The selection in front of the command disappears. Thus, logging in to the real target device is now possible.

4.4.13 Reset device origin [device name]

Function	The command "Reset device origin [device name]" deletes all applications, boot applications and remanent variables on the device.
Call	Via the context menu of the control in the Project Explorer or via the menu entry of the control.
Requirement	The application is in online mode.



If a safety control is configured under the control, this command can permanently interrupt the communication settings of the safety control to other safety controls (via safety network variables), to field devices and to the development system! The safe field devices or the other safety controls can go to the safe state as reaction. The connection to the development system is only affected if the safety control is connected to the main control via the field bus.

4.4.14 Exporting

This menu item exports elements to an external file. A wizard executes the export.

In the first dialog, the elements to be exported, the path to save the file or an existing file are selected. In addition, the export file can be provided with a description (in the upper section of the dialog).

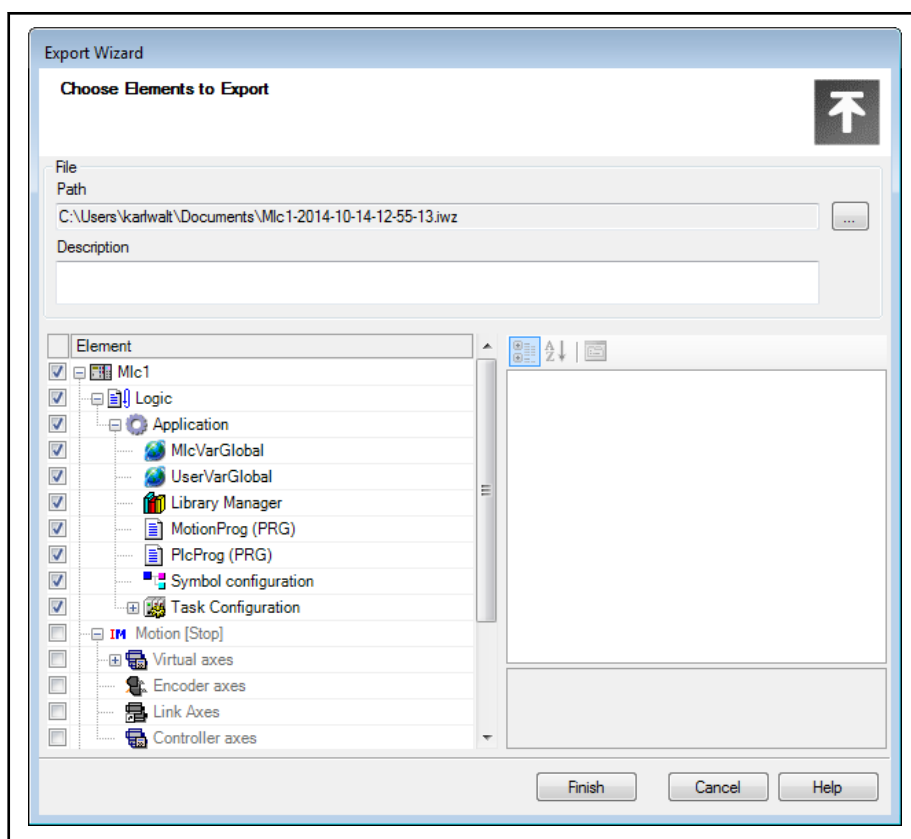


Fig. 4-113: Example: Selecting elements to be exported

In the last dialog, an export summary is displayed. This shows whether the export was successfully completed.

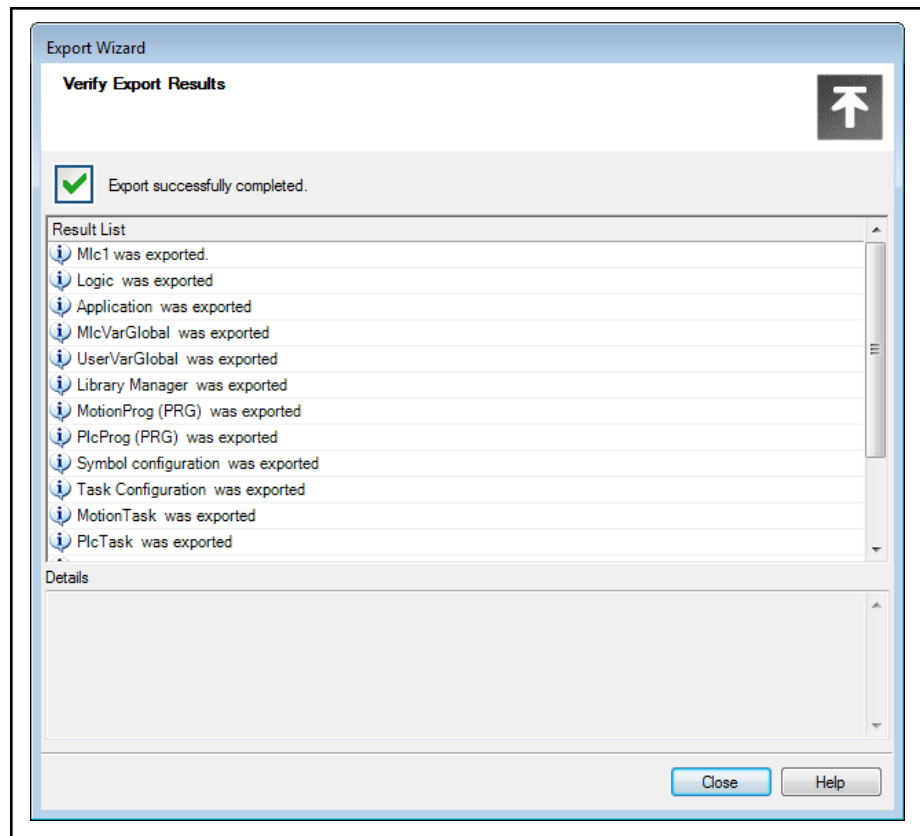


Fig. 4-114: Displaying an export summary

4.4.15 Importing

Use this menu item to import elements from an external export file back to the project. The wizard executes the import.

In the first dialog (Windows default dialog "Open"), an already existing export file (*.iwx, *.iwz) has to be selected for import.

In the second dialog, parts (such as nodes "Logic", "Logic") or the complete device (in the example "Mlc1") can be selected for import under "Element".

Under "Operation", select how the elements highlighted for the import are imported to the project.

There are the following options:

- **Replace**
Overwrites existing elements, adds new elements and deletes elements not existing in the export file
- **Insert**
Only available when importing a complete device. If a device with the same name already exists in the project, the name of the device to be imported is renamed (in the example Mlc1 -> Mlc11) (see [fig. 4-116 "Displaying an import summary" on page 272](#))
- **Overwrite**
Overwrites existing elements and adds new elements from the export file to the project if required

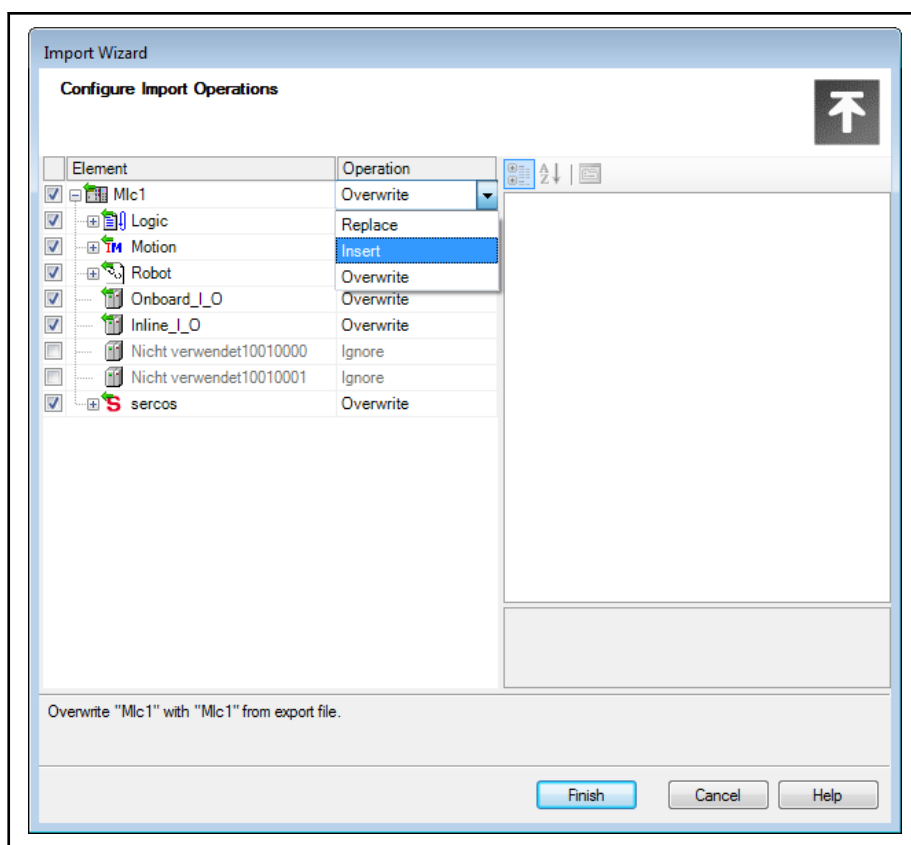


Fig. 4-115: Example: Selecting the area to be imported (in the example the complete device Mlc1)

The last dialog displays an import summary. This shows whether the import was successfully completed.

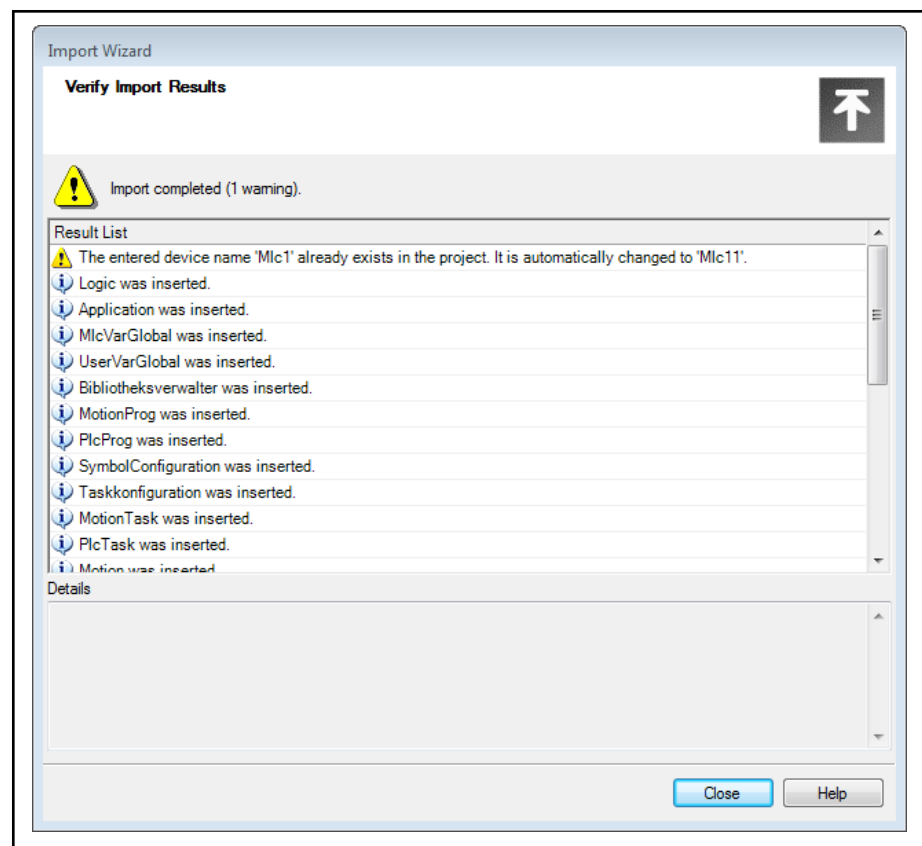


Fig. 4-116: Displaying an import summary

4.4.16 Comparing/merging

General information

The basic functions of the "Compare..." context menu item are identical to all other IndraWorks components (for a description refer to Comparing project data).

The special behavior of IndraLogic objects is described in the IndraLogic manual or help.

Additional deviations in the Motion objects compared to the normal behavior are described in the following.

General rules for Motion objects

Irrespective of the object type, IndraWorks ensures that the following rules are observed when merging objects:

- The value of a merged object has to be different
- Dependent properties are compared and merged
- The merging result may not cause a conflict

Control

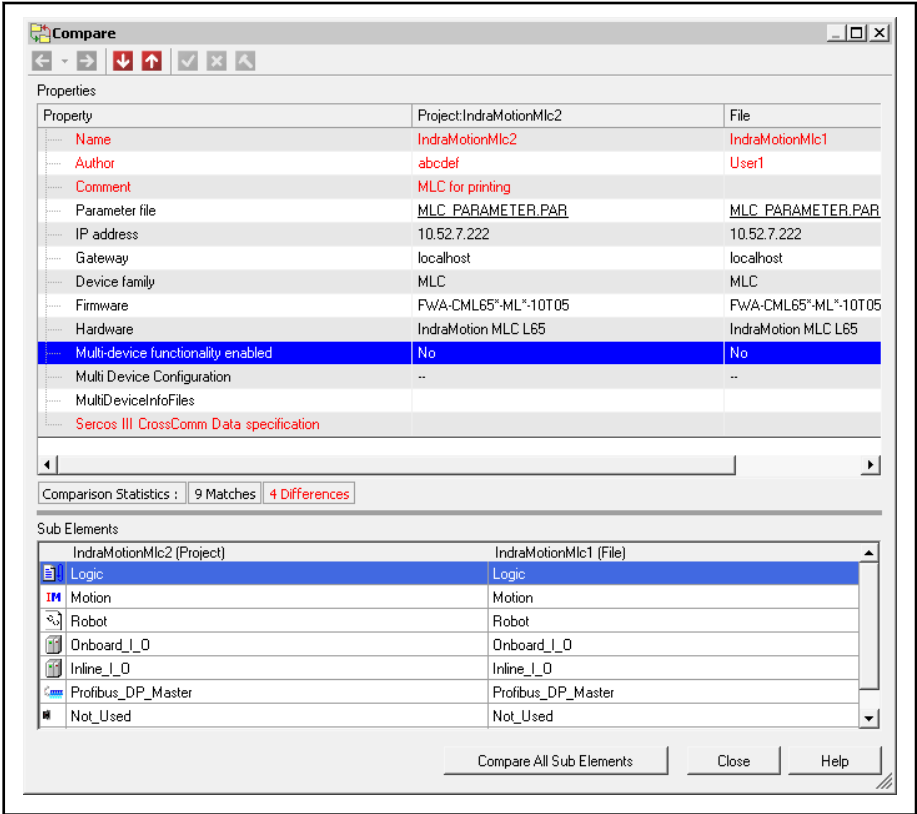


Fig. 4-117: "Compare" dialog

The file names are underlined. Click on the file to display the content. The file is opened in the editor linked to this file type.

Restrictions when merging:

- When comparing different controls (e.g. MLC XM2 and MLC XM4), the firmware cannot be merged.

Axes

General information

An axis can only be compared and merged with an axis of the same type.

Real axis

Compare and merge operations cannot directly be executed for a real axis. This has to be performed with the respective drive node below the Sercos node instead.

Restrictions when merging:

- Neither the Sercos address nor the axis number can be merged

Encoder axis

Restrictions when merging:

- The respective drive and drive address are always merged

Behavior of all other axis types

Restrictions when merging:

- The axis number has to be unique. Each merging operation violating this rule causes an error message when executing the action.

Robot (only for MLC)

Kinematics

Restrictions when merging:

- The kinematic number has to be unique. Each merging operation violating this rule causes an error message when executing the action.

- The kinematic axes used have to be available in the project when the merging operation is executed

RCL program Restrictions when merging:

- The RCL program, its name and .pkt file are always merged

Function modules

General information

A function module can only be compared or merged with a module of the same type.

CrossComm Sercos III (only for MLC) function module

Restrictions when merging:

- The control number, the produced data and the "Device is master" property are always merged

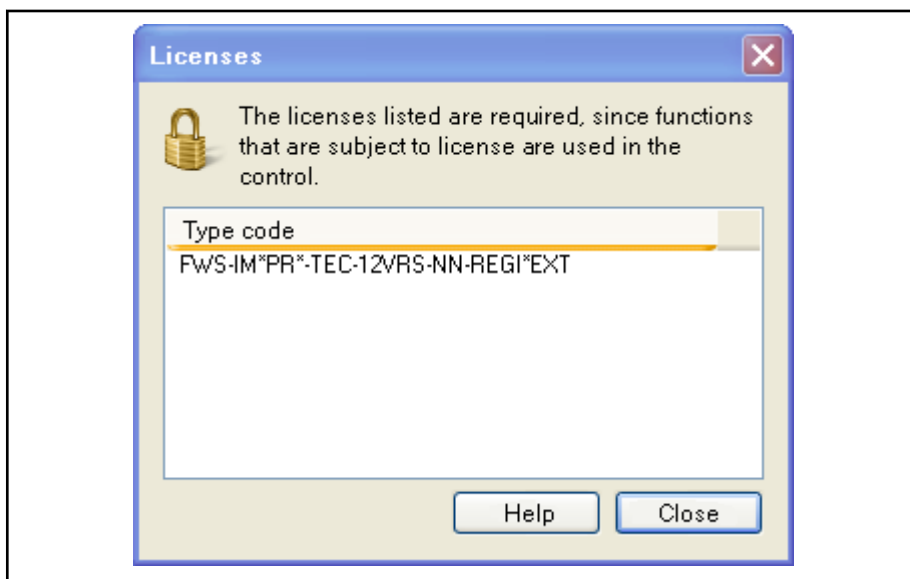
4.4.17 Runtime licenses

The "Runtime Licenses" dialog outputs all licenses used by the PLC program at runtime as well as the function packages selected for the control. Required licenses are only displayed if the function subject to license is actually used or called. The list of the used functions subject to license is deleted when switching off the control.

The dialog has only a display function. Values cannot be changed.

Availability This function is available in online mode.

Structure Open the "Runtime Licenses" dialog via the context menu of the control.



Type code: Type code of used function that is subject to license

Fig. 4-118: "Runtime Licenses..." dialog

4.4.18 Print preview

This menu item can be used for a print preview of the following data categories of a control:

- Projected properties
- Parameters

In the first dialog box, the control as well as the data for the print preview can be selected.

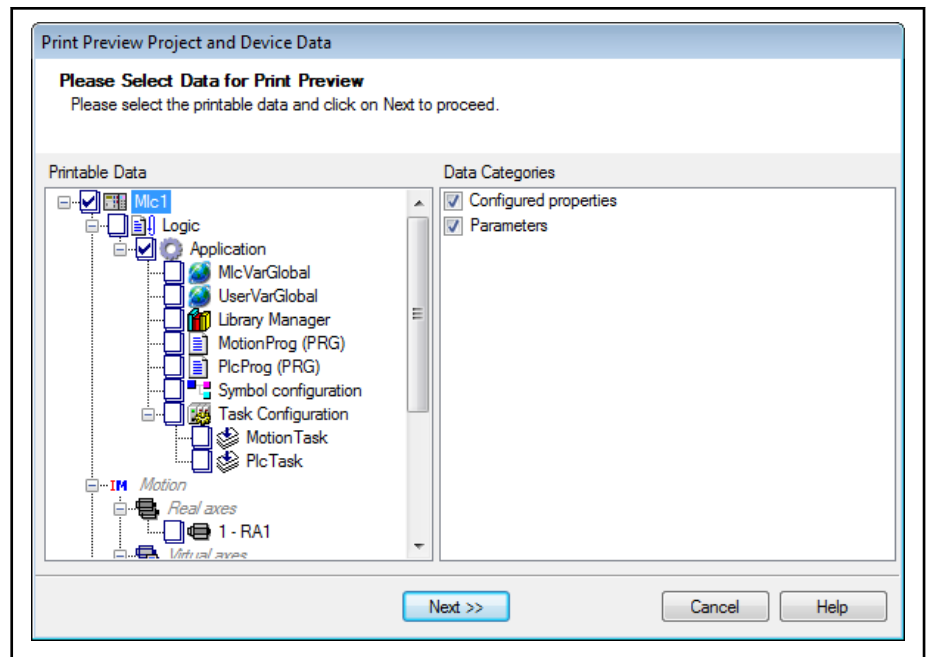


Fig. 4-119: Example: Selecting data for the print preview of an MLC control

Data category **Projected Properties**

Includes project details such as project name, creation date, device names, general data, firmware versions and communication settings.

Data category **Parameters**

Lists all parameters, project name, creation date and device name.

In the following dialog box, check the previously selected settings and set the print settings (printer selection, layout, paper size and page setup) via **Page Setup....** **Finish** starts the print preview.

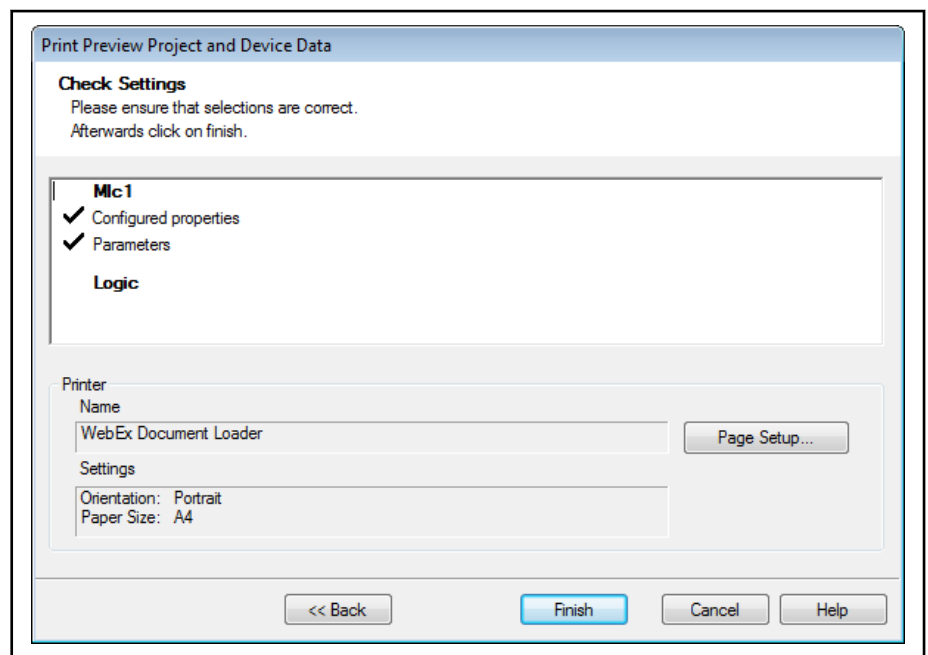


Fig. 4-120: Example: Checking print preview settings for an MLC control

The print preview can be displayed in the parameterization mode as well as in the operating mode. Especially in the second case, the print preview can take several minutes.

4.4.19 Printing

This menu item can be used for an unformatted documentation of the following data categories of a control:

- Projected properties
- Parameters

In the first dialog box, the control as well as the data to be printed can be selected.

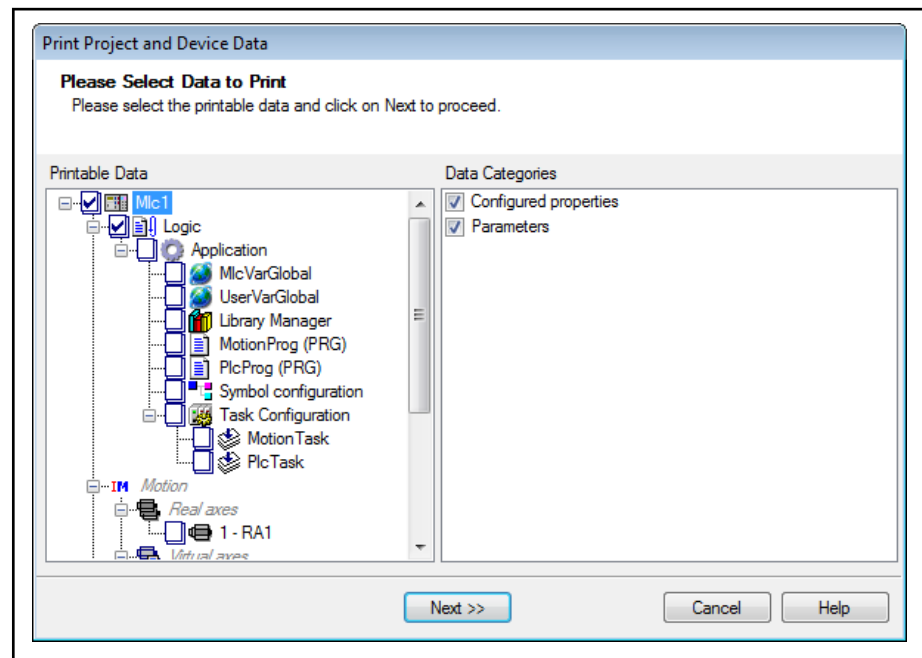


Fig. 4-121: Example: Selecting data to be printed in an MLC control

Data category **Projected Properties**

Includes project details such as project name, creation date, device names, general data, firmware versions and communication settings.

Data category **Parameters**

Lists all parameters, project name, creation date and device name.



Controls store C-parameters, real/virtual/encoder/link axes store A-parameters and IndraDrive/HydraulicDrive drive store S- and P-parameters.

If an axis/a drive is disabled, only the A-parameters duplicated on the control can be printed.

In the following dialog box, check the previously selected settings and set the print settings (printer selection, layout, paper size and page setup) via **Page Setup....** **Finish** starts printing.

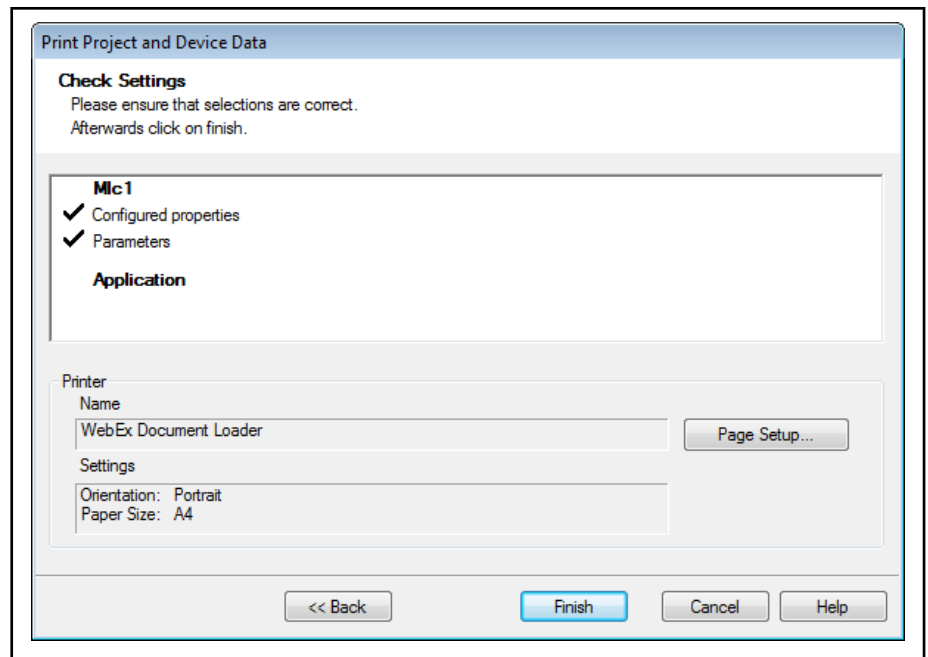


Fig. 4-122: Example: Checking print settings for an MLC control

In can be printed in the parameterization mode as well as in the operating mode. Printing can, particularly in the second case, take one or even several minutes.

4.4.20 Control properties

Open this dialog via the context menu item "Properties ..." of a control.



Properties of a control can only be edited if there is no connection to the control (the control is neither online nor logged in).

The "Properties" dialog has three tabs.

Tab "General information"

The tab provides the following settings:

- **Device name:**
This name has to be unique and IEC-compliant. Otherwise, a warning is displayed.
- **Comment:**
This text is displayed as tooltip on the control if neither a warning nor an error is reported for the control.
- **Creator:**
Information about the author or to implemented changes.

"Hardware/communication" tab

The following settings can be changed in this tab and the communication connection can be checked:

Device configuration:

- **Device type**
System and hardware of the projected control can be changed. The control hardware is written on the type plate of the control.

The following hardware types are available for the IndraMotion MLC:

Type code	IndraControl	Sercos III	Profibus/Profinet/ Ethernet IP onboard
CML45.1-3P	L45	•	•/•/•
CML65.1-3P	L65	•	•/•/•
CML75.1-3P	L75	•	•/•/•
XM2100.01-.../ XM2200.01-...	XM2	•	-/-/-
XM4203.21-...	XM4	•	-/•/•
MLC VP SET	VPx	•	•/○/○

- Default
- Option
- Not available

Tab. 4-7: IndraMotion MLC hardware variants

The following hardware types are available for the IndraLogic XLC:

Type code	IndraControl	Sercos III	Profibus/Profinet/ Ethernet IP onboard
CML45.1-3P	L45	•	•/•/•
CML45.1-NP	L45	-	•/•/•
CML65.1-3P	L65	•	•/•/•
CML65.1-NP	L65	-	•/•/•
CML75.1-3P	L75	•	•/•/•
CML75.1-NP	L75	-	•/•/•

- Default
- Not available

Tab. 4-8: IndraLogic XLC hardware variants



The device types (product family and hardware) differ in their functional scope.

If the newly set device type does not support certain features of the source device type, these special project plannings are deleted during conversion (e.g. Sercos III available/not available). Features only supported in low numbers are maintained but generate a warning before online switching (e.g. different axis numbers).

Before applying the property dialog configuration, it is checked if the device type has changed. In case, an information dialog with a change preview is displayed providing information on the additional or unsupported features of the target device.

The device conversion can still be cancelled. The device type is only changed when the change preview is confirmed with **OK**.

• Firmware version

Generally corresponds to the IndraWorks Suite version.

- **Firmware release**

Indicates the firmware release in the version.

The release can be subsequently updated taking the set project version into account. That means that the version of the compatibility mode has to be increased if necessary.

Ethernet communication

- **Engineering**

For the IndraControl XMx control, the communication can also be established via the micro USB port of the hardware instead of the Standard Ethernet Engineering port.

If the "Micro USB" option is selected, the IP address to set to "192.168.234.234".

- **IP address**

The entered control address has to be valid. Otherwise, there is no communication to the control.

The IP address corresponds to the IP address set in section [chapter 3.3.6 "Setting the IP address" on page 33](#).

- **PLC gateway**

Use "localhost" if the PLC gateway is on the computer IndraWorks is installed on. Otherwise, enter the IP address of the computer and of the gateway.

- **PLC communication**

From version 14VRS, it can be chosen between two PLC communication types.

- **TCP** is recommended due to a better firewall handling and no required broadcast (no broadcast towers). Due to the protocol, it is slower than UDP.
- Due to compatibility reasons, **UDP** is provided for controls of 13VRS.

- **Connection test**

First, the connection test checks whether a control with this IP address (ping) exists and responds with the device name of the control and the current user name (author). Both can differ from the device name and the author listed in the previous figure. In the second step, the PLC communication is checked.

Tab "Extended settings"

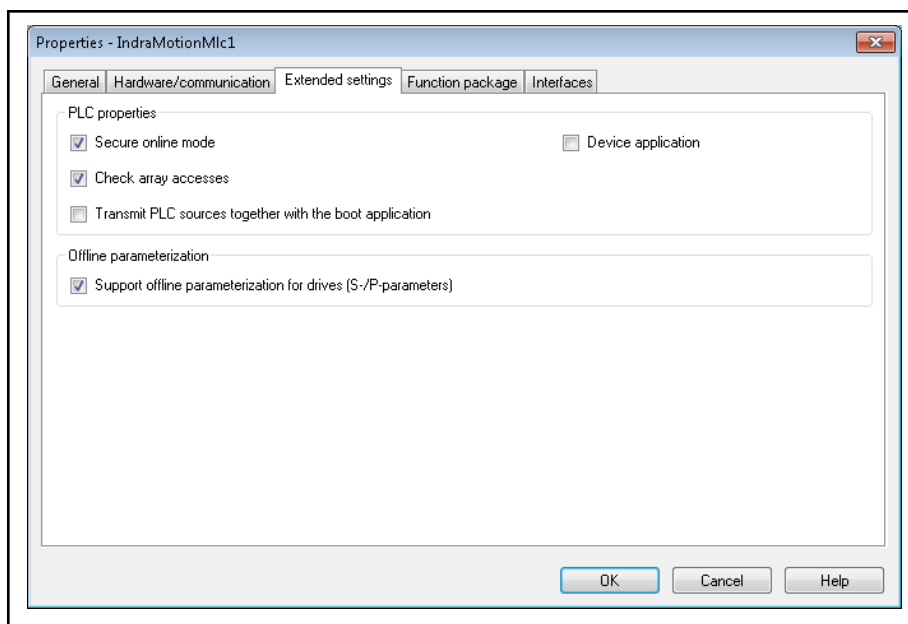


Fig. 4-123: Control properties dialog "Extended settings"

The following settings can be selected in this tab:

Prerequisite: The control is offline

- **PLC properties**

- **Secure online mode**

Enables additional queries for the PLC start and stop as well as for forcing values in the PLC monitoring

- **Checking array access**

If this switch is enabled, the check function "CheckBounds" is automatically inserted below the PLC application node (for details, refer to ["Step 3: Extended settings" on page 117](#)).

- **Transferring PLC sources together with the boot application**

When transferring the boot application, PLC program sources (POUs, tasks, etc.) are transferred to the control in addition to the compilation.

Use this function to additionally display a detailed comparison for the PLC elements during online comparison.

- **Offline parameterization**

The option "Support offline parameterization for drives (S-/P-parameters)" allows to edit drive parameters in offline mode without being connected to a real drive.

Go to the control properties, dialog "Advanced settings" to subsequently enable or disable the offline parameterization in the project.



The offline parameterization can cause a higher project data volume and longer runtimes, e.g. during parameter adjustment or archiving.

For additional information, refer to:

- ["Step 3: Extended settings" on page 117](#)

Tab "Function packages"	The firmware functionality is scaled via function packages. The tab lists the function packages configured in the project.
Tab "Interfaces"	The tab provides an overview on the current configuration of the hardware interfaces of the control as well as the option to change the interface configuration. Optionally, the interfaces can be edited directly at the interface nodes in the Project Explorer.
 Before applying configuration changes, it is checked if the interface configuration has changed. If an existing element is deleted by the change, an information dialog with a change preview is displayed. The conversion can still be cancelled. The changed configuration is only applied when the change preview is confirmed with OK.	

4.5 Access protection to devices

4.5.1 General information

Overview The access protections ensures that the protected device functionality can only be used by authorized persons within their authorization profile.

The IT security for embedded systems basically consists of data protection guarantee and information security.

The following figure shows the key elements of a secure industrial automation component.

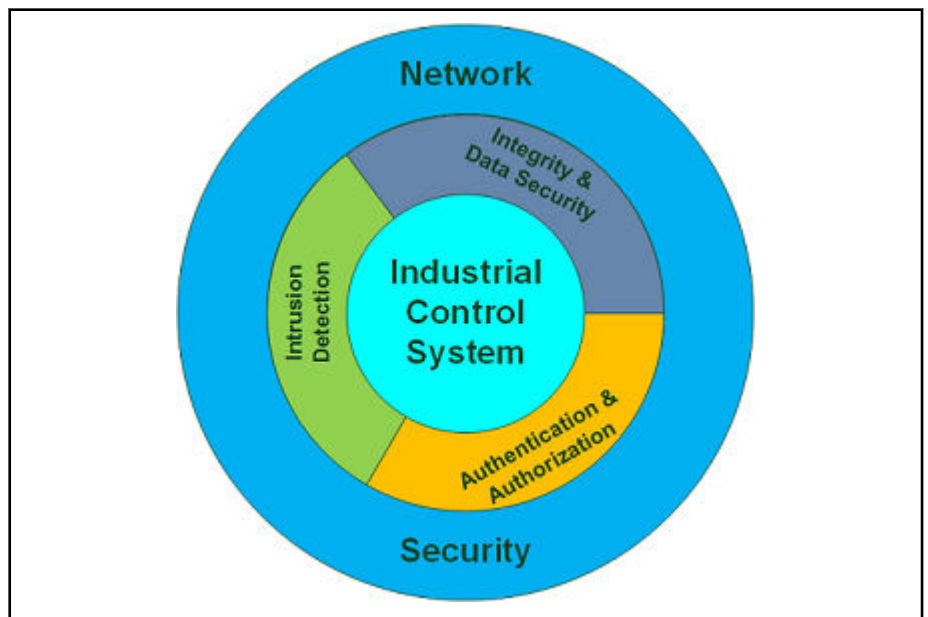


Fig. 4-124: Network security elements

The following device types are equipped with access protection:

- XM2*
- XM4*
- VPx
- CML75

Functional principle The access protection is based on the device

- All access data (users, groups, rights etc.) is saved on the device.
- Authentication/authorization as well as access restrictions are integrated in the device firmware and are executed directly on the device.

The access protection is configured using IndraWorks

- IndraWorks is connected to the device.
- Access protection data are read out of the device or written to the device
- At no time, there are more access protection data in the PC memory than required for the current configuration.
- There were no "traces" on the hard drive of the PC.

4.5.2 Users, groups and rights

Users Users are persons that can use a certain protected functions after logging in to the device.

On devices with access protections, a list of users who can log in to the device with user name and password is available.

Group A group represents a selection of users having the same rights (e.g. Engineering functions) regarding a protected functional scope.

The authorization profile of a user results from the sum of rights of all groups in which the user is a member in.

Authorization A right allows the use of a certain protected function of the device. Rights are directly assigned to groups, whereas users are indirectly assigned rights by membership in groups.

4.5.3 Delivery state/default user

Default user on device:

User name	boschrexroth
Password	boschrexroth

Tab. 4-9: Access protection to devices - Default user

The default user has the full scope of user rights.

Use the default user for initial commissioning of the device and to configure the access protection for more users and groups.



After the device has been commissioned, delete the default user due to safety reasons or rename the user and change the password.

4.5.4 Login user to the device

Login user To login to a device in IndraWorks, enter your user name and password into the login dialog.

Open the context menu of the device in the Project Explorer and select **Access protection ► Login user**.

In case of initial commissioning or if the access protection has not yet been configured on the control, use the default login data:

User name	boschrexroth
Password	boschrexroth

Tab. 4-10: Default user - Login data

Otherwise, enter the login data defined while configuring the access protection on the control.

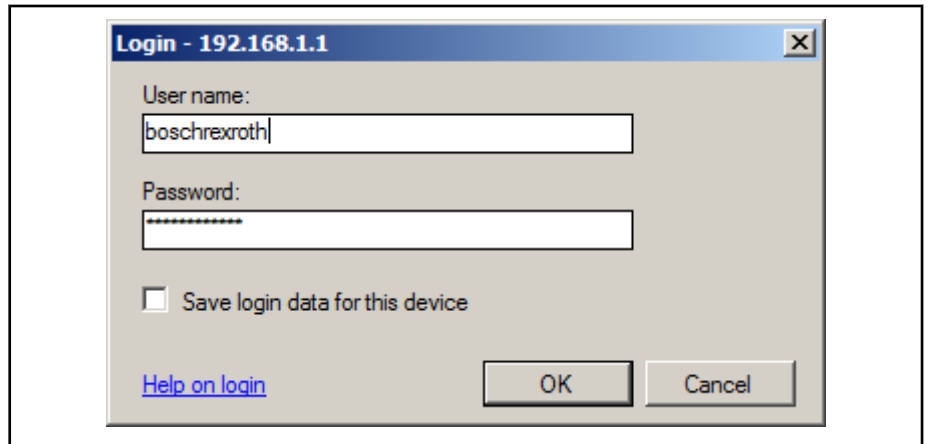


Fig. 4-125: Access protection - Login dialog

Option 'Save login data for this device'

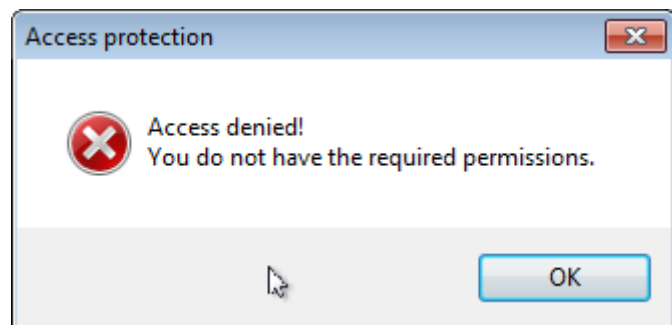
To automatically use the entered login data when establishing the connection to the control again, select "Save login data for this device".

Thus, the entered login data for the device is stored in the Windows Credential Manager. Consequently, the login data does not have to be entered again in the login dialog.

To reset stored login data, proceed as described in [chapter 4.5.6 "Access protection in practice" on page 304](#).



If the option "Save login data for this device" has been selected but the login data of a user not authorized for this action has been entered, the following message is displayed:



In this case, the login data of the Windows Credential Manager can be overwritten by logging in again with the option "Save login data for this device".

It is not required to manually remove the login data from the Windows Credential Manager.

User - Changing password

Open **Access protection** in the context menu of the control and the "Change password" command in the submenu of the Project Explorer.

The dialog "Change password" opens.

To change the password, enter the old password and the new password including the confirmation.

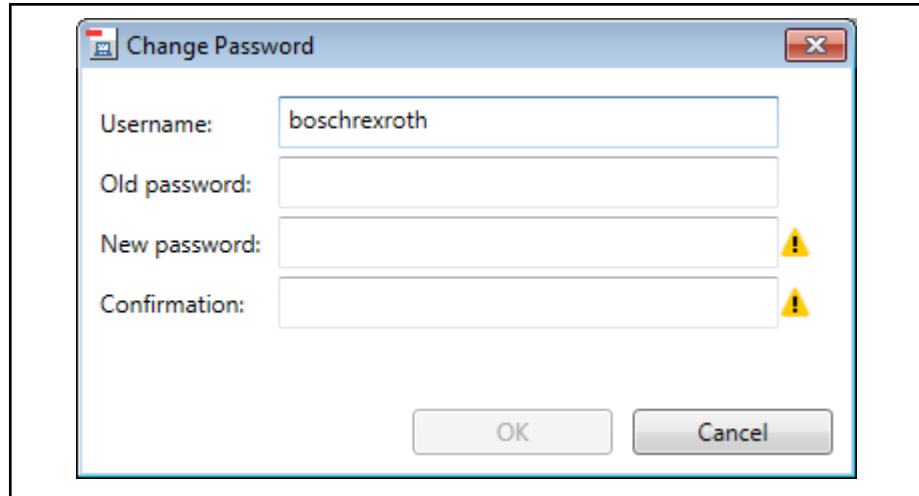


Fig. 4-126: Dialog Change password

4.5.5 Configuring the access protection

General information The compliance with name and password conventions is monitored in the input fields of the configuration dialog. The maximum possible device-dependent number of characters is monitored for the description field. In case of violation of valid conventions or exceedance of the maximum possible characters, a warning icon is displayed with a tooltip to the right of the input field.



Users working with IndraWorks Engineering, have to be assigned the role "engineer".

The "engineer" group has all rights to access the control via IndraWorks and to administer the control.

The "engineer" group can neither be changed nor deleted. To ensure that the access protection can be configured in IndraWorks, at least one user has to be assigned to the "engineer" group to be able to login.



Thus, to ensure that the access protection can be configured in IndraWorks, the "engineer" group has to be assigned to at least one user who is able to log in.

Configuration dialog

Call In the Project Explorer via the context menu of the control, call the menu item **Access protection ► Configure access protection....**

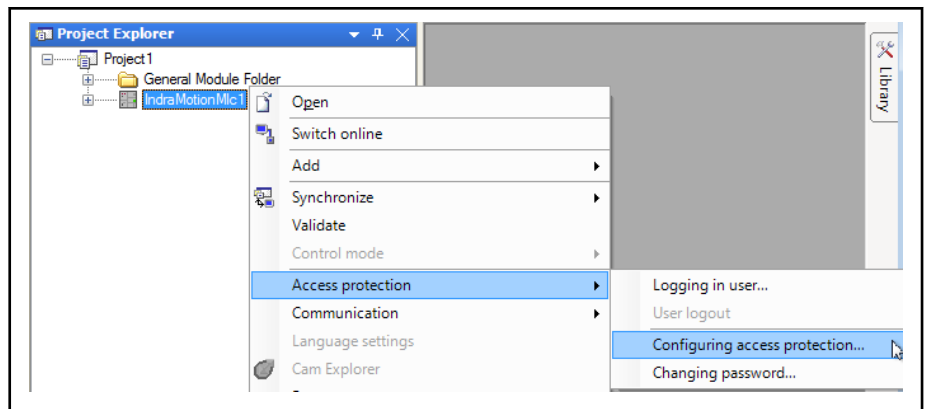


Fig. 4-127: Access protection to devices - Dialog call

- Requirement**
- The control has to be connected to IndraWorks
 - A user of the "engineer" group has to be logged in at the access protection of the control



Users working with IndraWorks Engineering, have to be assigned the role "engineer".

The "engineer" group has all rights to access the control via IndraWorks and to administer the control.

The "engineer" group can neither be changed nor deleted. To ensure that the access protection can be configured in IndraWorks, at least one user has to be assigned to the "engineer" group to be able to login.

Login If you are not logged in to the device, the login dialog is displayed. Enter your user name and password of a user authorized to configure the access protection in the login dialog.

Default user:

User name	boschrexroth
Password	boschrexroth

Tab. 4-11: Default user - Login data

Confirm the login dialog with "OK".

The dialog "Access protection configuration" is opened.

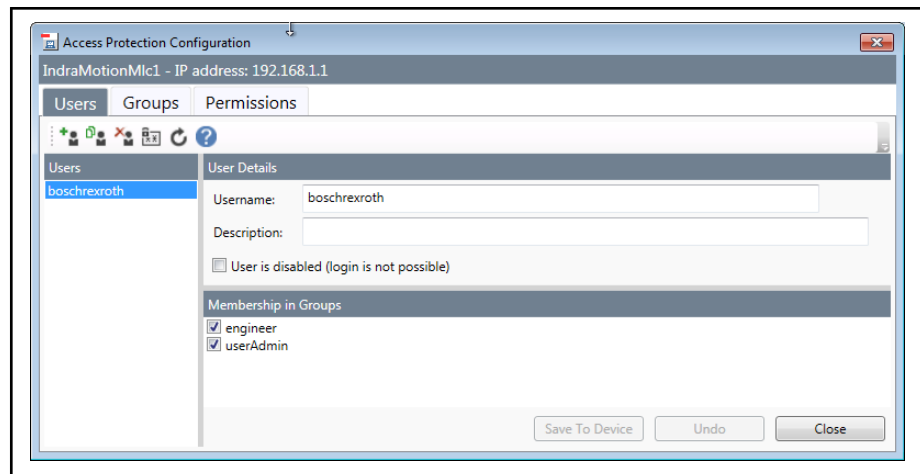


Fig. 4-128: Dialog "Access protection configuration"

Configuration dialog - Elements

In the configuration dialog header, the name and the IP address of the device whose access protection configuration is currently being edited.

The configuration dialog consists of three tabs: **User**, **Groups** and **Rights**.

Tab	Function
Users	- Create, edit and delete users - Define group membership Refer to chapter "'User' tab" on page 287
Groups	- Create, edit and delete groups or members - Define group rights Refer to chapter "'Groups' tab" on page 292
Rights	Show or define which groups are assigned certain rights Refer to chapter "'Rights' tab" on page 297

The toolbar is contained in the tab header. The commands can be selected via icons in the toolbar.

The lower part of the configuration dialog contains the interfaces **Save in device**, **Undo** and **Close**.

Button	Function
Save in device	Writes changes to device
Undo	Undoes changes without writing the changes to the device
Close	Closes the dialog without writing changes to the device (with safety prompt)



The configuration dialog only reads the scope of data of the control currently required for the current operation.

If data was changed (e.g. user or group properties, group affiliation, user rights etc.), the changes have to be written to the device first or they have to be discarded with "Undo" before other data can be viewed or edited.

Thus, inconsistencies in data storage are avoided.

Once changes are applied, it is displayed in the lower window bar with an icon and the text "Modified data...".

'User' tab

Call

In the Project Explorer via the context menu of the control, call the menu item **Access protection ► Configure access protection....** The dialog "Access protection configuration" is opened. Select the main menu tab "User".

If no user has been logged in to the access protection of the control, a login dialog is displayed. See [chapter 4.5.4 "Login user to the device" on page 282](#).

Prerequisites

- The control has to be connected to IndraWorks
- A user of the "engineer" group has to be logged in at the access protection of the control



Users working with IndraWorks Engineering, have to be assigned the role "engineer".

The "engineer" group has all rights to access the control via IndraWorks and to administer the control.

The "engineer" group can neither be changed nor deleted. To ensure that the access protection can be configured in IndraWorks, at least one user has to be assigned to the "engineer" group to be able to login.

Function

The tab facilitates the administration of user accounts. Users can be created, deleted or assigned to groups. Thus, the user is assigned the rights of the relevant group.

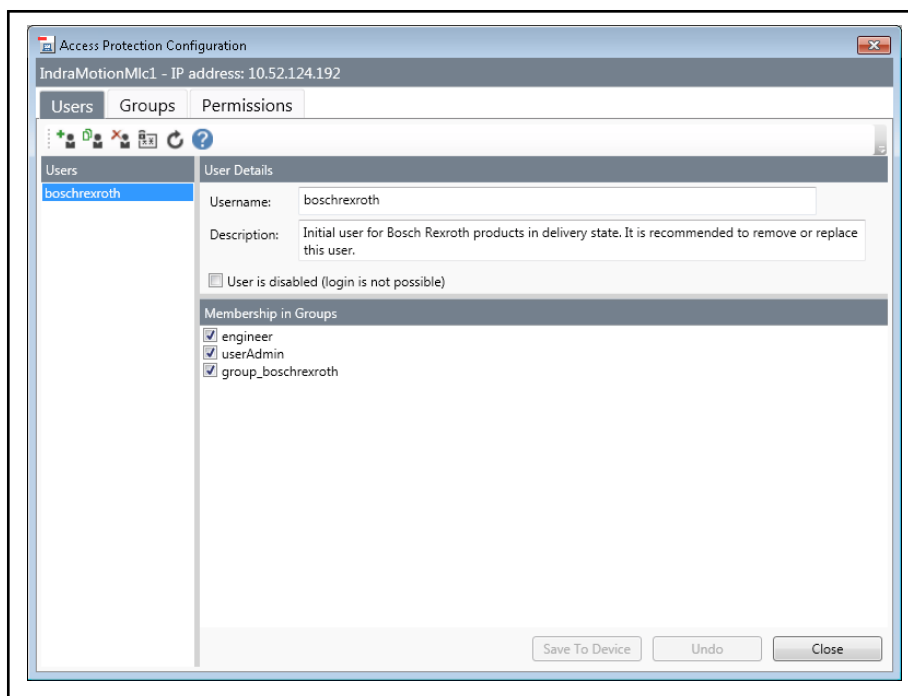


Fig. 4-129: Dialog "Access protection configuration" tab "user" (default)



User name and description "boschrexroth" is specified by the control firmware by default.

Elements of the "User" tab

"User" tab	Overview of the available users (on the control). Select the user for editing.
"User details" field (Properties of the selected user, can be edited)	User name of the selected user Requirements for name allocation: - The user name has to be unique - Comply with the user name conventions. "User name conventions" on page 292
	Description of the selected user.
	User is disabled: A user can be disabled using the lock status. For example, a user can temporarily be locked without having to delete him. ☐ : Lock status disabled. The user can only login to the access protection of the control. ☒ : Lock status enabled. The user cannot login to the access protection of the control.
"Group membership" field	Dialog to specify the membership of a user in groups. Refer to "Assign group membership" on page 291
Toolbar	
	Create new user, see "Create new user" on page 289

	Copy user, see "Copy user" on page 289
	Delete user, see "Delete user" on page 290
	Reset password "Reset password" on page 291
	Reload group, see "Reload data" on page 291

Create new user

A new user can be created as follows:

1. Select the command "Create new user" in the "User" tab by clicking on the toolbar button  or by right-clicking on the user in the user overview and by selecting the command "Create new user".
2. In the user details field, enter the details for user name, description and password.
Please comply with the password conventions, see ["Password conventions" on page 292](#).
3. Transfer the new user to the control by clicking on "Save in device".

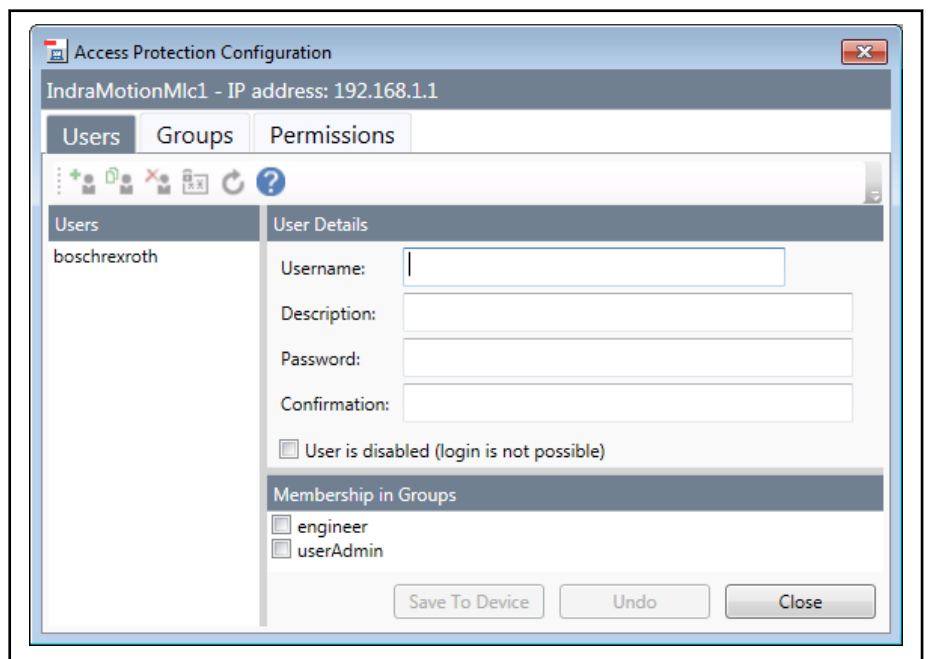


Fig. 4-130: Dialog "Access protection configuration" - "Create new user"



From version release 14V20, new users are automatically assigned to the "engineer" group.

The "engineer" group has individual rights in IndraWorks, see [chapter "Individual rights - Overview" on page 299](#).

From 14V22, new users are initially not assigned to any group.

Copy user

An existing user can be copied as follows:

1. Select the user to be copied in the "User" tab.

2. Select the command "Copy user" by clicking on the toolbar button  or by right-clicking on the user in the user overview and by selecting the command "Copy user".

A copy of the user is generated.

The copy contains all assignments and rights group of the copied user. The name is applied from the original and supplemented by an extension (continuous number in brackets).



It is recommended to assign a unique user name and to adjust the description. Changes can be discarded using the "Undo" button.

If no changes have been implemented, exit the dialog by selecting a different user or by selecting a different tab without generating a copy.

3. Before the copied user can be applied to the control, enter a password under "User details" and confirm it by re-entering it.

Please comply with the password conventions, see ["Password conventions" on page 292](#).

4. Transfer the new user to the control by clicking on "Save in device".

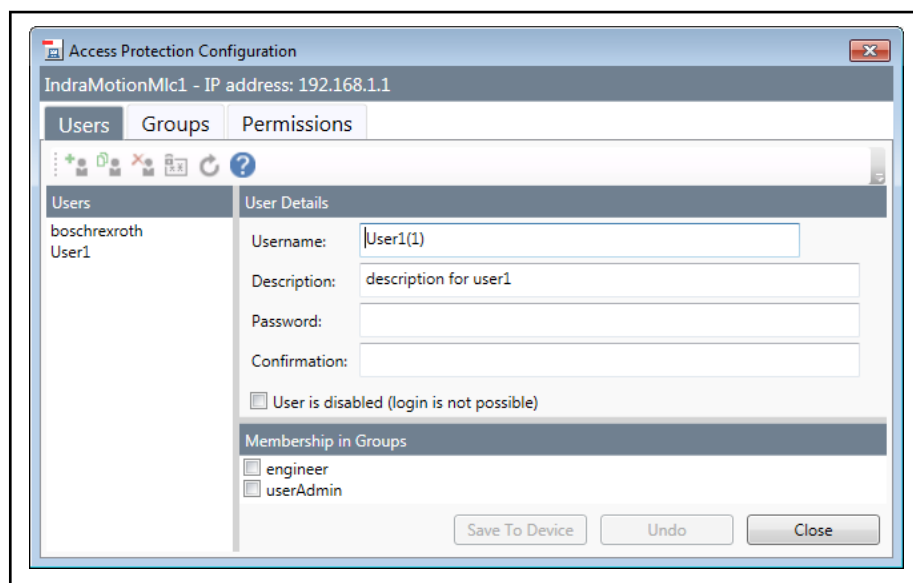


Fig. 4-131: Dialog "Access protection configuration" - "Copy user"

Delete user

An existing user can be deleted as follows:

1. Select the user to be deleted in the "User" tab.
2. Select the command "Delete user" by clicking on the toolbar button  or by right-clicking on the user in the user overview and by selecting the command "Delete user".
A safety prompt is displayed.
3. Once the safety prompt to delete is confirmed, the user is deleted on the control. The user is deleted from the user overview.



The user currently logged in to the device cannot be deleted.

Reset password

The user password is reset as follows:

For requirements, see ["Prerequisites and notes on resetting passwords" on page 291](#)

1. Select the user whose password is to be reset in the "User" tab.
2. Select the command "Reset password" by clicking on the toolbar button  or by right-clicking on the user in the user overview and by selecting the command "Reset password".

The "Reset password" dialog is opened.

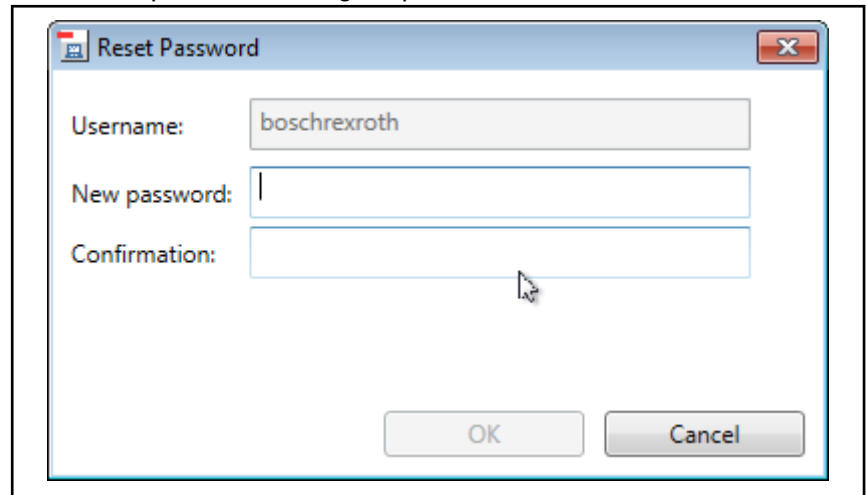


Fig. 4-132: Dialog "Access protection configuration" - "Reset password"

3. Enter a new password and confirm it by entering the password again and by clicking on "OK".

The password was changed.



If the password of the currently logged in user has been changed, this user has to log in again.

The password assigned during the reset has to be changed by the user immediately.

Prerequisites and notes on resetting passwords

To be able to reset passwords for access protection, the user has to log in to the access protection of the control. Select a user account with individual rights of the "engineer" group.

If it cannot be logged in to the access protection anymore, for example because the password for the "engineer" user has been forgotten, the access protection of the control can only be reset to default using the factory reset of the control (XM2*) or XMM clean (CML).

After a factory reset or XMM clean of the control, all users and passwords have to be assigned again!



In case of a factory reset or an XMM clean on the control, the PLC project and the Motion configuration are also deleted from the control!

Reload data

Use the toolbar button  to read out the access protection data from the control and to refresh the dialog.

Assign group membership

The membership of users in groups can be assigned as follows:

1. In the "User" tab, select the user whose membership is to be assigned.
2. Select the groups ☒ the user is to be assigned to in the "Membership in groups" field.



Users can be members in several groups, see [chapter "Groups' tab" on page 292](#)

3. Transfer the new group assignment to the control by clicking on "Save in device".

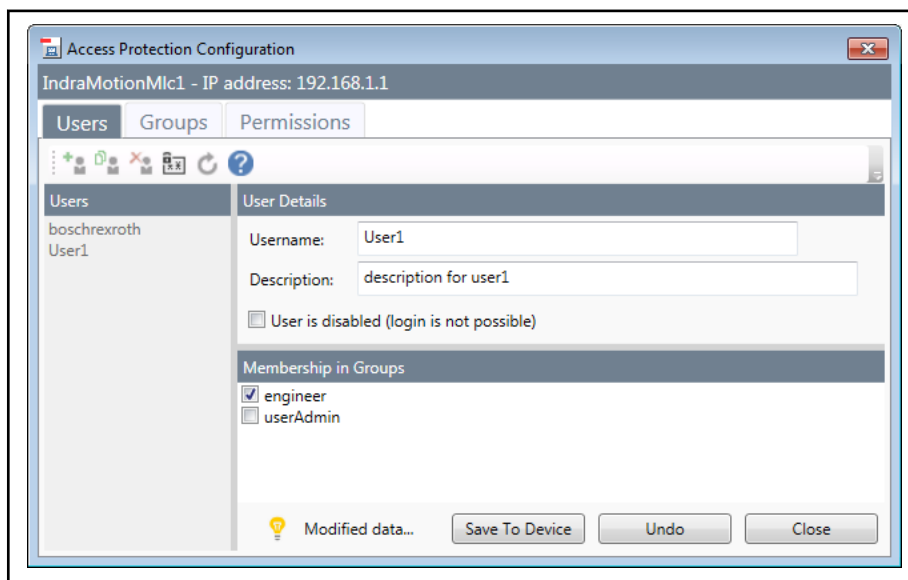


Fig. 4-133: Dialog "Access protection configuration" - "Membership in groups"

User name conventions

The following conventions apply for user name assignment:

1. The user name must not contain any spaces.
2. The following characters are not allowed in the file name: ", " "; " " % "

Password conventions

The following conventions apply for password assignment:

1. The length of the password has to be at least of eight characters. Space characters are not permitted
2. Special characters and digits are allowed for the password and should also be used to create a strong password.

'Groups' tab

Call In the Project Explorer via the context menu of the control, call the menu item **Access protection ► Configure access protection....** The dialog "Access protection configuration" is opened. Select the main menu tab "Groups".

If no user has been logged in to the access protection of the control, a login dialog is displayed. See [chapter 4.5.4 "Login user to the device" on page 282](#).

Prerequisites

- The control has to be connected to IndraWorks
- A user of the "engineer" group has to be logged in at the access protection of the control



Users working with IndraWorks Engineering, have to be assigned the role "engineer".

The "engineer" group has all rights to access the control via IndraWorks and to administer the control.

The "engineer" group can neither be changed nor deleted. To ensure that the access protection can be configured in IndraWorks, at least one user has to be assigned to the "engineer" group to be able to login.

Function The "Groups" tab provides an overview over the user groups established in the access protection of the control. Individual rights of a group can be defined.

User rights to user accounts on the control are assigned via the group affiliation. This is the case if the user is assigned to one or several groups. Thus, the user is assigned the rights of the relevant group.

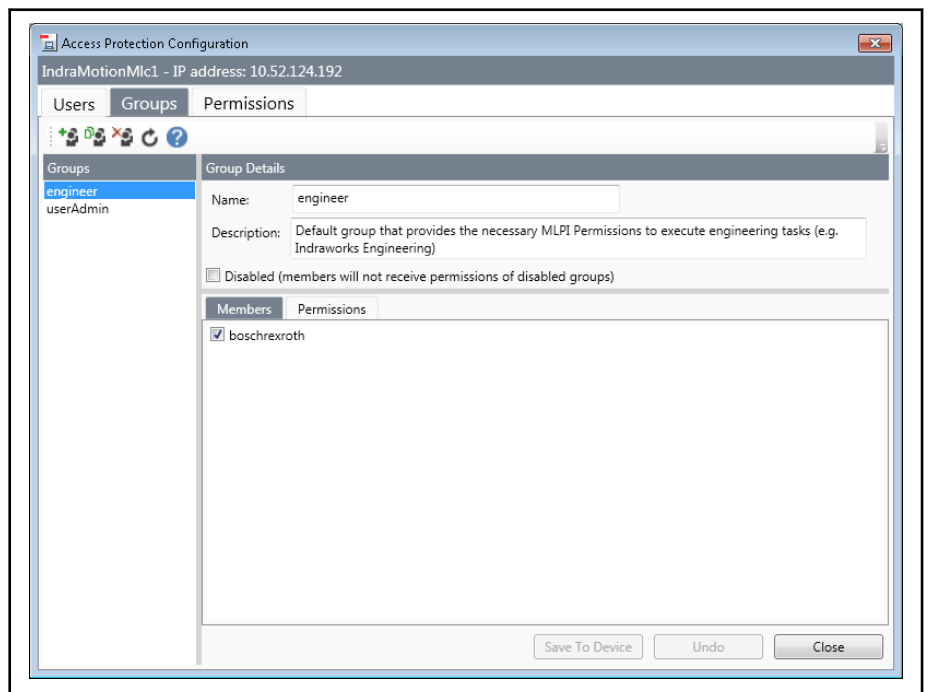


Fig. 4-134: Dialog "Access protection configuration" - "Groups" tab (default)



Group name and description "engineer" and "userAdmin" is specified by the control firmware by default.

Elements of the "Groups" tab

"Groups" field	Overview of the available groups (on the control). Select the group for editing.
"Group details" field (Properties of the selected group, can be edited)	Name of selected group. Requirements for name allocation: - The group name has to be unique - Comply with the group name conventions. "Group names conventions" on page 297
	Description of the selected group.
	Locked: Assigned rights can be removed from a group using the lock status. For example, a group can temporarily be locked without having to delete it. ☐ : Lock status disabled. The assigned rights are available to the group on the control. ☒ : Lock status enabled. The assigned rights are not available to the group on the control.
"Members" tab	Specify members of the group. Refer to "Assign group members" on page 296
Tab "Rights"	Specify group rights. Refer to "Assign group rights" on page 296
Toolbar	
	Create new group, see "Create new group" on page 294
	Copy group, see "Copy group" on page 295
	Delete group, see "Delete group" on page 295
	Reload group, see "Reload data" on page 296

Create new group

Create a new group as follows:

1. Mouse-click on the toolbar , or right-click on an existing group and select the "Create new group" command
2. Enter the name and the description of the new group in the "Group details" window
3. The users for the new group can be selected in the "Members" tab.
4. Individual group rights can be assigned in the Rights tab.
5. Transfer the new group to the control with "Save in device".

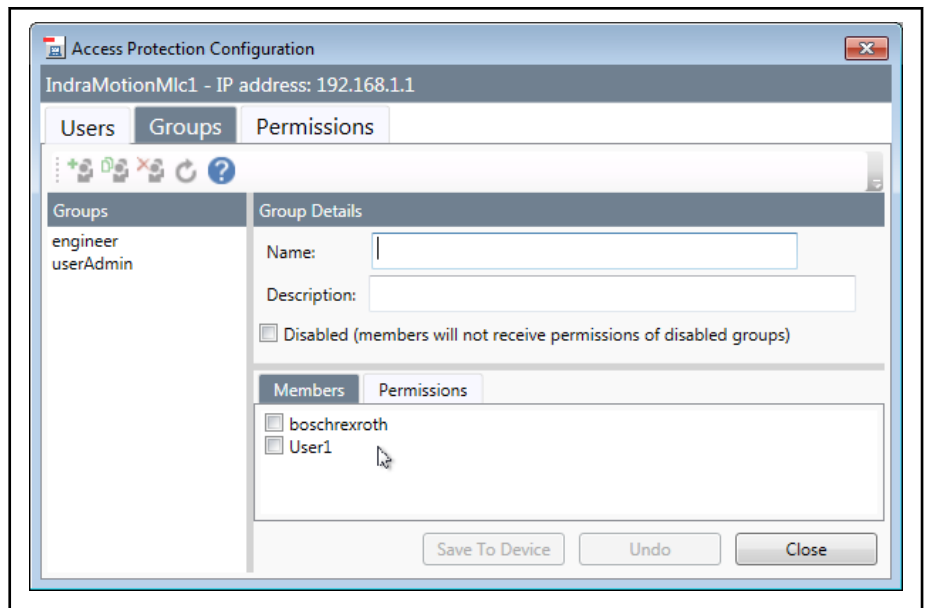


Fig. 4-135: Dialog "Access protection configuration" - "Create new group"

Copy group

An existing group can be copied as follows:

1. Select the group to be copied in the "Groups" window.
2. Trigger the copy command by clicking on the toolbar button  or by right-click on the selected group and by selecting the context menu "Copy group".
A copy of the original group with the configured group members and rights is created.
The copied group is assigned the name and the description of the original group with a name suffix (continuous number in brackets).



Before transmitting the copied group to the control, a unique name is assigned and a matching description is entered.

3. Transmit the copied group to the control with "Save in device".



If no changes have been made, the dialog can be exited by selection of a different group in the overview or by selecting another tab. No copy is generated.

Delete group

An existing group can be deleted as follows:

1. Select the group to be deleted in the "Groups" window.
2. Trigger the Delete command by clicking on the toolbar button  or by right-click on the selected group and by selecting the context menu "Delete group".
A safety prompt is displayed.
3. Once the safety prompt to delete is confirmed, the group is deleted on the control.
The group is deleted from the group overview.

Reload data

Use the toolbar button  to read out the access protection data from the control and to refresh the dialog.

Assign group members

Users can be assigned to a group as follows:

1. Select a user in the "Groups" window to assign him to a group.
2. In the "Members" tab, assign the user to the group ☒ or remove him ☐.
3. Transmit the changed group assignment to the control with "Save in device".

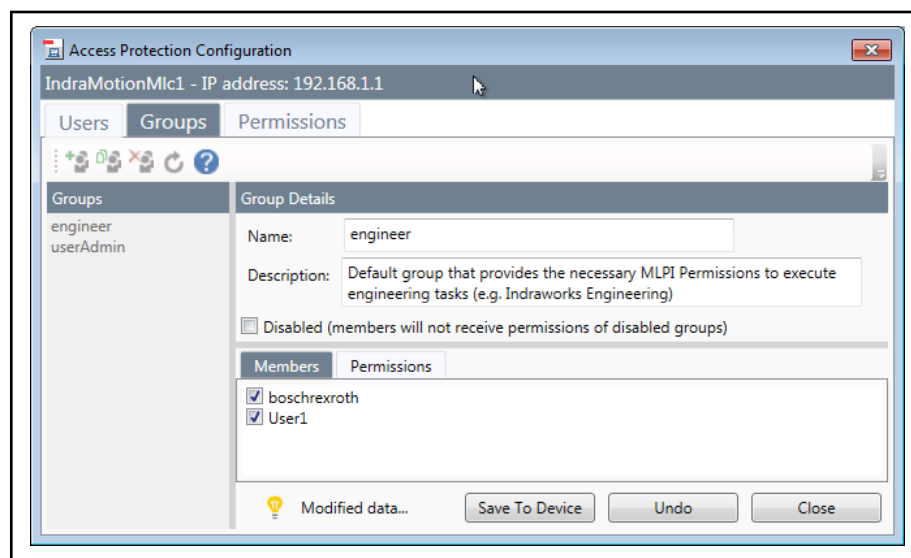


Fig. 4-136: Dialog "Access protection configuration" - "Members" tab

Assign group rights

Rights can be assigned to a group as follows:

1. Select the group in the "Group" window whose rights have to be assigned or changed.
2. Expand the rights category in the "Rights" tab and disable the individual right ☐ or enable it ☒.



By enabling or disabling the rights category, all subordinate individual rights can generally be enabled or disabled.

An action right can be assigned to several groups.

Also refer to [chapter "Rights categories - Overview" on page 299](#).

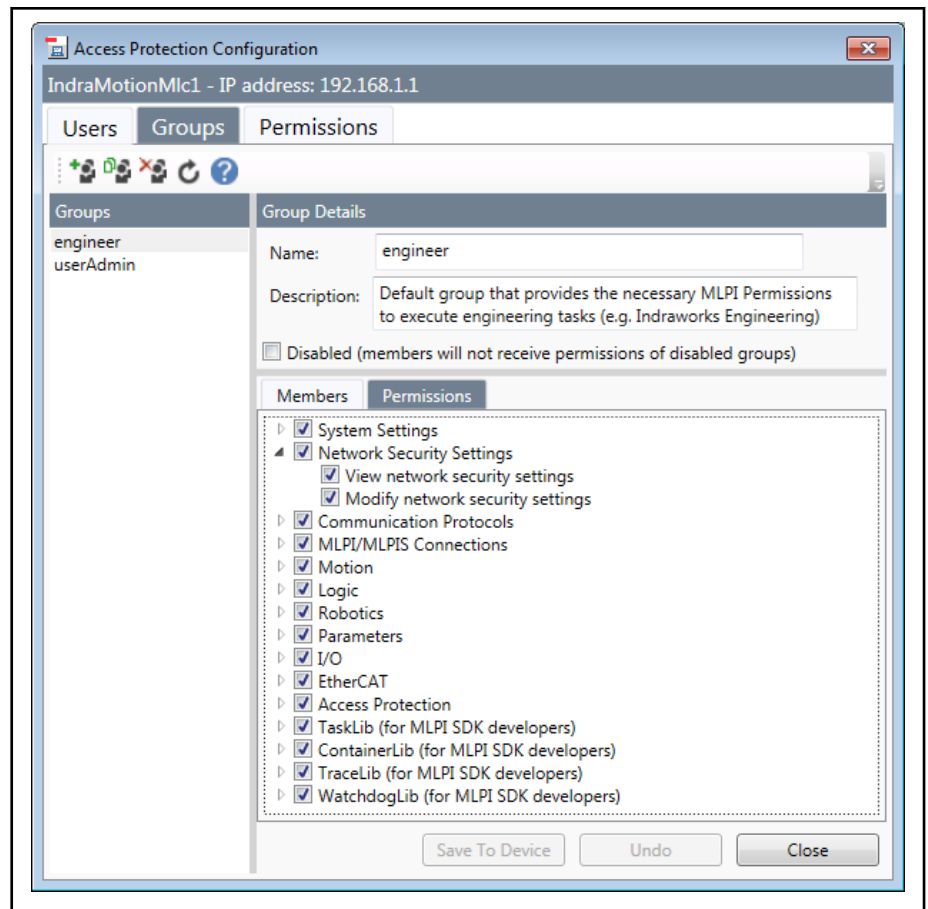


Fig. 4-137: Dialog "Access protection configuration" - "Rights" tab

Group names conventions

The following conventions apply for user name assignment:

1. The group name must not contain any spaces.
2. The following characters are not allowed in the file name: " , " " ; " " % "

'Rights' tab

Call In the Project Explorer via the context menu of the control and the menu item **Access protection ► Configure access protection...**, call the "Access protection configuration" and select the main menu tab "Rights".

If no user has been logged in to the access protection of the control, a login dialog is displayed.

Prerequisites

- The control has to be connected to IndraWorks
- A user of the "engineer" group has to be logged in at the access protection of the control



Users working with IndraWorks Engineering, have to be assigned the role "engineer".

The "engineer" group has all rights to access the control via IndraWorks and to administer the control.

The "engineer" group can neither be changed nor deleted. To ensure that the access protection can be configured in IndraWorks, at least one user has to be assigned to the "engineer" group to be able to login.

Function The "Rights" tab provides an overview of the rights categories, the subordinate individual rights and which group is assigned an individual right. Additionally, the name and a short description of the right is displayed.

Expand the "Rights category" in the "Rights" field and select an individual right.

In the view, rights can be assigned to the groups, see [chapter "Groups' tab" on page 292](#)

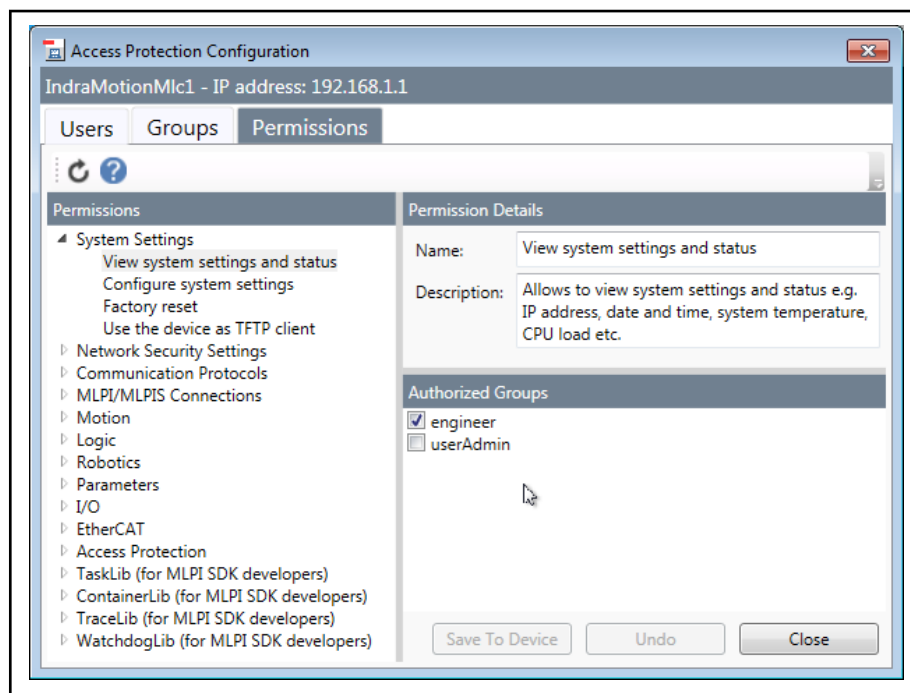


Fig. 4-138: Dialog "Access protection configuration" - "Rights" tab

Elements of the "Rights" tab

"Rights" field	List of available rights categories and subordinate individual rights.
"Rights details" field	Name and description of right.
"Authorized group" field	Display of available groups. By enabling the check box, the group is assigned the selected right.
Reload data	Via the  symbol in the tool bar, the rights and group assignments can be read out from the device or refreshed.

Rights categories - Overview

Overview of action rights on the control

This chapter provides an overview of the available rights categories in which the individual rights are summarized. Individual rights can be assigned to the user via his user group affiliation, see [chapter "Rights' tab" on page 297](#).

Overview of action rights categories

Rights category	Description
System settings	Rights to access system settings and status, e.g. IP address, date, time, etc. and to restart the device.
Network security settings	Permissions to view and change network settings of the device
Communication protocols	Permissions to set up a connection to a device using specific protocols
MLPI/MLPIS connections	Rights to set up, manage and debug MLPI/MLPI connections to the device
Motion	Permissions to set up, move and monitor axes
Logic	Permissions to control and manage the Logic runtime system
Robotics	Permissions to define robots, control motions and determine robot data
Parameters	Read/write rights on parameters of the device and of connected devices
I/O	Permissions to access I/Os
EtherCAT	Permissions to access EtherCAT
Access protection	Rights to view and set up the access protection to a device
TaskLib (for MLPI SDK developers)	Rights to use the "TaskLib" for MLPI client applications
ContainerLib (for MLPI SDK developers)	Rights to use the "ContainerLib" for MLPI client applications
TraceLib (for MLPI SDK developers)	Rights to use the "TraceLib" for MLPI client applications
WatchdogLib (for MLPI SDK developers)	Rights to use the "WatchdogLib" for MLPI client applications

Tab. 4-12: Overview - Rights categories

Individual rights - Overview

This chapter provides an overview of the available individual rights, summarized in categories:

Rights category - System settings

Rights in the rights category "System settings"

Rights details	
Name:	Description:
View system settings and system status	Allows to view system settings and status, e.g. IP address, date, time, system temperature, CPU load, etc.
Configure system settings	Allows to configure system settings, e.g. IP address, date, time, etc. and restart the device
Factory reset	Allows to reset the device to the delivery state
Use the device as TFTP client	Allows to use devices as TFTP client, e.g. for the IndraDrive firmware update

Tab. 4-13: Rights of the category "System settings"

Rights category - Network security settings

Rights in the rights category "Network security settings"

Rights details	
Name:	Description:
View network security settings	Allows to view network security settings, e.g. activation status of specific communication protocols
Modify network security settings	Allows to change network security settings, e.g. disabling specific communication protocols

Tab. 4-14: Rights of the category "Network security settings"

Rights category - Communication protocols

Rights in the rights category "Communication protocols"

Rights details	
Name:	Description:
FTP - File Transfer Protocol	Allows to establish connections to the device using FTP protocol
SFTP - Secure File Transfer Protocol	Allows to establish connections to the device using SFTP protocol
SSH - Secure Shell	Allows to establish connections to the device using SSH protocol
MLPI - Motion Logic Programming Interface	Allows to establish connections to the device using MLPI protocol
MLPIS - MLPI Secure	Allows to establish connections to the device using MLPIS protocol
OPC-UA - OPC Unified Architecture	Allows to establish connections to the device using OPC UA protocol

Tab. 4-15: Rights if the category "Communication protocols"

Rights category - MLPI / MLPIS connections

Rights in the rights category "MLPI/MLPIS connections"

Rights details	
Name:	Description:
Determine connection status	Allows to determine the status of MLPI/MLPIS connections
Manage connections	Allows managing of MLPI/MLPIS connections, e.g. listing, changing or closing connections
Debug connections	Allows debugging of MLPI/MLPIS connections, e.g. performance and stability test
Use deprecated functions (potentially insecure!)	Allows to use deprecated functions, e.g. mlpApiGetAccounts, mlpApiUserAccountControlLoadAccounts (not recommended, potentially insecure)

Tab. 4-16: Rights of the category "MLPI connections"

Rights category - Motion

Rights in the rights category "Motion"

Rights details	
Name:	Description:
Monitor axes	Allows to monitor axes, e.g. current position, current acceleration, etc.
Move axes	Allows moving of axes
Create, delete and configure axes	Allows to create, delete and configure axes

Tab. 4-17: Rights of the category "Motion"

Rights category - Logic

Rights in the rights category "Logic"

Rights details	
Name:	Description:
View PLC application status	Allows to view the PLC application status
Read variables and memory areas and get address of symbols	Allows to read variables and memory areas and to determine symbol addresses
Write variables and memory areas	Allows to write values and memory areas
Load PLC application	Allows to load PLC applications
Start, stop, reset and debug PLC application	Allows to start, stop, reset and debug PLC applications

Tab. 4-18: Rights of the category "Logic"

Rights category - Robotics

Rights in the rights category "Robotics"

Rights details	
Name:	Description:
Read robot information	Allows to read information, e.g. position, status and diagnostics
Move robots	Allows to move robots
Set up robots and clear errors	Allows to set up robots and clear errors
Teach-in	Allows teach-in of positions for robots

Tab. 4-19: Rights of the category "Robotics"

Rights category - Parameters

Rights in the rights category "Parameters"

Rights details	
Name:	Description:
Read parameter value or status	Allows to read parameter values or the status
Write parameter value	Allows to write parameter values
Execute command via parameter	Allows to execute commands via command parameters and to read the command status

Tab. 4-20: Rights of the category "Parameters"

Rights category - E/A

Rights in the rights category "I/O"

Rights details	
Name:	Description:
Read inline and fieldbus master/slave lists and information	Allows to read inputs of Inline and field bus master/slave lists and information
Read input	Allows to read inputs
Write output	Allows to write to outputs
Update I/Os	Allows to update I/Os

Tab. 4-21: Rights of the category "I/O"

Rights category - EtherCAT

Rights in the rights category "EtherCAT"

Rights details	
Name:	Description:
Get status and configuration info of bus and devices	Allows to determine the status and the configuration of the EtherCAT bus and EtherCAT devices
Read data from devices	Allows to read data of EtherCAT devices
Write data to devices	Allows to write data to devices

Rights details	
Name:	Description:
Set up and configure master and devices	Allows to set up and configure EtherCAT master and devices
Operation	Allows to set the bus status, execute bus scans and reset statistics

Tab. 4-22: Rights of the category "EtherCAT"

Rights category - Access protection**Rights in the rights category "Access protection"**

Rights details	
Name:	Description:
View users, groups and permissions	Allows to view users, groups and permissions
Set up users, groups and rights	Allows to create, edit and delete users and groups and to assign permissions

Tab. 4-23: Rights of the category "Access protection"

Rights category - TaskLib (for MLPI SDK developer)**Rights in the rights category "TaskLib (for MLPI SDK developers)"**

Rights details	
Name:	Description:
Use task viewer	Allows to use the task viewer
Modify task priorities	Allows to start and stop tasks, change task priorities and wait for events
Modify task trigger	Allows to change task triggers

Tab. 4-24: Rights of the category "TaskLib"

Rights category - ContainerLib (for MLPI SDK developers)**Rights in the rights category "ContainerLib (for MLPI SDK developers)"**

Rights details	
Name:	Description:
Browse	Allows to browse through existing containers
Info	Allows to determine container information, e.g. name and elements
Setup	Allows to create and delete containers and to set the container name.
Update	Allows to read/write data from/to containers; depending on the container type

Tab. 4-25: Rights of the category "ContainerLib"

Rights category - TraceLib (for MLPI SDK developer)**Rights category "TraceLib (for MLPI SDK developers)"**

Rights details	
Name:	Description:
Use task viewer	Allows to use the task viewer
Modify task priorities	Allows to start and stop tasks, change task priorities and wait for events
Modify task trigger	Allows to change task triggers

Tab. 4-26: Rights of the category "TraceLib"

Rights category - WatchdogLib (for MLPI SDK developer)**Rights category "WatchdogLib (for MLPI SDK developers)"**

Rights details	
Name:	Description:
Use watchdog library	Allows to use the WatchdogLib for MLPI client applications

Tab. 4-27: Rights of the category "WatchdogLib"

4.5.6 Access protection in practice

Manually store login information

When commissioning or servicing, it is often required to restart the control or to close and reload the project in IndraWorks. Subsequently, the user has to login in again each time via the access protection.

In this case, it is recommended to use auto login by storing the login data of the control in the login information management of the Windows operating system.

Procedure:

1. Open the Windows control panel.



Select the "Category" option.

2. Call **User accounts ► Login information management**.

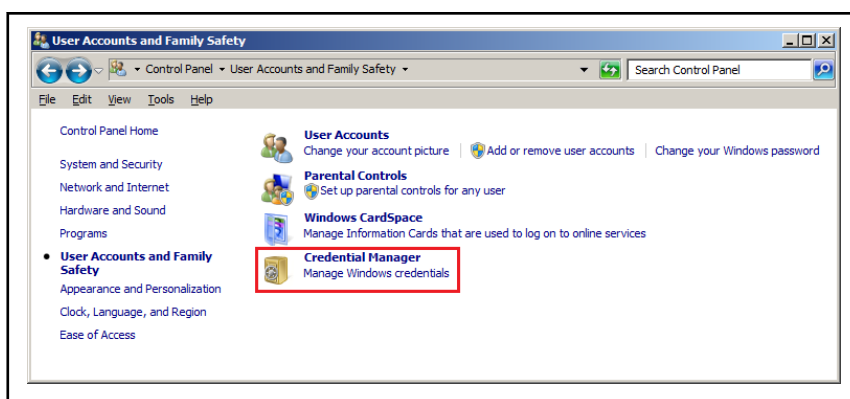


Fig. 4-139: Control Panel - User accounts

3. Click on "Add a Generic Credential" in the Windows Credential Manager.

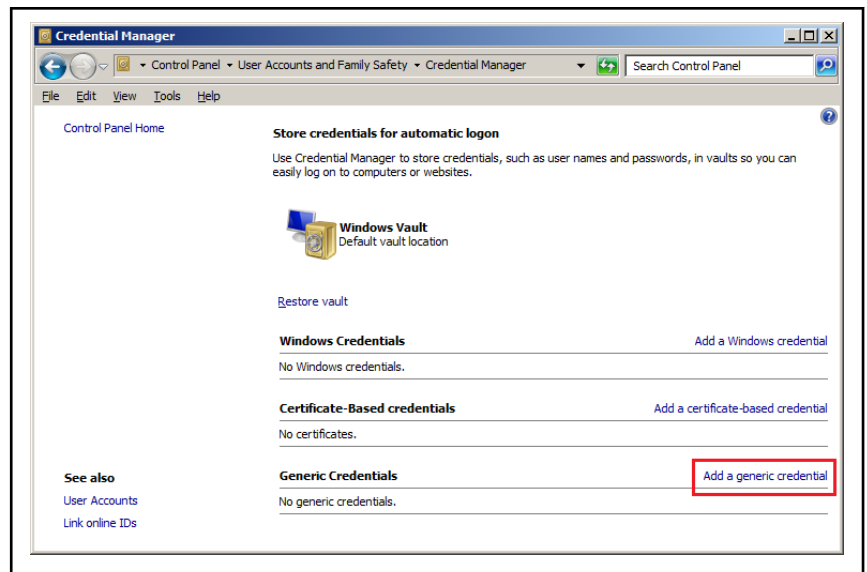


Fig. 4-140: Windows Credential Manager

4. Enter the control address as "indraworks:<IP address of the control>" as well as user name and password.



Ensure the correct writing (upper/lower case letters, colon) of the identifier "indraworks:" preceding the IP address.

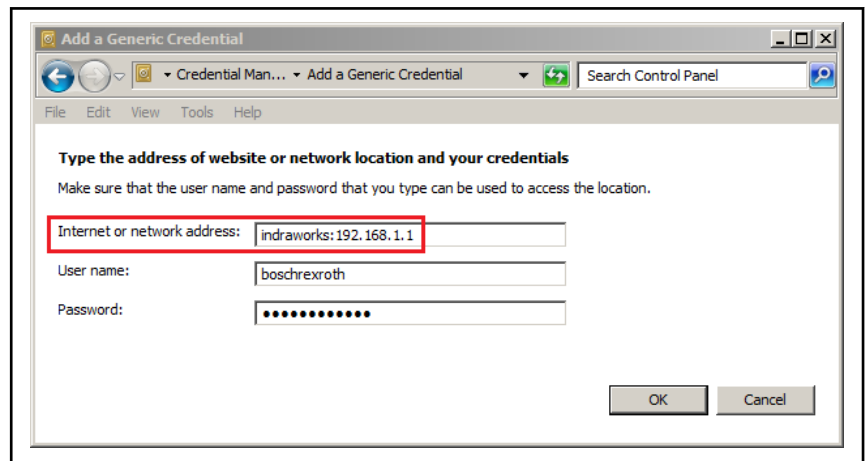


Fig. 4-141: Input dialog for credentials



Applications installed under the user account of the Windows user can access this information.

Insufficient user rights of stored login information

If the stored individual rights of a user are insufficient to execute and action, the following message is displayed:

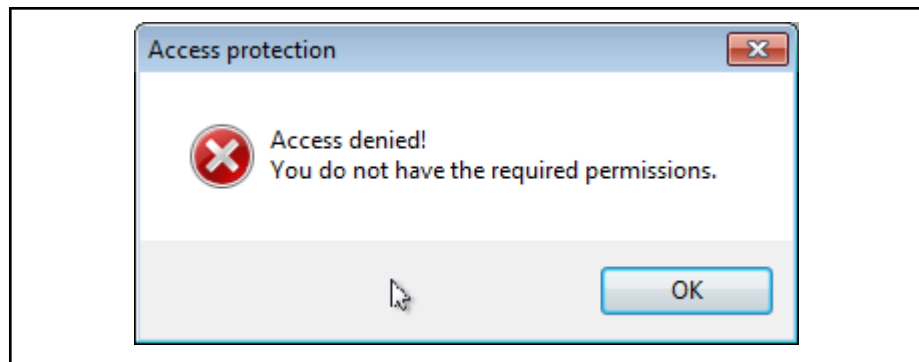


Fig. 4-142:

Solution:

- Login with a user assigned the required individual rights, see [chapter 4.5.4 "Login user to the device" on page 282](#)
- Add the rights of the affected users by assigning the user to the relevant group, see ["Assign group membership" on page 291](#)

Delete login information

The stored login information can be removed from the Windows login information management as follows:

1. Open the login information management, see [chapter "Manually store login information" on page 304](#).
2. In "Generic login information", navigate to the entry in the relevant control.
3. Expand the entry of the control and select "Remove from safe".

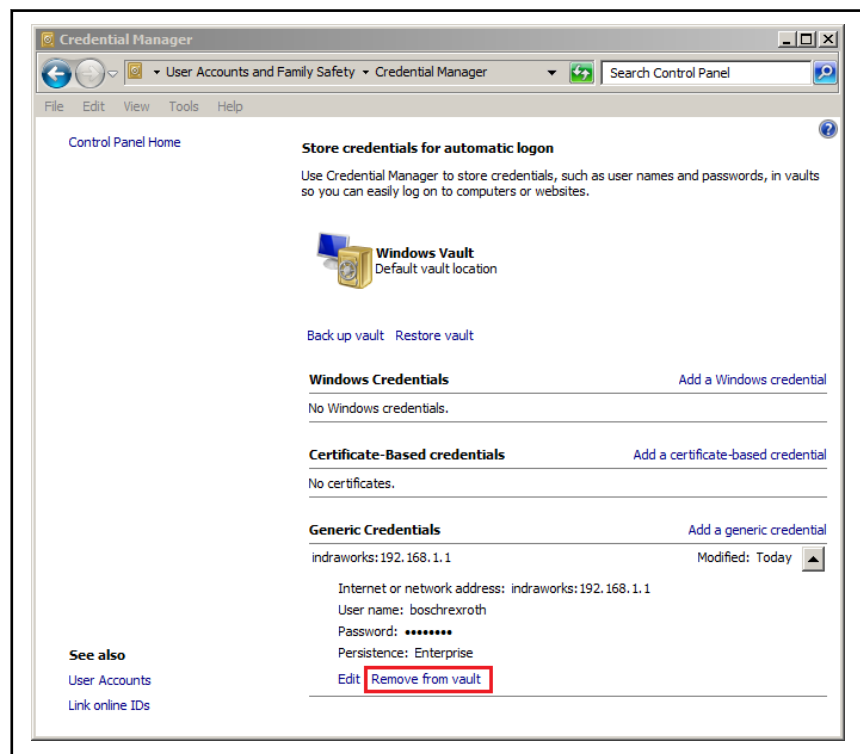


Fig. 4-143: Windows Credential Manager

Confirm the dialog for removal and the credentials are deleted.

4.5.7 Make devices safe

Default users The default user "boschrexroth" has to be protected against unauthorized use. Proceed as follows:

- Password change or renaming, see ["Reset password" on page 291](#)
- For how to create a new user or delete a user "boschrexroth", see ["Create new user" on page 289](#)

4.5.8 Devices notes - Restrictions

Note to devices with 14V20 firmware

The firmware of version 14V20 does not yet have the full functional scope with regard to access protection. In the following, only a part of the functionality is available in the configuration dialog.

Example: When connecting to a device with 14V20 firmware, only the "User" tab is supported.

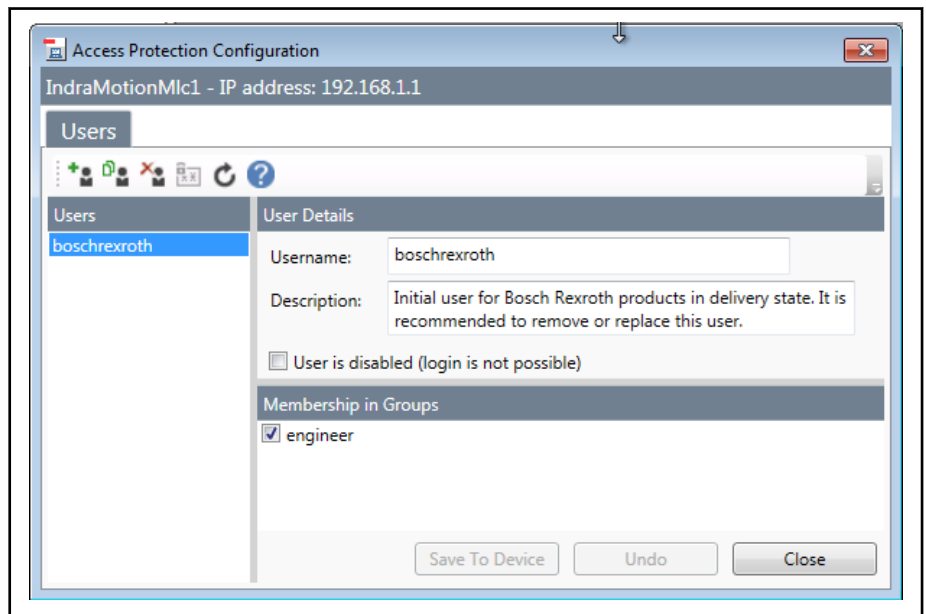


Fig. 4-144: Dialog "Access protection configuration" - in firmware 14V20

Note on firmware update on controls

If on a device with firmware < 14V22 the firmware is updated to firmware ≥14V22 via access protection set up via MLPI, existing access protection data is converted to the new format and stored on the control.

In the new format, individual rights are assigned to user groups and not the user himself.

Actions executed by the update:

- A new group is created for each existing user
(Example: User = Example → group_Example)
- The group is assigned the rights of the previous user and additionally, all protocol rights (MLPI, MLPIS, FTP, SSH, SFTP, OPCUA)
- The user is member of this group and is assigned the previously configured rights via the group affiliation

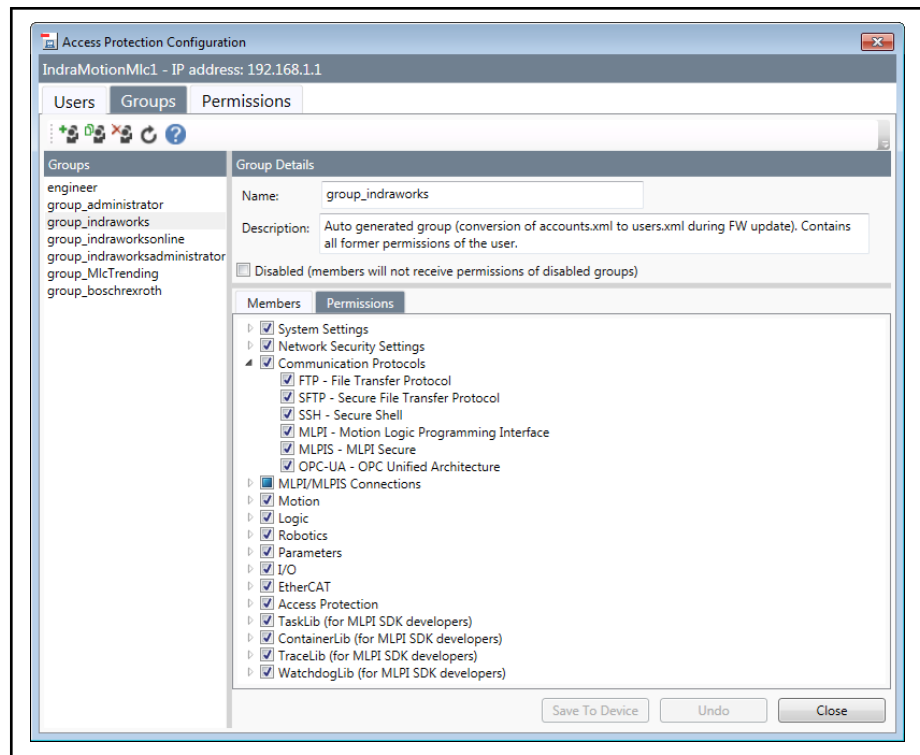


Fig. 4-145: Dialog "Configure access protection" - after a firmware update

4.6 Version control of the control

4.6.1 Introduction

All of the controls in IndraWorks listed below support version control:

- IndraLogic XLC L45
- IndraLogic XLC L65
- IndraLogic XLC L75
- IndraMotion MLC L45
- IndraMotion MLC L65
- IndraMotion MLC L75
- IndraMotion MLC VPx
- IndraMotion MLC XM2
- IndraMotion MLC XM4

The documentation of the version control system in IndraWorks can be found in the "IndraWorks 14VRS Engineering" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

4.6.2 Special features

Project management

There are some special features in the version control of MotionLogic devices.

CrossComm function module (only for MLC)

The MLC control and the CrossComm function module (Sercos II and Sercos III) are handled together. This avoids that several inconsistent versions are created due to simultaneous editing (by several users).

MlcVarGlobal	The "MlcVarGlobal" object is not version-controlled. This global variable list is automatically generated according to the Motion and Robot configuration.
Technology	The "Technology" node is not version-controlled. Instances of supported technology functions of the PLC program are displayed in the technology node. This node does not contain data to be version-controlled.
Real axes	The axes under "Real Axes" are not version-controlled. One drive in the "Sercos" node of the control belongs to the each of these axes. When editing a real axis, the respective Sercos device is automatically checked out.
Parameters	The parameters in the project are version-controlled. When changing a parameter in offline mode, check out the control, axis/drive or the kinematics before. After the check in and the update of the workspace, the changed parameters are also available to other users working in that team project.
Exchanging a drive	When using the "Exchange Drive" interface function, the version history of the exchanged drive is lost since the object is deleted and created again.

Using controls

Motion Connection with Version-controlled Project

If several users work on a team project with a common control, only one user can be connected online.

If each user is to have an own control, the IP address can be adapted without checking out the control. The IP address does not belong to the version-controlled data of the control in order to be independent from other users when working with different controls.

PLC connection with version-controlled project

The data connection between IndraWorks and the PLC of the control, allows only one user (like the Motion connection) to be connected. Each user can set his individual IP address without checking out the control.

Note that alternating login to the PLC by different users (with different work copies of the team project) cannot be performed by online change. For this change, a new program is downloaded in which the PLC has to be stopped.

Using multi-device configurations

The operating mode of the multi-device configuration of the control is documented in [chapter 4.4.8 "Multi-device" on page 244](#).

For version-controlled projects, in which the multi-device configuration is used, not the following:

- The multi-device table is version-controlled. A change can only be made by checking out or hijacking the control
- It can be switched between different controls via the multi-device configuration without checking out the control. Thus, each editor of the team project can change his control irrespective of the other users

4.7 Complete data backup

4.7.1 General information

Control data is completely backed up via archiving.



Depending on the project size and the number of axes, the data backup can take a few minutes.

The following data is archived:

- Configuration
- Control parameters
- Drive parameters
- Kinematic data (only for MLC)
- Libraries, device descriptions
- Compact Flash contents
- Data of external memory media (SD card USB data carrier, only for XM controls)

4.7.2 Complete backup

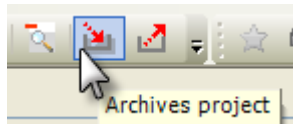


To ensure the archiving of the **current control data**, switch to **on-line**.

When working offline, only the control data last saved - if available - can be included in the archive.

The complete backup is as follows:

1.



Select the **Archives project** icon in the IndraWorks toolbar.

2. Enter the name of the archive as well as the optional input of a comment and/or password:

Fig. 4-146: Enter the archive name

3. Select the storage location (file system and/or FTP server):

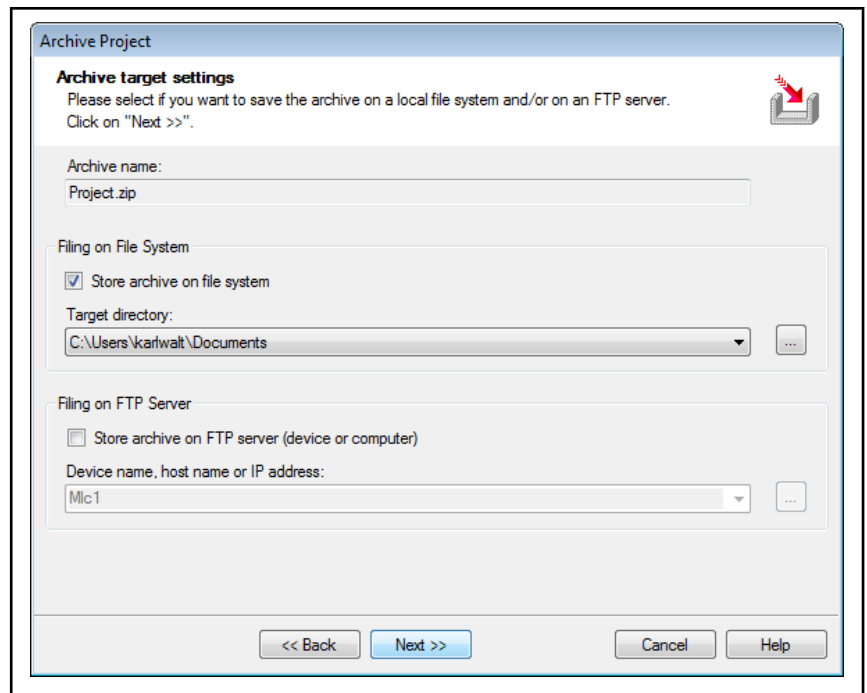


Fig. 4-147: Select the storage location

4. Selection of the components to be archived. If the project is selected, the complete project is archived. If the control (here "Mlc1") is selected, settings for the archiving can be made.

Select on the right, whether the compiled program and the default libraries are included in the archive:

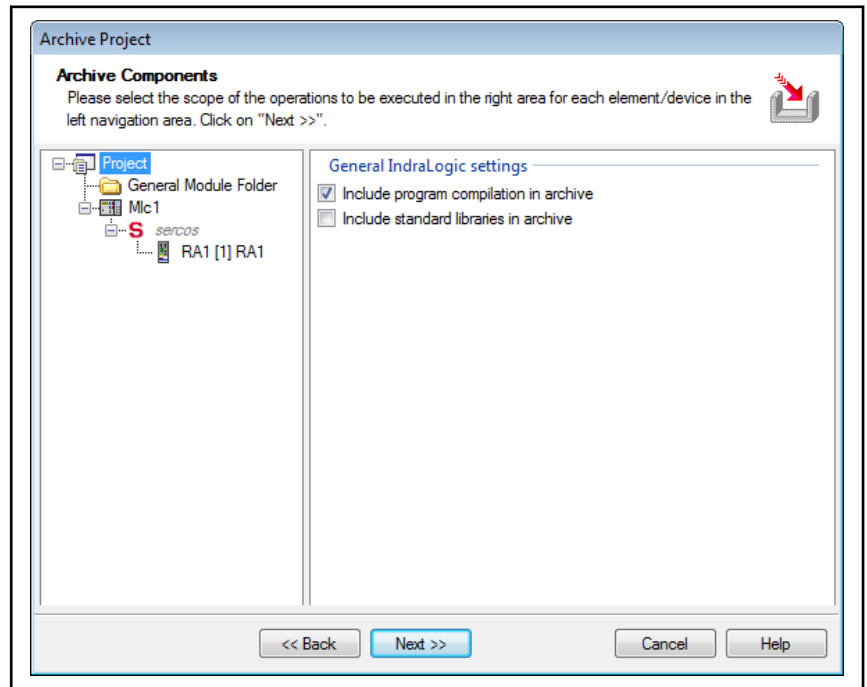


Fig. 4-148: Selection of the components to be archived

5. Select the data to be archived. It is possible to specify on the "General" tab whether the control data is to be backed up and which partitions of the control are to be backed up. The three partitions contain the following data:

- User partition: Cam tables transferred to the control, MotionProfile as well as any personal files
- OEM partition: Archives saved on the device, compiled PLC programs
- System partition: Firmware, PLC retain data
- Data of external memory media (e.g. REMOVABLE_SD_A): any own files

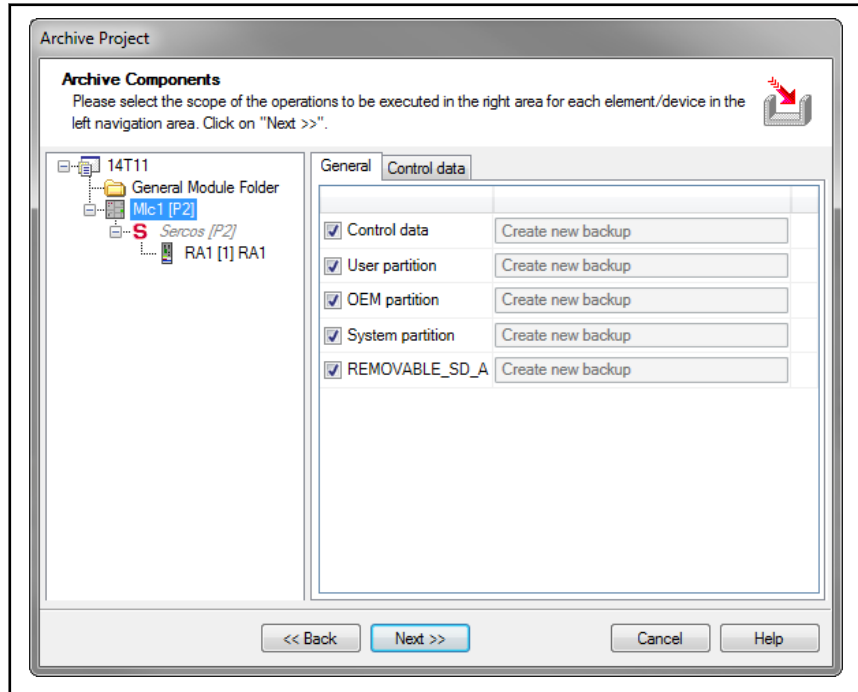


Fig. 4-149: Selecting components to be archived (1)

It is possible to specify the parameters to be saved and whether kinematic data (only MLC) is to be saved on the "Control data" tab.

It is only possible to make an entry on this page if "Create new backup" was selected on the "General" tab at "Control data".

If not at least one kinematics of the version "Robot Control V2" is configured in the control, the archiving of kinematic data cannot be enabled in "Other data".

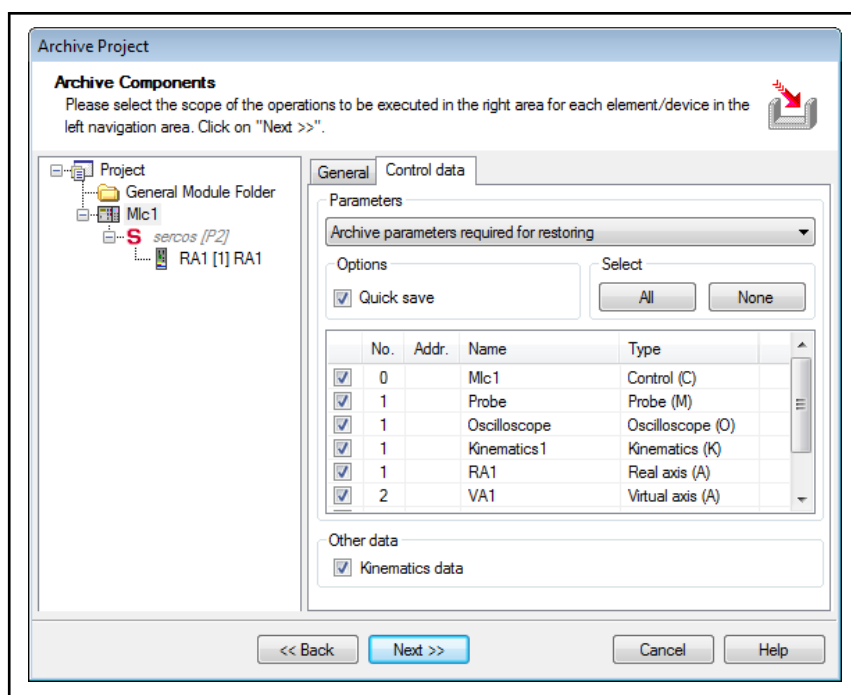


Fig. 4-150: Selecting components to be archived (2)

6. Check user inputs:

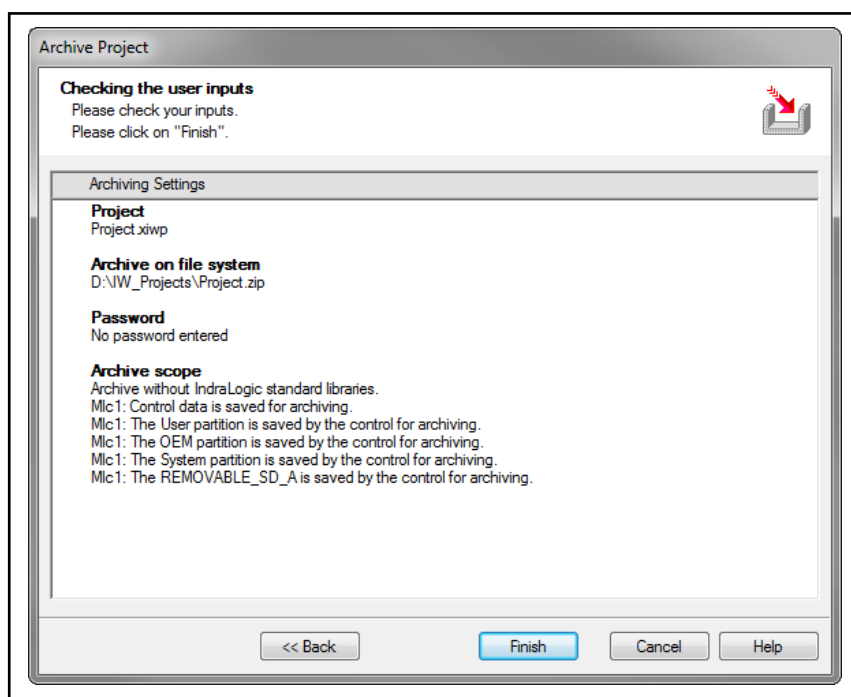


Fig. 4-151: Checking user inputs

7. Archiving with progress bar:

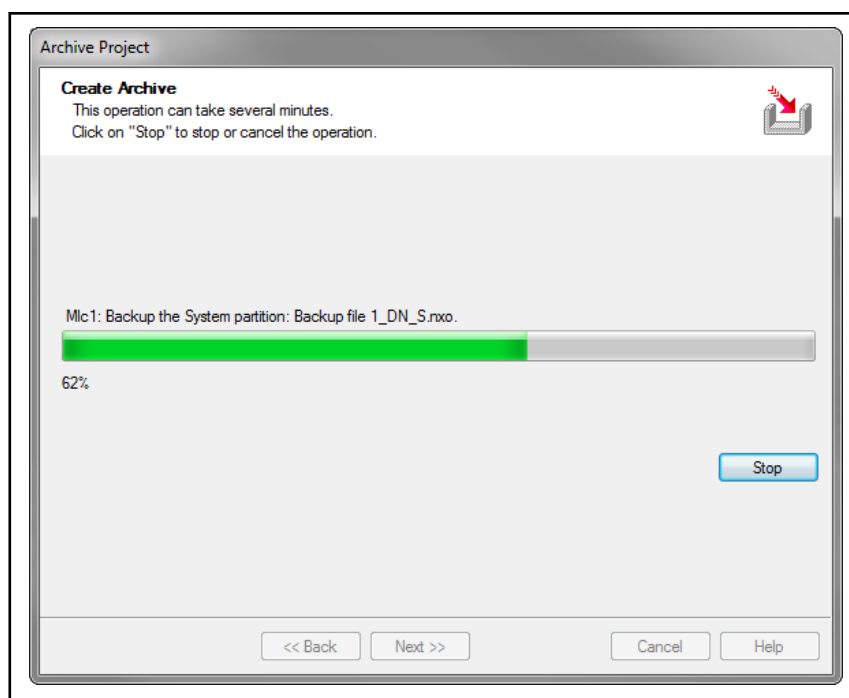


Fig. 4-152: Archiving...

8. Display of a summary:

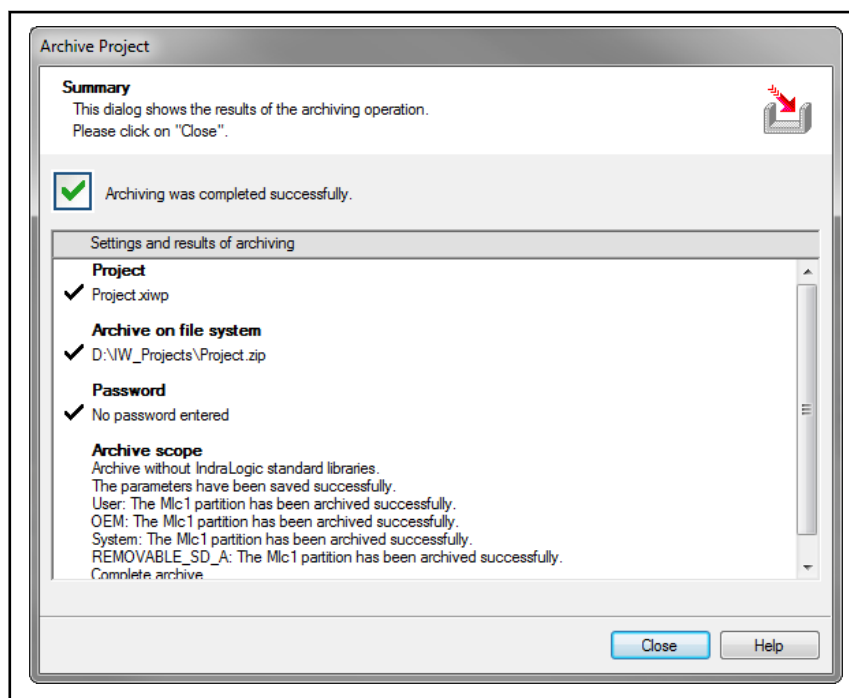
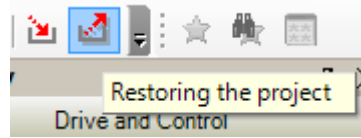


Fig. 4-153: Summary of the project backup

4.7.3 Restoring a project

The project is restored as follows:

1.



Select the **Restoring the project** icon in the IndraWorks toolbar.

2. Specify the restoration type, that is the source (file system or FTP server) of the project to be restored:

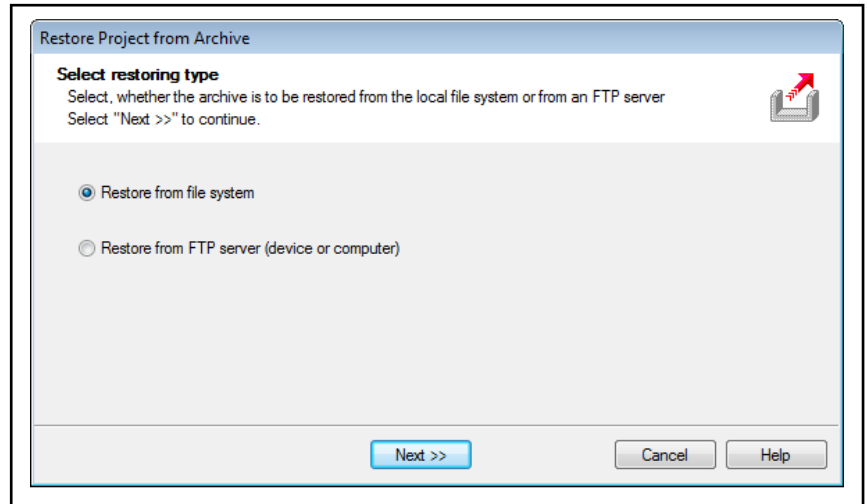


Fig. 4-154: Specifying the restoration type

3. Selecting the archive to be restored:

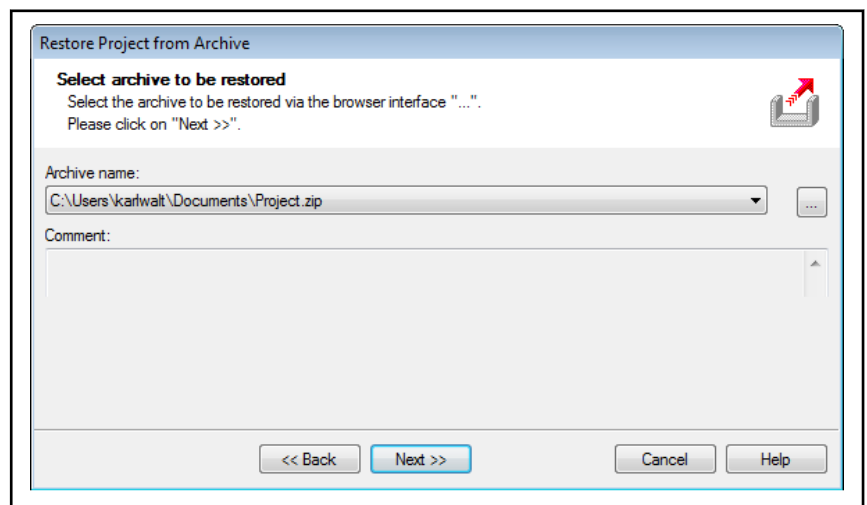


Fig. 4-155: Selecting the archive to be restored

4. Selecting the directory in which the archive is to be restored. A folder with the project name is automatically created.

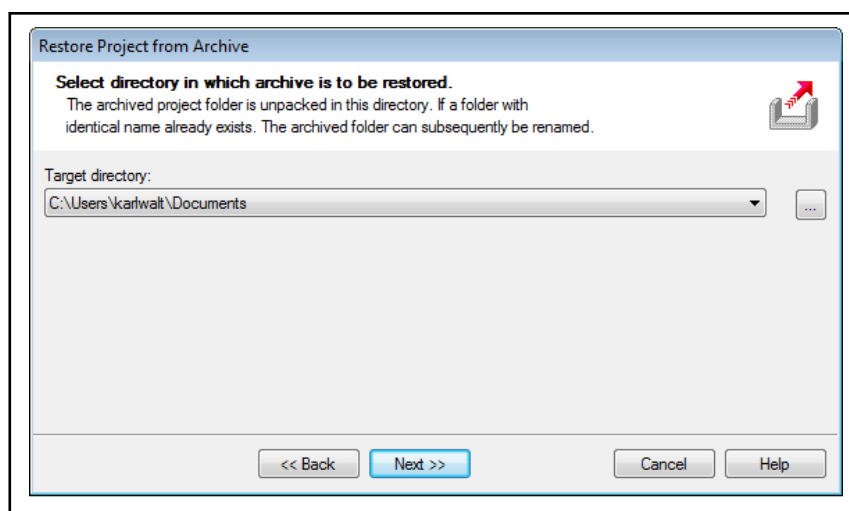


Fig. 4-156: Selecting the directory...

5. Checking the previous specifications:

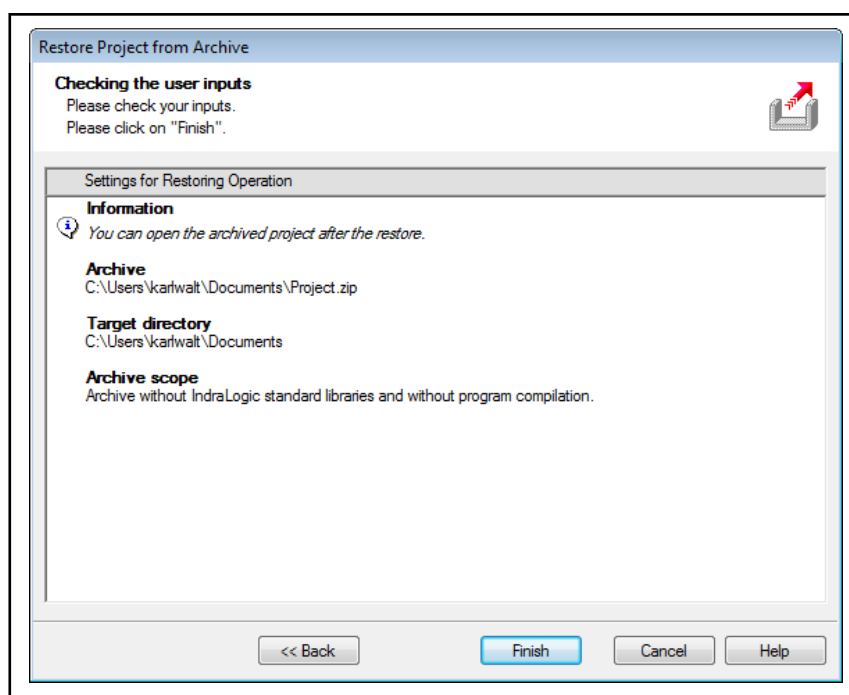


Fig. 4-157: Checking the specifications made

If a password was specified when the project was archived, a dialog to enter the password opens:

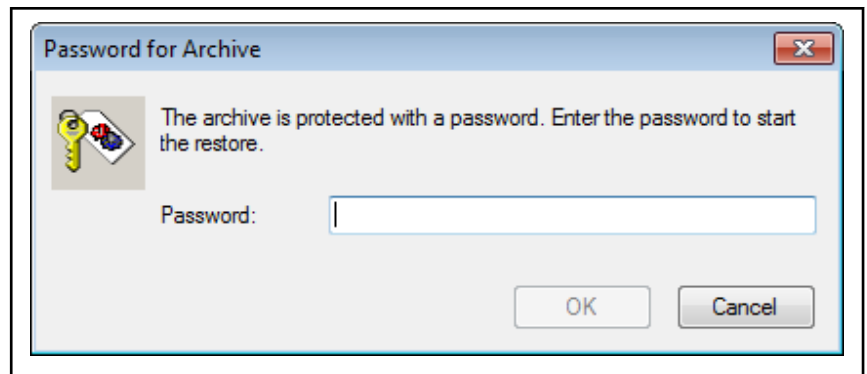


Fig. 4-158: Input dialog for the password

6. A summary of the project restoration is displayed. The selected archive, the target directory, the project directory and the archive size are displayed:

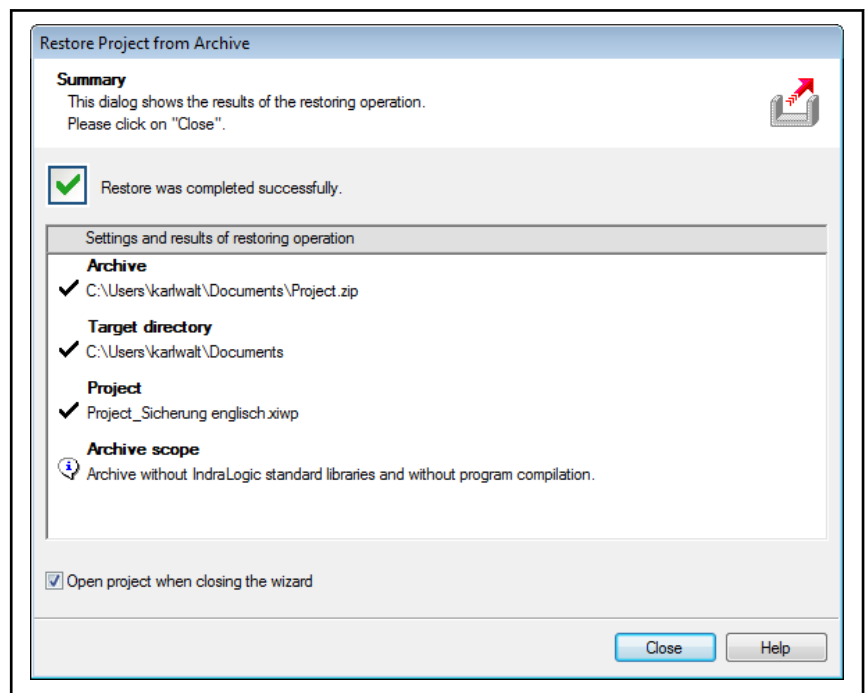


Fig. 4-159: Displaying a summary

7. The project was restored. If device data is present in the project, the following message is displayed when opening the project for the first time:

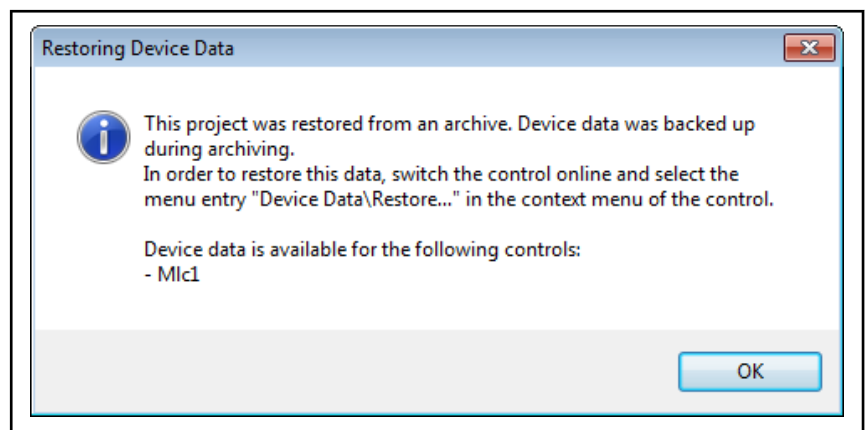


Fig. 4-160: Message to restore device data

The menu item **Restore Device Data** is located in the context menu of the control (see [chapter "Restoring" on page 263](#)).

4.8 Multicore

Multicore - General information

A multi-core processor has multiple cores. This architecture allows to parallelly execute arithmetic operations on the respective processor cores. To effectively use multiple cores, the software has to be able to simultaneously process data parallelly on multiple cores and has to ensure that possible dependencies are included using respective synchronization mechanisms.

The controls IndraControl CML75 and IndraControl XM42 are provided with a dual core processor. The major part of the firmware functionality is executed on processor core 1. Some background tasks with a lower priority are processed on the processor core 2. From IndraWorks ML 14V22, the Motion computation automatically distributes axis-related arithmetic operations that are independent from each other and can thus be computed parallelly to the processor core available in total.



Only the system firmware distributes the computing tasks of the individual processor cores. The user cannot assign own arithmetic operations to the individual cores.

4.8.1 Configuration

Control configuration (C-0-0036)

Bit 23 in the parameter C-0-0036, Control configuration is used to configure whether to use multicore for the Motion computation on the respective control system.

4.8.2 Load of individual processor cores

CPU load

The following parameters show the respective load of the processor cores used:

- C-0-0465, CPU load per core, current
- C-0-0466, CPU load per core, maximum
- C-0-0467, CPU load per core, minimum

These parameters are shown in the "Load" dialog, refer to [chapter "Load" on page 236](#).

To open the dialog, go to the context menu of the control load in the Project Explorer: **Diagnostics ► Load**.

4.8.3 TaskExecutionViewer



In IndraWorks 14VRS, the TaskExecution Viewer only records activities present on processor core 1. Both cores are included in IndraWorks 15VRS and higher.

4.8.4 Known problems

F5180005 Cycle time exceeded for Motion kernel after updating to 14V22

Important information:

WARNING

Using multicore can exceed the cycle time of the Motion kernel if a motion-synchronous PLC task with a priority directly above the Motion kernel is used (e.g. Motion task of priority 2, Motion kernel: Priority 3).

For multi-core control (L75, XM4), the priority of the Motion kernel (see parameter C-0-0403) has to be at least two priority levels higher than all PLC tasks commanding the Motion synchronously (e.g. Motion task priority 2, Motion kernel: Priority 4). Otherwise, the error [F5180005](#) Cycle time exceeded for Motion kernel can result. Note that no further PLC tasks run with the same priority as in the Motion kernel!

5 PLC programming

5.1 General information

This chapter provides a brief overview on the PLC programming on the IndraLogic XLC/IndraMotion MLC systems. Following a short introduction, the chapter deals with the library manager and the task system. I/O access by the PLC is described in the following. The chapter ends with a section on the memory organization of the control and memory access from the PLC.

For a more detailed functional description of the IndraLogic PLC, refer to the documentation "IndraWorks 14VRS IndraLogic 2G PLC Programming System" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

5.2 Creating PLC programs

5.2.1 Opening PlcProg object

Double-click to open the "PlcProg" object in the Project Explorer. Alternatively, click on "Open" to open the "PlcProg" object via the context menu. The workspace of the "PlcProg" object opens. The upper area is used to edit the variables (declaration part) and the lower area to edit the instruction (instruction part).

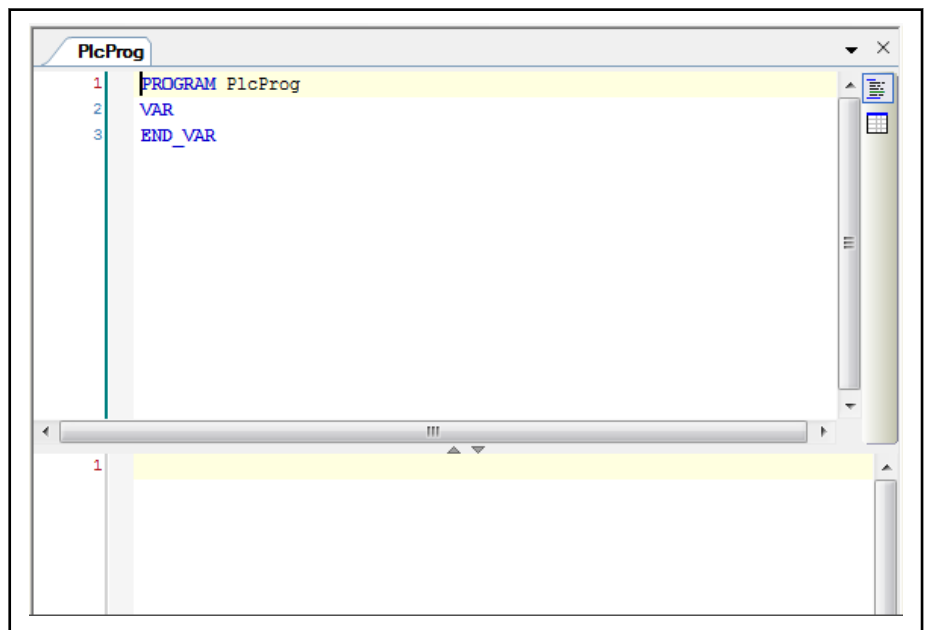


Fig. 5-1: PlcProg

5.2.2 Declaring variables

Enter the line "i:=i+1;" in the code section (lower area) and confirm with "Return". The "Auto Declare" input field opens automatically to declare the variable "i".

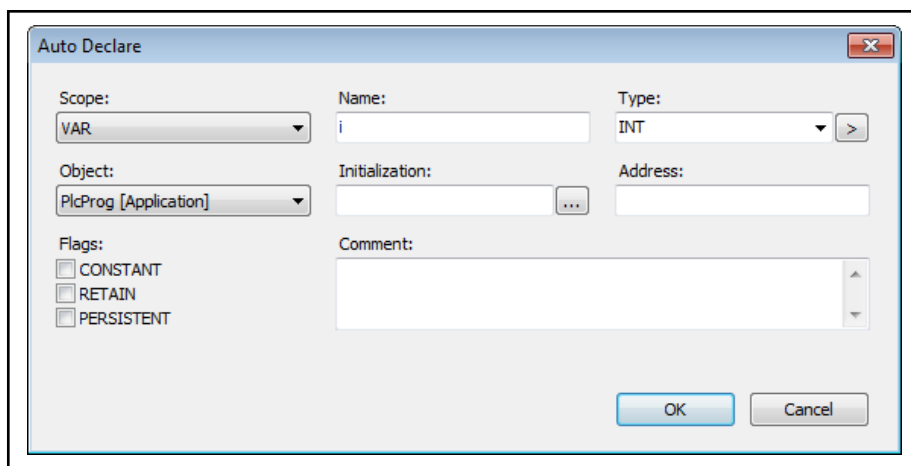


Fig. 5-2: Declaring variables

Confirm the specified values with **OK**. The variable "i" of the "integer" type is now declared.

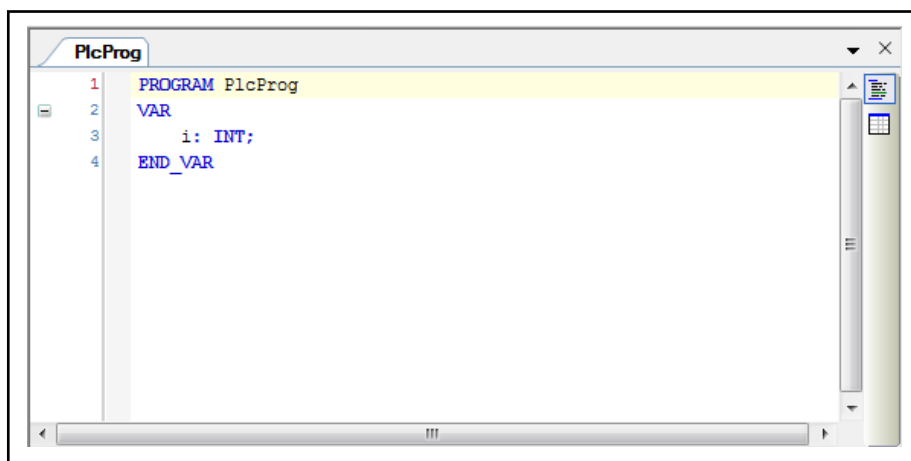


Fig. 5-3: Declared variable



The variable "i" can also be declared in the upper workspace by manual entry.

5.2.3 Editing instruction

It is possible to edit instructions in the lower area of the window.

The following programming languages are available:

- ST (structured text)
- LD (ladder diagram)
- IL (instruction lists)
- CFC (continuous function chart)
- FBD (function block diagram)
- SFC (sequential function chart)

For a detailed description, refer to the online help under "Editors".

5.2.4 Compiling programs

To compile the project, select **Create ► Generate Code**.

IndraLogic then starts the compilation and outputs the result (in this case 0 errors, 0 warnings) in the task list. The task list contains all messages from the most recent compilation, check or comparison.

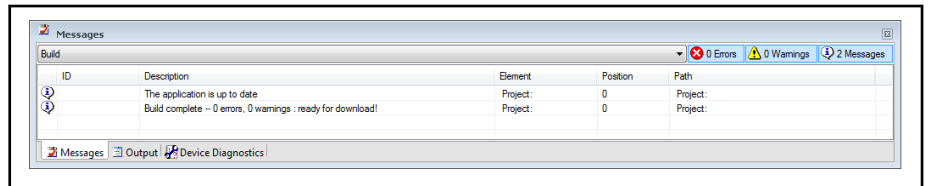


Fig. 5-4: Compiling a program

5.2.5 Loading a PLC program to the control

To load the project to the control, select **Debug ► Login**.

The following dialog is displayed.

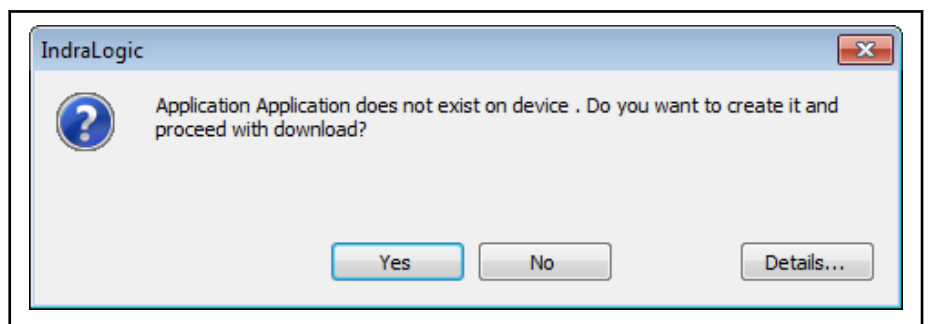


Fig. 5-5: "Load program" dialog

Select **Yes** to confirm the dialog. You are now connected online to your device.

Select **Debug ► Start** in the menu bar to start the PLC program.

Select **Debug ► Generate Boot Application** in the menu bar to create a boot project. If this command is executed online, the compiled project is stored on the control so that the control can automatically load it upon restart.

Select **Debug ► Stop** in the menu bar to stop the PLC program.

Select **Debug ► Logout** in the menu bar to log out of the control.

5.3 Library management

5.3.1 General information

Libraries can provide functions, function blocks, data types, global variables and even visualizations to be used in the project.

The default extension for a library file is ".library" in contrast to ".lib" used for files in previous versions. Encrypted libraries have the extension "*.compiled-library".

Libraries in a project are managed in the library manager. The previous installation on the system was made via the "Library repository" dialog.

The project functions for a global and local "find" and "replace" can also be used for libraries that are not encrypted.

Refer to the following general information on:

- [chapter 5.3.2 "Library overview" on page 324](#)
- [chapter 5.3.3 "Installing on the system and integrating into a project" on page 325](#)
- [chapter 5.3.4 "Referenced libraries" on page 326](#)

- [chapter 5.3.5 "Library versions" on page 326](#)
- [chapter 5.3.6 "Unique access to library function blocks \(namespace\)" on page 327](#)
- [chapter 5.3.7 "Creating libraries" on page 328](#)
- [chapter 5.3.9 "Integrating external code" on page 329](#)

5.3.2 Library overview

Libraries available for the control:

Name	Description	Documentation ¹⁾
RIL_CheckRtv	Automatic monitoring of internal range exceedances	IndraWorks 14VRS Basic Libraries IndraLogic 2G
RIL_CommonTypes	Data types of the PLCopen function blocks, system-comprehensive	
RIL_Utility	General IL functions and function blocks	
RIL_LoopControl	Controller function blocks	
RIL_Inline	Diagnostic functions for Rexroth Inline modules	IndraWorks 14VRS Field Buses
RIL_ProfibusDP_02	Profibus DP-V1 services, diagnostics, Sync and Freeze	
RIL_ProfinetIO	Functions for Profinet I/O	
RIL_ProfinetIODevice	Functions for the control as Profinet I/O device	
RIL_EtherNetIP	Diagnostic and communication services for Ethernet IP device	
RIL_EtherNetIPAdapter	Functions for Ethernet IP adapter	
RIL_SercosIII_IO	Functions for Sercos III I/O	
RIL_FieldbusTypes	Internal library for field bus data types	
RIL_NetXLoad	Internal library to operate the Profibus/Profinet interface	
RIH_CMLx	Hardware information CML45/L65/L75, IndraControl VPB (operating hours, temperature, el. type plate, display output)	IndraWorks 14VRS Basic Libraries IndraLogic 2G
ML_Base	Basic system library	IndraLogic XLC/ IndraMotion MLC 14VRS PLCopen Libraries
ML_PLCOpen	PLCOpen function blocks for Sercos drives	
MP_PLCOpenFieldbus	PLCOpen function blocks for field bus drives	
ML_TechInterface	AxisInterface	IndraLogic XLC IndraMotion MLC 14VRS Generic Application Template

¹⁾ [Refer to chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)

Name	Description	Documentation ¹⁾
ML_TechBase	Function blocks for basic technology functions	IndraMotion MLC 14VRS Technology Libraries
ML_TechMotion	Function blocks for general Motion applications	
ML_TechRegi	Function blocks for register controllers	
RMB_TechWinder	Function blocks for winders	
MH_HydrControl*	Hydraulic central controller	IndraMotion MLC 14VRS MH_HydrControl
MH_SynchControl*	Hydraulic synchronization controller	IndraMotion MLC 14VRS MH_SynchControl
MH_TechHydrBase*	Hydraulic basic functions	IndraMotion MLC 13VRS MH_Tech-HydrBase
MH_TechHydrMotion*	Hydraulic motion functions	IndraMotion MLC 14VRS MH_Tech-HydrMotion
ML_SeqProg	Functions for sequential programming	IndraLogic XLC IndraMotion MLC 14VRS Sequential Programming
RIL_SocketComm	Functions to communicate via TCP/IP and UDP	IndraWorks 14VRS Basic Libraries IndraLogic 2G
RIL_ModbusTCP	Functions for ModbusTCP-compatible HMI devices	Refer to RIL_ModbusTCP.library
RIL_Diagnosis	HMI diagnostic functions	
RIL_HMI_Uilities	Functions to load HMI M-keys	Refer to RIL_HMI_Uilities.library
IL_VCP_DP	Functions for the communication with the small control panels (VCP) via Profibus DP	IndraWorks 14VRS Basic Libraries IndraLogic 2G

* only for MLC
Tab. 5-1: Basic Libraries

5.3.3 Installing on the system and integrating into a project

Library repository

Libraries can be managed on the local system in various "repositories" (directories, storage locations). Before a library can be integrated into a project, install it on the local system in such a repository. This is done in the Library repository dialog.

1) *Refer to chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6*

Library information	A prerequisite for the installation is that the library information of a library project has a title, version information and the name of the vendor (company). Optionally, a category name can be entered that can subsequently be used in the library manager for sorting. If there is no category assignment in the library information, the library automatically belongs to the "Other" category. If other library categories are used in addition to this default category in libraries created in the IndraLogic XLC/IndraMotion MLC system, they are defined in one or more external XML file(s) "*.libcat.xml" that can also be extended and created again. Such a file can then be called in the "Library information" dialog to select a category. For more information on the categories, refer to chapter 5.3.7 "Creating libraries" on page 328.
Library manager	Libraries are integrated into a project using the Library Manager. In a "default project", it is automatically assigned to the default device first. The library manager can also be added explicitly to the Project Explorer (below a device or an application) or globally to the "General module" folder. This is done, as with other objects, using the "Add object" dialog. Therefore, highlight the application and select Add ► Library manager in the context menu. Libraries integrated into a library are also displayed already preset in the library manager. However "hidden libraries" are also possible, see also chapter 5.3.4 "Referenced libraries" on page 326. If the library is not encrypted and the ".library*" file is also present, double-click on the respective entry to open the library POU's listed in the library manager.
Searching sequence	If a library function is addressed in the project, the libraries and repositories are searched in the order in which the libraries and repositories are listed in the "Library Repository" dialog, see also chapter 5.3.6 "Unique access to library function blocks (namespace)" on page 327.

5.3.4 Referenced libraries

A library can reference other libraries (referenced libraries). The nesting depth is arbitrary. If such a "father" library is integrated into a project, the libraries referenced in the project are also available. However, only those libraries integrated into the "father" library in the global "General module" folder are available!

- Visibility** When creating a library project that references other libraries, it can be defined in the Properties of each integrated library how it will respond once it is integrated into a project using the "father" library:
1. Its visibility in the library manager, indented below the "father" library, can be disabled. Thus, "hidden libraries" can be provided in a project.
 2. If a pure "container" library is created, in other words, a library project that does not define any function blocks, but instead only references other libraries, a subsequent access to its function blocks can be simplified. When a "container" library is integrated into a project, a whole set of libraries is integrated along with it. In this case, simplify the access to the function blocks of these libraries by defining them as "top level" libraries. Subsequently, when accessing the function blocks, the namespace for the libraries can be omitted. To do this, use the "Publish..." option in the library properties. However, use this option only when creating a container library project!

5.3.5 Library versions

- Multiple versions of a library can be installed simultaneously on the system

- Multiple versions of a library can be simultaneously integrated into a project. The following clearly specifies on which version an application accesses in this case:

If multiple versions are located on the same level in the library manager, the version to be used (a specific one or always the latest one) depends on the definition in the Library Properties. If multiple versions are located on different levels (with referenced libraries for example), enter the corresponding namespace (see [chapter 5.3.6 "Unique access to library function blocks \(namespace\)" on page 327](#)) for a unique access to library function blocks

5.3.6 Unique access to library function blocks (namespace)

- Basically, the following applies: If several function blocks with the same name are available in the project, access to a function block component has to be unique. Otherwise, compiler errors result. This applies to local project function blocks and to function blocks available in integrated and libraries referenced in these. In such cases, add the namespace in front of the function block name to ensure uniqueness
- The default namespace for a library is defined in the Library properties. If the namespace is not explicitly defined, the library name is automatically used. However, when creating a library project, another default namespace can be entered into the "Properties" dialog. Later, when a library is already integrated into the library manager of a project, the namespace can always be changed locally - also in the "Properties" dialog
- In the following examples, the "namespace" of the library "Lib1" is added to the library properties with "Lib1". In the right column, there are the namespaces for unique access to the variable "var 1" defined in the function block "module1" and in the function block "POU1"

	The variable "var1" is defined in the positions (1) to (5) in the project:	Unique access to "var1" using the corresponding namespace specifications...
(1)	In the library "Lib1" in the global library manager, in the "General module" folder	"Lib1.module1.var1"
(2)	In the library "Lib1" in the library manager below an application "App1" of a control "Dev1"	"Dev1.App1.Lib1.module1.var1"
(3)	In the library "Lib1" integrated into the library "F_Lib" (referenced) in the global library manager in the "General module" folder	Preset: (Option "Publish..." is disabled in the library properties of Lib1 when "Lib1" is added to "F_Lib"): "F_Lib.Lib1.module1.var1" If the option "Publish..." were enabled, "module1" is treated like a component of a library integrated at top level. Subsequently, access without entering the namespace of the "father" library "F_Lib" is usually possible: "Lib1.module1.var1" or "module1.var1"). In the present example, however, this causes a compiler error, since the call is no longer unique; see points (1) and (4)
(4)	In the object "module1" defined in the "General module" folder	"module1.var1"
(5)	In the object "POU1" defined in the "General module" folder	"POU1.var1"

Tab. 5-2: Namespaces

5.3.7 Creating libraries

A library can be created and saved from the global "General module" folder. Highlight the "General module" folder and select the menu item **Create Library...** in the context menu. Alternatively, create a library via the main menu items **Tools ► Create Library....** Consider the following when creating a library:

- To generate a library, some library information has to be specified in the "Library Info" object. Highlight the global "General module" folder and select **Add ► Add Library Info Object** in the context menu to add the "Library Info" object. Alternatively, use the mouse to drag the "Library Info" object from the "PLC Objects" library to add it to the global "General module" folder. Double-click on the "Library Info" object or use **Open** in the context menu to open the "Library information" dialog

In Library information on the "Summary" tab, enter a "title" a "version" and the "company". If the "default namespace" differs from the library name, it can be defined here. Using the option to enter a "category" is also recommended, since this category is later used in the "Library Repository" dialog and in the library manager for sorting purposes

If the library does not belong to the default category "Other", load a corresponding category description either from an XML file "*.libcat.xml" or from another library that already contains the information for such a description file. If necessary, create the category description file again or modify an existing file. The content of the description file is transferred to the library project and then to the library repository during installation. Afterwards, the categories are known in the repository. If, afterwards, when another library that is installed "contains" a description file with the same identifier but with different contents, the information from the more recent file applies to the entire repository to display the categories

- Note the behavior of referenced libraries when the "father" library is integrated into a project. Important are version handling, namespace, visibility and access option configured in the "Properties" dialog of the individually referenced library. If the library is to reference another library depending on the target system, the "placeholder" reference can be set now during definition
- If the library function blocks are to be protected from viewing and accessing, a library project can be saved in encrypted format (<Project-Name>.compiled-library)
- The data structures of a library can be highlighted as library-internal. These non-public objects have the attribute "hide" and are therefore not displayed in the library management, the Intellisense functionality or the input wizards
- To easily provide information on a function block to library users, a corresponding comment can be added to the declaration of a function block parameter when creating a library project. Later, when the library is integrated into a project, it is displayed in the library manager on a "Documentation" tab

5.3.8 Converting IndraLogic 1.x libraries

- Libraries created with IndraLogic V1.x (*.lib) and earlier versions are still supported
- An old library project (*.lib) can be read via the library import of the "General module folder" (**General Module Folder ► Library Import...**). After the import, the library can be saved via **General Module Folder ► Create Library...** in the new *.library format

- If an old IndraWorks or IndraLogic project that references old libraries is converted via the menu items **Project ► Data Transfer**, it can be selected whether these references are to be retained, replaced or deleted. If the references are to be retained, the corresponding libraries are converted into the new format and automatically installed in the system library repository. Rexroth system libraries are automatically detected and converted here. If the system libraries do not contain the necessary "library information", it can be immediately added. The mapping, by which an old library was once handled while converting an old project, can be saved in the project options. Thus, the same library does not need to be explicitly processed every time in future project conversions

For a procedure description to convert projects and libraries, refer to the on-line help under "Data Transfer".

5.3.9 Integrating external code

External and internal libraries or library function blocks, late linking

- An "external library", in contrast to an internal (IndraLogic XLC/IndraMotion MLC library), is a library file that is programmed outside of the IndraLogic XLC/IndraMotion MLC system in another programming language, e.g. C. The library has to be on the target system and is only implemented if the application is running there
- As in IndraLogic 1.x, it is also possible to link an IndraLogic XLC/IndraMotion MLC library as external library later on, i.e. when the application is first operated on the runtime system. In addition, it is now possible to define the late linking individually for every library function block. For this purpose, enable the property in the object properties ("external implementation") of one or all function blocks

5.4 Task system

5.4.1 General information

The control can execute several tasks simultaneously. A "job" is called "task". For instance, controlling an axis by a task while another task is performing complex calculations is possible. A PLC task can process one or multiple programs. These programs are then processed successively by the task as defined. The PLC programs of a task can be located below the "Application" node of the control as well as below the "General module folder".

Task types

Tasks are divided into several types:

- **Cyclic:** The task is processed cyclically with a fixedly defined time interval (e.g. every 10 ms). This is the usual case for PLC tasks
- **Free running** (free wheeling): The task runs continuously. Once the attached PLC program has ended, it is immediately restarted
- **Event-controlled:** The task is always started when a specific Boolean PLC variable receives a rising edge
- **Externally event-controlled:** The task is always started when a specific event task occurs

Interval

Cyclic tasks are started at a defined interval. The runtime of the tasks is to be set smaller than the set interval. If the task is not completed after timeout, it is only restarted in the next interval cycle. This case is to be avoided. It is possible to monitor the task runtime using watchdogs (see ["Watchdog" on page 331](#)).



In order not to unnecessarily increase the CPU load, the cycle times is be selected in such a ways that the application requirements are fulfilled but without executing any undesired processes.

Events An event is either a changing PLC variable (for event-controlled tasks) or an external event named as such (for externally event-controlled tasks).

The following external events can occur in an IndraLogic XLC/IndraMotion MLC system:

- **EVENT_OP_MODE_MOTION_CYCLIC:** This event is triggered by a Motion cycle. This event is used to synchronize a PLC program with the calculation of axis motions. For controls with a Sercos interface, the "MotionTask" created by default uses this event (for IndraLogic XLC controls only for variants with a Sercos bus).

- **EVENT_OP_MODE_SERCOS_CYCLIC:** This event is triggered with every Sercos cycle in an IndraLogic XLC. This event can be used to synchronize with Sercos I/Os. This event is only available with IndraLogic XLC controls for variants with Sercos bus.

- **EVENT_Local_Input_Bitx:** This event is triggered by the onboard inputs of the control. Every input is mapped on Bit "x" x according to its number. A rising edge at the input triggers the respective event (see also [chapter "On-board and Fast I/Os" on page 344](#)).

Task priority

Only one task can run simultaneously as only one processor is available on the control. Task priority decides about the processing order if several tasks are ready for processing. A low number in the task priority means that this task has a high priority and is thus preferred.

If a task with a higher priority is ready for processing, any other running low-priority tasks are interrupted until the task with the higher priority is completed.

The following figure shows the processing of tasks with different priorities:

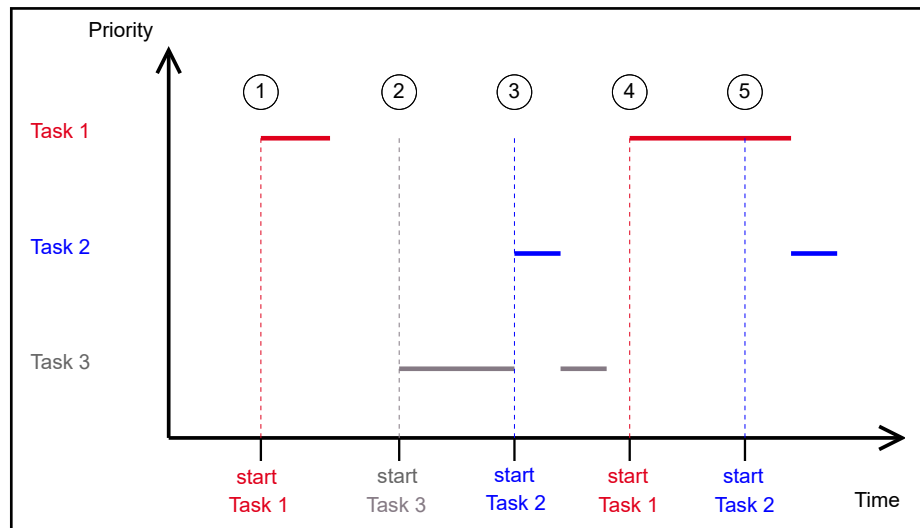


Fig. 5-6: Processing different task priorities

The horizontal lines in the figure above represent the times at which the individual tasks are running.

- ① Task 1 is started and starts to run immediately as it is the only executable task at this point
- ② Task 3 is started and immediately starts to run as well since no other task is running
- ③ If task 2 is started, task 3 interrupts, as task 2 has a higher priority. Subsequently, task 3 runs until completion
- ④ Task 1 is started and starts to run immediately as it is the only executable task at this point
- ⑤ Task 2 is started and cannot start running as the higher priority task 1 is still running. Once this task is completed, task 2 can run



Also ensure that PLC tasks are adjusted to this application. The priority of the different tasks is to be selected according to their processing relevance. The priority prevents that tasks whose job is irrelevant with regard to time block important tasks that need to be processed in specified cycles.

If several competing tasks have the same priority, the so-called round-robin method is applied. A running task is interrupted after 1 ms and the next task with the same priority becomes active. This takes place for all tasks with the same priority. This method is applied providing no higher-priority task is started or the starting condition of such a task is met.

The following figure shows the processing of several tasks with identical priority:

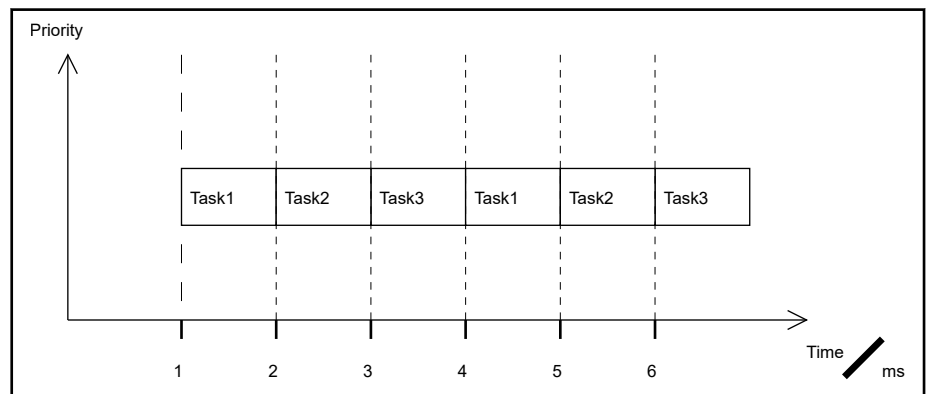


Fig. 5-7: Round-robin method

Tasks 1, 2 and 3 have the same priority. If a task needs more than one millisecond, it is interrupted and the next task is started. This is done until all tasks have been processed.



Assigning the same priorities is only required for a few applications. It is difficult to predict the behavior of the system and is thus to be avoided.

For tasks with the same priority and the same starting condition, call programs in one task if possible.

Watchdog

The watchdog is used to monitor the computing time of a task. The watchdog reacts if a task runs longer than defined in the watchdog. Triggering the watchdog always leads to a PLC exception and thus to the stop of the corresponding task. The watchdog is to be set in such a way that the job of the

tasks is still completed on time. If the value is too small, the system stops unnecessarily. If the value is too high, the watchdog only starts at extreme events such as endless loops in the PLC program.



The watchdog should always be activated and set to the respective time for time-critical tasks.

Alternating memory access

Consistency problems can also occur in multi-tasking systems when other global objects (global variables, function blocks) are accessed by several tasks if these global objects exceed the data width of the processor (structures or arrays that form a logical unit). Access to resources has thus to be protected and blocked from simultaneous access by other tasks. As a solution, functions and function blocks of the "SysSem" library system are available.

5.4.2 Node "Task configuration"

General information

Task configuration defines one or more tasks for controlling and executing the application program on the control.

The task configuration is automatically created by adding the control.



If the task configuration was deleted by mistake, the task can be subsequently inserted into the application via the context menu using the **Add ► Task...** command or by dragging from the library **PLC Objects ► General Objects**.

The uppermost node of a task configuration is always called  task configuration. Defined tasks are attached below. Each is represented by its name.

The program calls of the individual tasks are not shown in the tree.

Certain types of objects, such as a visualization object create their individual task automatically (VISU_Task).

In the task configuration, the usual commands for editing an object tree can be used to insert tasks and to copy, cut or delete. To add a new task, use the command **Add ► Task...** via the context menu.

Alternatively, add a task by dragging it from the library **PLC Objects ► General Objects**.

The individual tasks are configured in the [chapter 5.4.3 "Task editor" on page 335](#) also providing an online view. The configuration options depend on the target system.

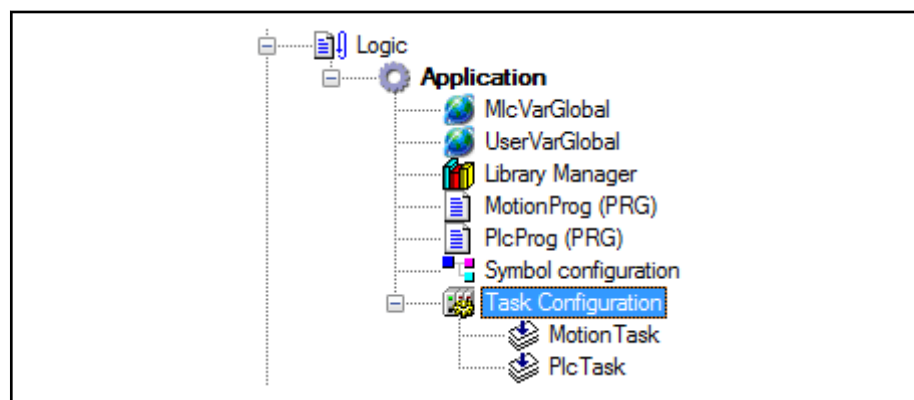


Fig. 5-8: Task configuration below an application in the Project Explorer

In online mode, the "task editor" provides a monitoring view with information on cycles, cycle times and task status.

Default tasks The following two PLC tasks are set up automatically when creating the control:

- **PlcTask**

This task is called cyclically every 10 ms. Time-critical PLC program processes cannot be implemented in this task

The cycle time and priority of this task can be adapted to the needs of the PLC program

- **MotionTask**

The MotionTask is of high priority and therefore only to be used for time-critical tasks that require synchronization with axis motions. The MotionTask is of a high priority and therefore only to be used for time-critical tasks that require synchronization with axis motions.

The Motion task provides dead time-optimum behavior for axis-synchronous processes (that is, all dead times related to axis motions are of a minimum)

A task runtime that is too high can lead to the error Cycle time exceedance (see [chapter 5.4.8 "System tasks" on page 345](#)).

The settings of this task are not to be changed

Other PLC tasks can be created at any time if required. The maximum number of tasks depends on the control used.

CML L45	CML L65	CML L75	VPx	XM2	XM4
20 tasks	20 tasks	20 tasks	20 tasks	20 tasks	20 tasks

Tab. 5-3: Maximum number of PLC tasks that can be configured

Configuration examples

Preconfigured tasks are sufficient for the majority of applications. As additional computational effort is required for each task, the number of configured tasks is to be as low as possible. If additional tasks are to be created, it is important to know how these tasks can be integrated into the existing system or how they affect the system behavior.

New PLC tasks can be created using the "Task Configuration".

The following examples illustrate how new tasks can be integrated into the system.

The following figure illustrates the default settings (see [chapter 5.4.8 "System tasks" on page 345](#)).

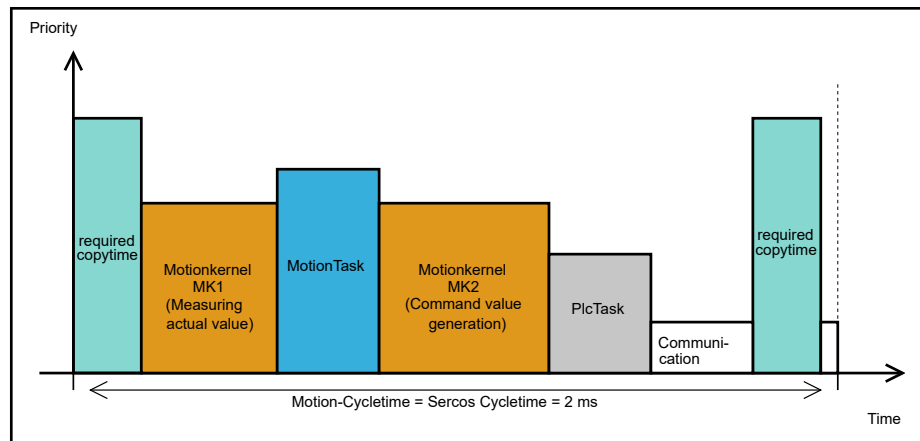


Fig. 5-9: Default setting before adding

Example: 1

As an example, a new PLC task with the name "NewTask" is added.

This task is configured cyclically. The cycle time is 1 ms.

The task priority is set to 15 and no watchdog is active.

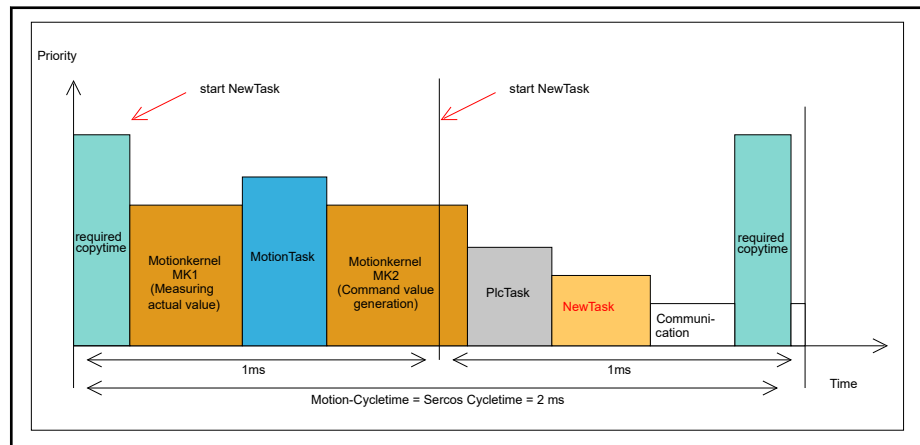


Fig. 5-10: Example 1, creating new PLC task

The "NewTask" is started each millisecond. However, tasks with a higher priority are running at this time. Thus, the "NewTask" cannot run during this period. The "NewTask" can only be processed after all tasks with a higher priority have been completely processed. The task has already been started twice up to this point at which the NewTask is processed. The task runs only once.



If a PLC task is started several times without being processed, the next time, it is started only once.



If a PLC task is still running when it is supposed to be started again, the start is ignored. The task is processed completely and is not immediately started again.

Example 2:

The priority of the "NewTask" of example 1 is now set to "1".

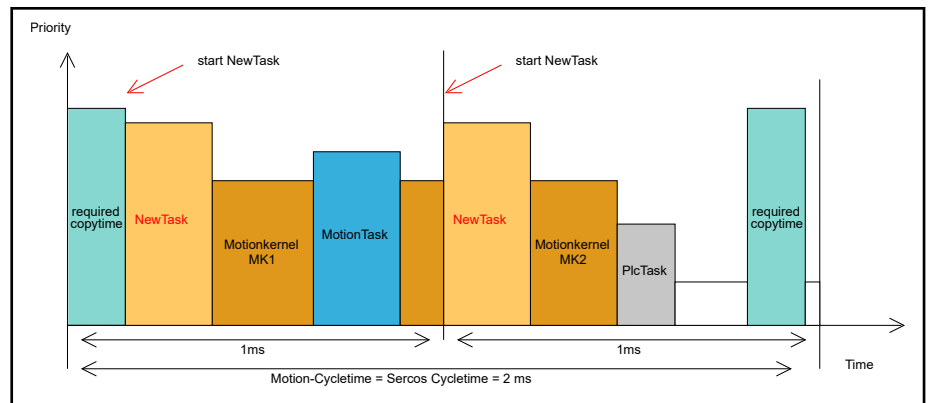


Fig. 5-11: Example 2, the priority of "NewTask" of example 1 is now set to 1

The "NewTask" has now a higher priority than the other tasks. Thus, the task is processed immediately at the starting times. During the second starting point shown in the figure, the "NewTask" interrupts MK2 until it is completely processed.



The task responsible for copying the real-time data has a higher priority than all other tasks, as it always has to be processed in each cycle. The priority of this task cannot be changed.

Example 3:

A PLC task with the name "SercosSyncTask" is added to the default tasks. The "SercosSyncTask" is event-controlled configured and has the priority 10. The external event triggered by the task is EVENT_OP_MODE_SERCOS_CYCLIC, i.e. the task is started in each Sercos cycle.

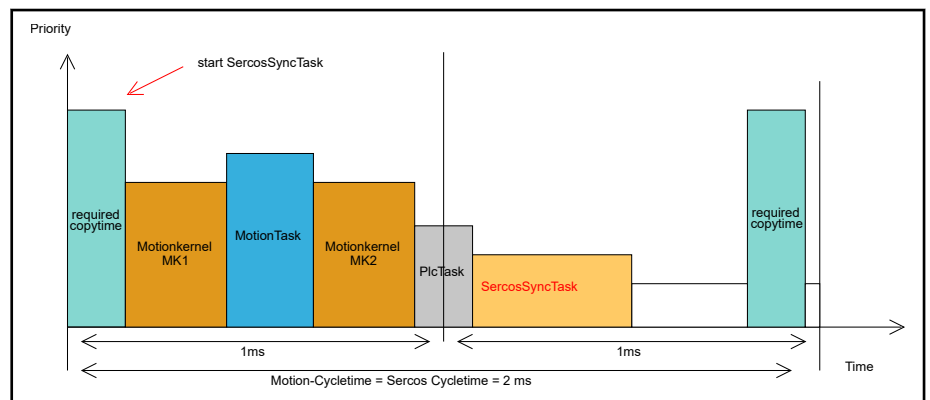


Fig. 5-12: Example 3, creating another task

In this example, the Sercos and the Motion cycle time are equal. The "SercosSyncTask" is started at the beginning of the Sercos cycle. However, this task can only run if all higher priority tasks have been completed.

5.4.3 Task editor

General information

Use the task editor to configure individual tasks for an application.

Open the task editor window by double-clicking on a task or by opening the context menu item "Open" of the task.

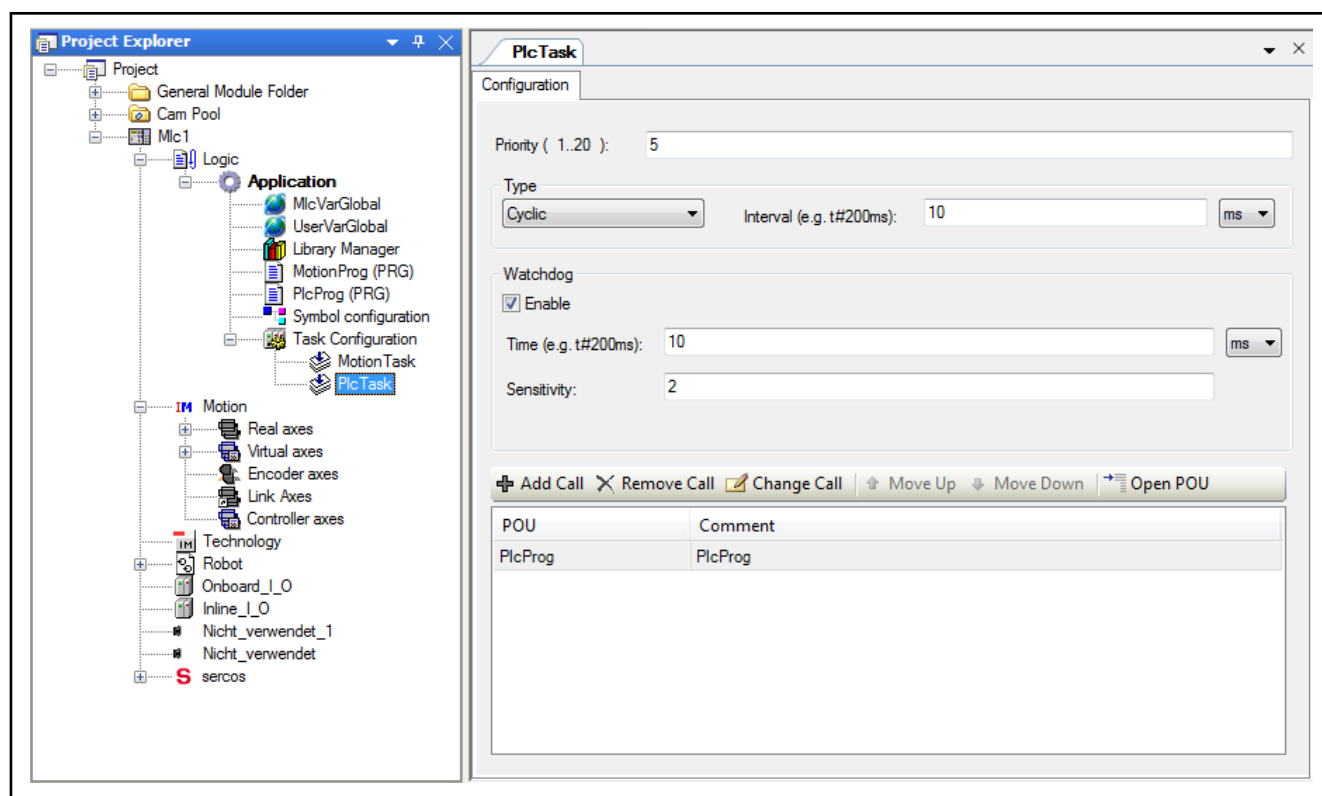


Fig. 5-13: Task editor, dialog to configure a task

The configuration options available in the dialogs depend on the target system used.

Configuring a task

Define the parameters as requested in [fig. 5-13 "Task editor, dialog to configure a task" on page 336](#):



A task can be renamed by editing its name in the Project Explorer.

Priority (1-20): Number between 1 and 20; 1 is the highest priority, 20 is the lowest.

Type: The selection list provides the following task types:

- **Cyclic:** The task is processed in cycles with a cycle time as defined in the "Interval" field (see below)
- **Free wheeling:** The task processing begins upon program start. At the end of the run, automatic restart occurs in a continuous loop. No cycle time is defined
- **Event-controlled:** Task processing begins as soon as the variable defined in the "Event" field receives a rising edge
- **Externally event-controlled:** The task processing begins as soon as the event defined in the "Event" field occurs. The events supported and provided in the selection list depend on the target system (do not confuse them with system events)

Obligatory entries depending on the task type:

- **Interval** (obligatory entry for the task type "cyclic" or for an "external event" if the event requires a time specification): Period after which the

task is to be restarted. If a number is entered, the unit can be set in the selection box behind the input field: milliseconds [ms] or microseconds [µs]. If the [ms] format is selected, an entry is automatically displayed in TIME format (e.g. "t#200ms") as soon as the focus is returned to the window. However, the entry can also be made directly in TIME format. Inputs in [ms] format are always displayed as number (e.g. "250")

- **Event** (for the task type "Event" or "External event"): Global variable triggering the task processing to start as soon as a rising edge is received.

Use the  button for a list of all available global variables

Watchdog: For each task, a watchdog can be configured. If the target system supports an extended watchdog configuration, it is possible that upper and lower limits and a default watchdog time are preset as well as a time specification in percent.

- **Enable:** If this option is enabled (, see below), the task is aborted with error status as soon as the processing has taken longer than the period defined in the "Time" field (see below)

If the option "Update I/O while in stop" (see [chapter "PLC settings" on page 211](#)) was enabled, the outputs are reset to the defined default values.

- **Time (e.g.: t#200ms):** Watchdog time; after this time period has been expired, the watchdog is enabled irrespective of whether the task has been completely processed. Depending on the target system, the monitoring interval might have to be entered in percent of the task interval. In this case, the drop-down list for the unit is grayed out and displays "%"
- **Sensitivity:** Number of times the watchdog time elapsed after which the task is stopped and a watchdog exception is output



Note that the "CmplecTask.library" provides a watchdog using the library functions "IecTaskDisableWatchdog2" and "IecTaskEnableWatchdog2". This can be used to temporarily deselect and re-select a configured watchdog monitoring. This can for example be useful for cycles that temporarily require more time due to initialization routines.

POUs:

The function blocks controlled by the task are listed in a table with the "POU" columns (function block name) and an optional "comment". There are commands for editing on the left of the table:

- To define a new program call, use the **Add Call** command to open the input assistance dialog and select the desired program from those available in the project
- To replace one call with another, highlight the entry in the table, open the input assistance with the **Input assistance** command and select another program
- To delete an entry, highlight it in the table and use the **Delete All** command
- The **Open POU** command opens the currently selected program in the respective editor

The arrangement of the function blocks in the list from top to bottom specifies the **execution sequence** of the programs in online mode. Use the **Move Up** and **Move Down** commands to move the currently selected entry in the list.



When configuring the task system, ensure that the available calculation time is used the best possible.

"Optimally" in this case means:

- that the application requirements have to be fulfilled
- that the system capacity should not be unnecessarily loaded

5.4.4 "Properties" dialog

Double-click to select the  node. Then, the "Properties" dialog opens in the "Task Configuration" dialog (refer to the following figure).

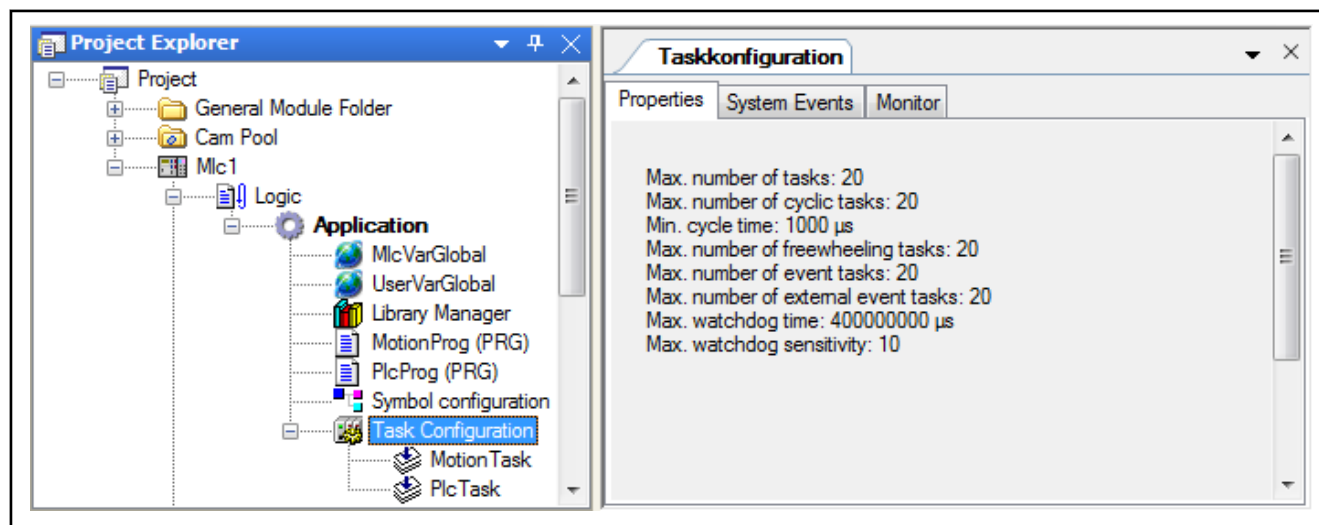


Fig. 5-14: Task configuration, "Properties" dialog, example

This is a display of general settings for task configuration as specified by the target system. For example, the maximum possible number of tasks per task type.

5.4.5 Task list/configuration

The task list enables the data of all tasks to be seen at a glance and the tasks to be prioritized.

Open this dialog via the context menu of the control. **Diagnostics ► Task List/Configuration.**

Availability

The table is available "online" as well as "offline". In offline mode, only PLC task data is available. The data of the Motion calculation (corresponds to the "Motion kernel" in previous versions) and the C-tasks (user tasks) (tasks created via "Motion Logic Programming Interface MLPI") are only available online since this data is read from the parameters of the control.

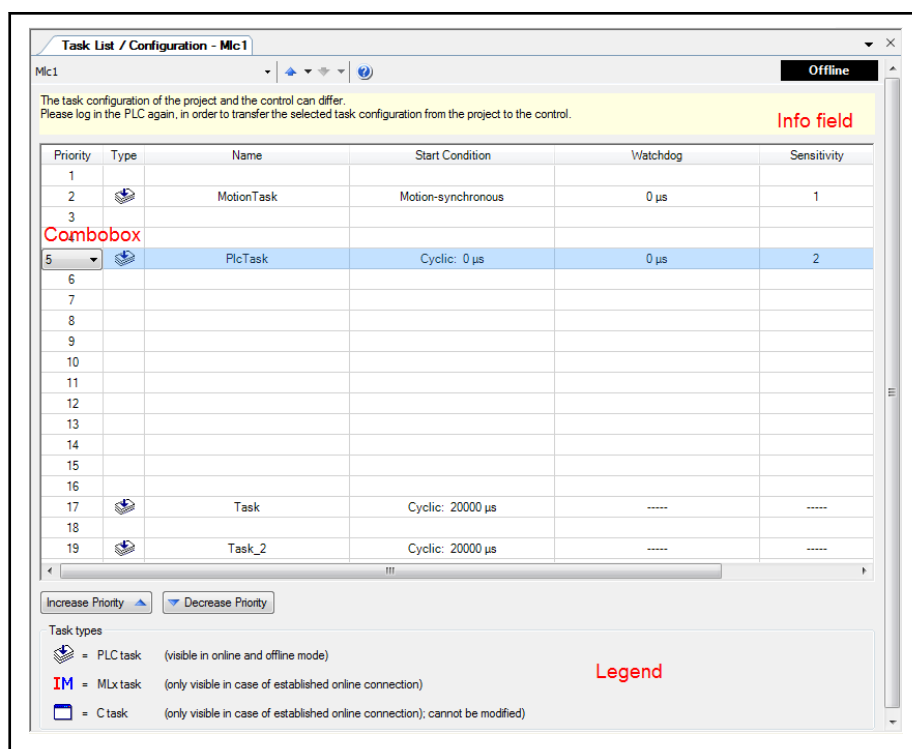


Fig. 5-15: Task list in offline mode

The key below the table shows symbols regarding the respective tasks and a note on visibility and changeability.

Up-to-dateness

The "Info" field above the table shows the current status of the configuration. Data can either be identical to the control data or differ. Additionally, it might not be possible to provide any statement regarding the status. This occurs if the dialog is opened without an established online connection, since the comparison is executed via the parameter.

Activation

If the PLC task configuration in the table is not identical to the control, log into the control to apply this configuration. If already logged in, log out and log in again to activate the configuration. Only the current values are displayed for the C-tasks and the Motion calculation, since they can only be influenced externally or data can be immediately applied.

Changeability

Only the priority of the individual tasks can be changed directly in the table. The C-tasks are an exception, since they are externally created. Therefore, they are only displayed and cannot be changed. The other PLC task data (e.g. starting condition) has to be configured via individual dialogs of the tasks (see [chapter 5.4.3 "Task editor" on page 335](#)). The individual dialog is only available for the PLC tasks.

For the Motion calculation, the sensitivity and the cycle time can be modified via the parameters "C-0-0420, Motion, watchdog sensitivity" and "C-0-0400, Motion, cycle time, command value".

There are two options to change the priorities in the table. The priority can be decreased or increased using the buttons below the table. The other option is to directly adjust the priority of a task by clicking on the respective cell. The combo box can be activated by clicking. A priority between 1 and 20 can be selected directly in this box.

Operation

The combo box is only available for lines in which changeable tasks are located. The same applies for the buttons below the table. If a line without content is highlighted, neither the combo box nor the buttons can be selected. If a

task is to be highlighted at the upper or lower end of the table, the respective button for increasing or decreasing the priority cannot be used.

5.4.6 Task viewer

This dialog shows the chronological sequence of task processing on the control. For the dialog, go to the context menu item "Diagnostics" -> "Task viewer" of the control.

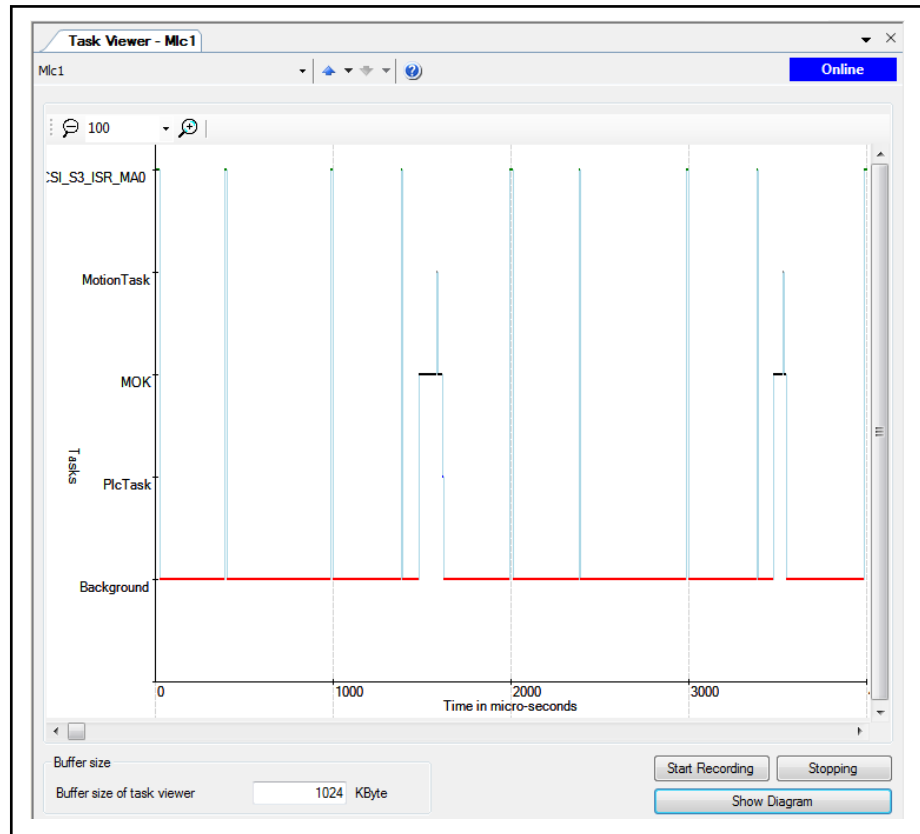


Fig. 5-16: "Task viewer" dialog

Availability	The "Task Viewer" is only available in "online" mode. PLC tasks are only displayed if the PLC program is loaded and running.
Recording depth	The recording period of the diagram is defined in the "Buffer size" field. The default setting is generally sufficient. The recording is created as ring buffer. The oldest values are lost when the buffer is full.
Task recording	The recording is started with Start Recording . The recording runs until Stopping is pressed. The Show Diagram button is pressed to transfer the recorded sequence from the control to the interface.
Recording analysis	The task diagram is displayed once the recording is completed. The "Tasks" axis represents task priority. The further up a task is displayed, the higher its priority. The "time axis" can be scaled via the and buttons. The recording can be moved horizontally if required.
Displayed tasks	Active tasks are represented by a horizontal blue line. Tasks of a higher priority replace tasks of a lower priority. Once a high-priority task is ended, the next lower-priority task ready for running automatically becomes active. Internal system tasks are processed if no task is ready to run. These internal system tasks are shown by a red line.

The following tasks are displayed in the "Task Viewer":

- PLC tasks: These are all tasks created in the task configuration (see [chapter 5.4.2 "Node Task configuration" on page 332](#)). These tasks are displayed with their name on the "Task" axis
- MOK: This task is the Motion kernel of the control. It calculates the axis motions
- SI_S3-ISR_MAO: This task is responsible for the Sercos III bus. It has the highest priority
- Background information: These are all further internal tasks with low priority. These tasks are shown by a red line

5.4.7 I/O turn-around times

General information

The term "turn around time" describes the time between an event and its resulting response. I/O turn around times are a special kind of turn around times. The turn around times are defined by the time span between the setting of an input and the resulting setting of the output.

Inputs and outputs are processed by the PLC. A PLC task according to the IPO principle (Input - Process - Output). Initially, a consistent input image is generated in which all required actual states are read. Thus, the I/O states are recorded at this point. Subsequently, the PLC task is sequentially processed (e.g. setting outputs). At the end of the PLC task, a consistent output image is generated and the newly calculated data becomes valid. At this point, outputs are set for example.

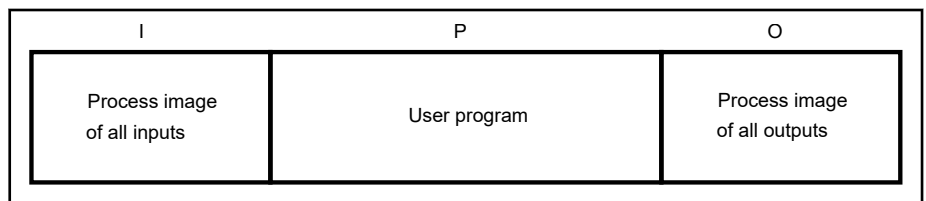


Fig. 5-17: Basic PLC task structure

[fig. 5-18 "Components of I/O turn around time" on page 342](#) shows the different components of the I/O turn around time. The entry is the time span between the setting of the input and the detection of the I/O hardware. The transmission time between the I/O hardware and the control is represented by the communication. The processing time is defined by the time required for calculating an output signal from the transmitted input signal. In the simplest case, it is the copy of the input signal to the output signal. Once the output signal is computed, it has to be transmitted for output (communication). The output time is the required time of the I/O hardware to set the output.

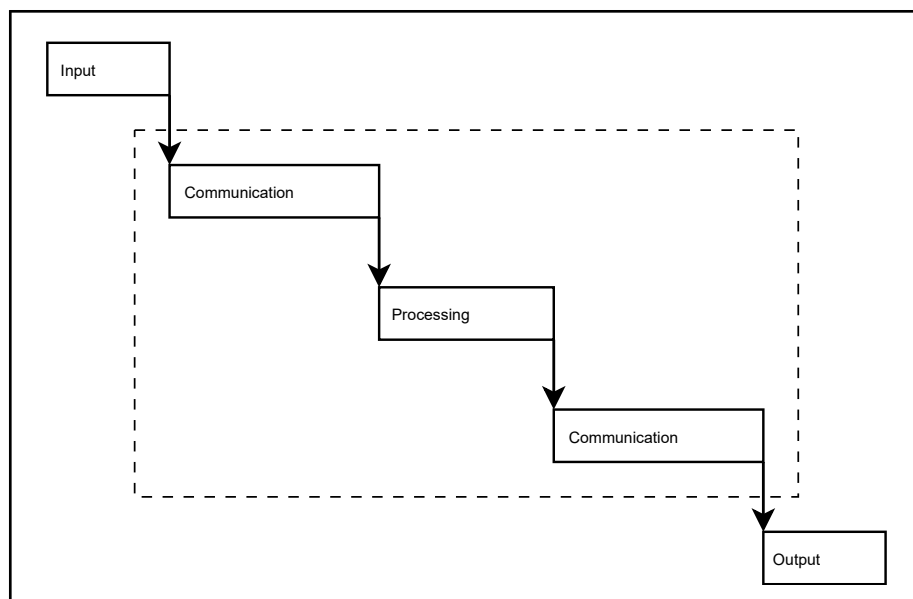


Fig. 5-18: Components of I/O turn around time

When implementing short I/O turn around times, ensure that the times are as short as possible.

However, there are defined times depending on the hardware. Input and output represent the times in the figure above. These delay times filter peak loads. It is filtered to detect only desired inputs or to set outputs. The time depends on the I/O hardware and is given in the respective hardware specification sheet.

The time required for communication depends on the connection of the I/O hardware to the control. This time can be reduced if required (e.g. Sercos cycle time).

The processing time depends on how fast I/O data is processed by the PLC task in which the I/O data is integrated. I/Os are only processed by the PLC (see [chapter "Configuring a task " on page 336](#)). If there is I/O data in the control, process it as quickly as possible.

After processing, I/O data is to be transmitted to the I/O hardware as quickly as possible.

These times have to be optimized in order to achieve the desired I/O turn around times.

Bus cycle task

The point in time of the I/O mapping can be set via the bus cycle task. The configuration can be made:

- globally in the PLC settings
- locally at the corresponding field bus master



The local setting at the local field bus master dominates the global setting.

For more information on this topic, refer to [chapter 5.5 "I/O access" on page 352](#).

Safe state

If the PLC task responsible for the I/O mapping is not running or stopped due to an event, the outputs go into a defined safe state. This state can be set globally in the "PLC settings" dialog. There are the following options:

- Update I/O while in stop: The inputs and outputs are still updated if the I/O task is stopped.
- Behavior of the outputs at stop:
 - Retain values: The values of all outputs remain. No outputs are reset
 - Set all outputs to default: The outputs are set to their respective default value
 - Execute program: A settable PLC program is executed. It can set the outputs to a safe state
- Update all variables in the devices

Profibus, Profinet and Inline I/Os

The I/O mapping for Profibus, Profinet and Inline I/Os can be coupled to a PLC task. Inputs are then copied before the PLC task starts. Outputs are copied following the end of the PLC task. A consistent state of the respective field bus is guaranteed at the time of mapping.

There are two options to configure the I/O task:

- Global: In the "Configuration" dialog of the control (double-click on the control), it is possible to set the so-called "Bus cycle task" for all field buses in the "PLC Settings" tab. The selected task then executes the I/O mapping for all field buses
- Field bus mode: The "Bus cycle task" can be set for Profibus and Profinet in the "Configuration" dialog for the field bus (by double-clicking on the respective field bus node) in the "I/O Mapping" tab. The task set here creates the I/O mapping for this field bus. This setting has a higher priority than the global setting

Sercos III I/Os

In order to have relatively short I/O turn around times with Sercos III I/O, perform the following steps:

- Adjusting Sercos cycle time (C-0-0503, sercos master, cycle time): The Sercos cycle time has to be adjusted to the desired I/O turn around time
- A Sercos-synchronous PLC task is to be used to process I/O data (type: externally event-controlled; external event: EVENT_OP_MODE_SERCOS_CYCLIC). This task is started in each Sercos cycle and can thus process the I/O data between receiving and sending data. To ensure that the task can run in each Sercos cycle, the priority of the task is to be adjusted (see [chapter 5.4.1 "General information" on page 329](#))

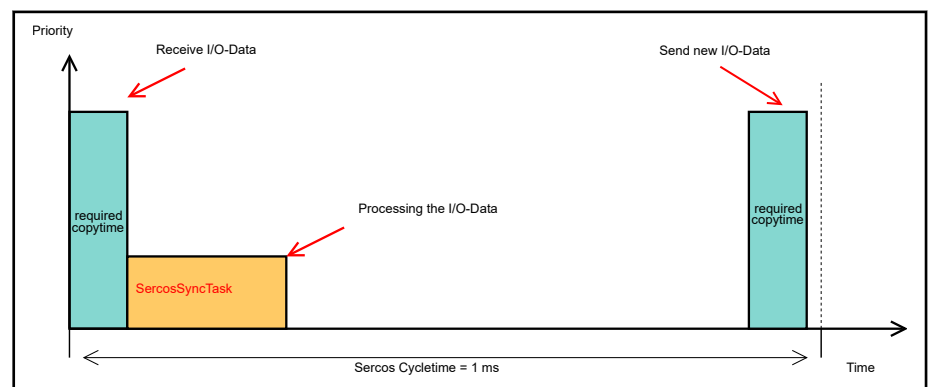


Fig. 5-19: Processing I/O data

As shown in the figure, the I/O data was received at the beginning of the Sercos cycle. This data can now be processed by the PLC task. One or several outputs are to be set if one or several inputs are set. The processed data is sent again at the end of the Sercos cycle.

The time required until the data is in the control depends on the Sercos cycle time and the time of setting the input with regard to the time of latching the inputs in the I/O hardware.

The following figure illustrates this process:

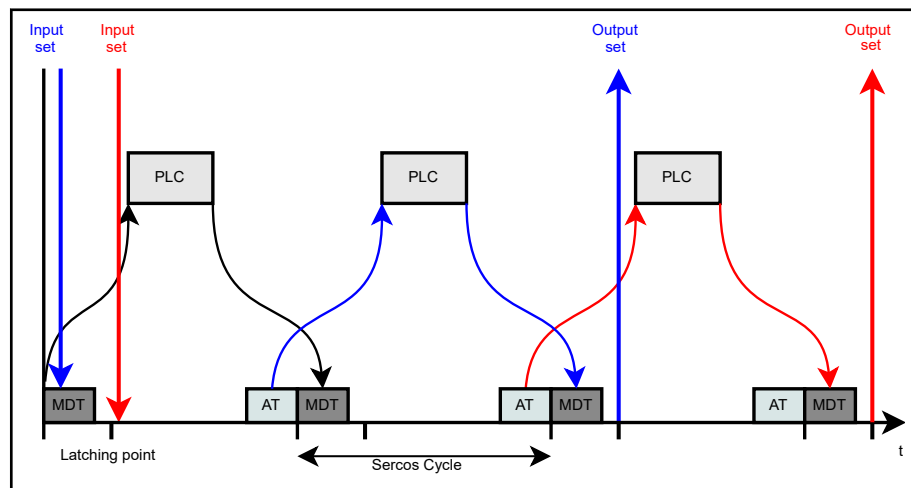


Fig. 5-20: Time required for data transfer

Changes of inputs and outputs become active after the **MasterDataTelegram** as shown in the figure above. There is only one I/O update per cycle. If an input is set after the MDT, it becomes active only in the next MDT and is sent in the subsequent **Acknowledgement Telegram**. This results in a maximum delay of two Sercos cycles. The PLC detects that the input is set and the output is also set. The data is sent in the next MDT and the output is enabled immediately after the MDT was received by the I/O hardware. Worst case: the I/O turn around time is three Sercos cycles plus filter times (for MDT and AT functionality, refer to "Data Exchange Between Control and Drives"). As a consequence, reducing the Sercos cycle time also reduces the I/O turn around time.



If Sercos I/Os are configured, data can be exchanged faster by reducing the Sercos cycle time. Thus, it is necessary to configure a Sercos-cyclic PLC task in which the I/O data is analyzed.

Onboard and Fast I/Os

The IndraLogic XLC/IndraMotion MLC L45/L65/L75 already have onboard I/Os and can be additionally extended via function modules. One of the function modules is the Fast I/O module.

For more information on function modules, refer to the application description "Rexroth IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Function modules and onboard I/Os are connected to the control via PCI bus. Therefore, the time required for communication is very low. The filter times are not high either and can be taken from the specification sheet. Processing is the decisive factor for reducing the I/O turn around time.

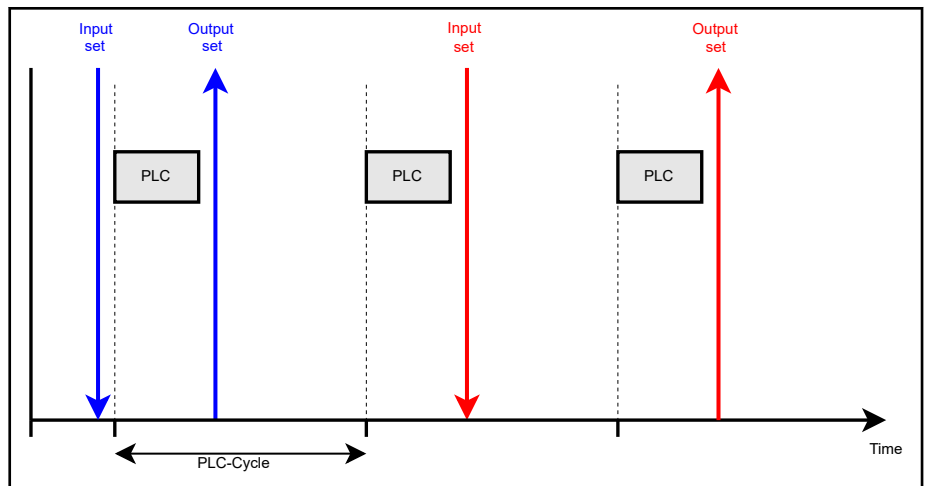


Fig. 5-21: I/O turn around time, Onboard I/O and Fast I/O

As shown in the figure above, the max I/O turn around time is one PLC cycle plus filter times plus the length of the PLC task.

With onboard I/Os, it is possible to directly start a task via an external event if an input is set. In order to start the task via an external event, an externally event-controlled task has to be configured with an external event, e.g. EVENT_Local_Input_Bit0. If this task has a higher priority than the other tasks, it is started immediately and the I/O data is processed immediately.

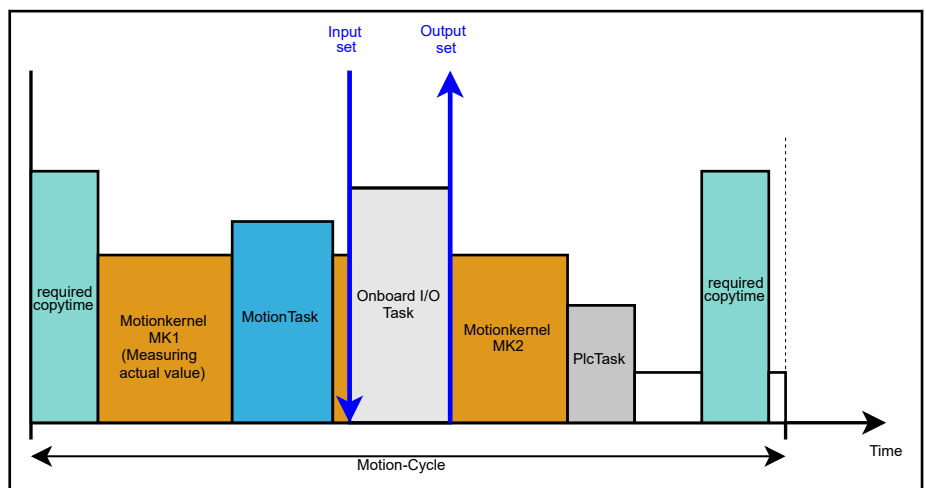


Fig. 5-22: I/O turn around time; task directly started via external event

As shown in the figure, a very short I/O turn around time can thus be achieved.

5.4.8 System tasks

Several system tasks are used to execute different tasks of the control.

Typical functions of the tasks:

- Communication (e.g. IndraWorks)
- Handling of real-time data of Sercos buses
- Collecting and generating real-time data
- Error reaction, etc.

These tasks are already configured in the control and cannot be influenced.

The task responsible for calculating the Motion is the only exception.

In the default setting, an entire Motion cycle runs as follows:

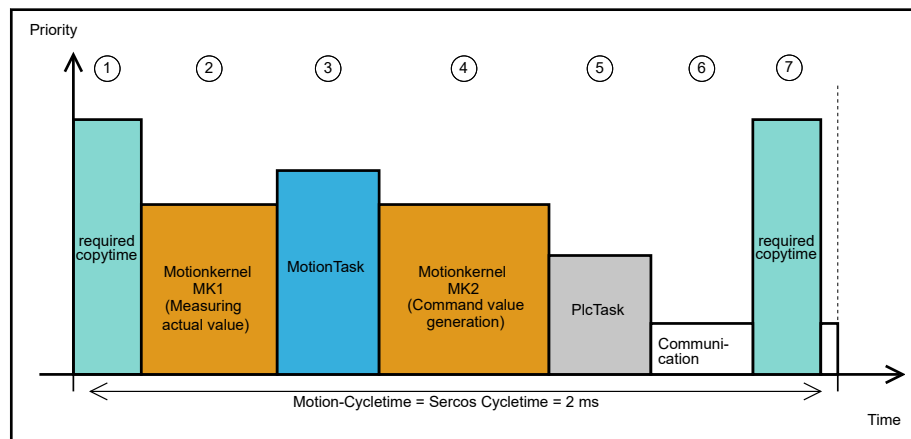


Fig. 5-23: Overview on the temporal behavior

In the default setting, the Motion cycle time (C-0-0400, Motion, cycle time, command value) is equal to the Sercos cycle time (C-0-0503, sercos master, cycle time) = 2 ms.

- ① Data received with the drive telegram (AT telegram) is copied to the local user memory. This is carried out in each Sercos cycle and requires some calculation time. The calculation time depends on the number of Sercos devices
- ② The Motion kernel is started and the actual value detected is executed
- ③ The MotionTask is started and interrupts the Motion kernel
- ④ The MotionTask is completed. The Motion Kernel continues to run and the command value is generated
- ⑤ The PlcTask is processed, as all tasks with a higher priority are now completed
- ⑥ PlcTask is completed. Now, low-priority tasks, so-called background tasks, can be processed. These tasks are used for different tasks. One of the most important functions is to control the communication (e.g. IndraWorks)
- ⑦ Data received with the MDT telegram is copied to the local user memory. This is carried out in each Sercos cycle and requires some calculation time. The calculation time depends on the number of Sercos devices. If data is copied, there is time left to perform background tasks up to the next cycle start



The figures illustrate this process and do not show the exact temporal behavior of the control. The required task times are considerably lower than shown in the figures!

The cycle time of this task for calculating the Motion, from now on referred to as **Motion kernel**, can be set via parameter "C-0-0400, Motion, cycle time, command value". The minimum and maximum cycle times depend on the hardware used. The currently valid cycle time can be read via the parameter "C-0-0410, Motion, cycle time (Tcyc), actual value". The Motion cycle time has to be equal to or a multiple of the Sercos cycle time "C-0-0503, sercos master, cycle time". These times can be set via the context menu of the control "Cycle Times" of the Motion node (see [chapter 7.2 "Cycle times" on page 519](#)).

The priority of the Motion calculation can be changed via the parameter "C-0-0403, Motion, priority calculation" in the priority table (see [chapter 5.4.5 "Task list/configuration" on page 338](#)). 20 different priorities can be assigned. The Motion kernel and the PLC task have the same priority.

As the Motion kernel is a real-time task, it has to be processed in the set cycle. Thus, it is checked in each Motion cycle if this was the case.

The sensitivity of this check can be changed via the parameter "C-0-0420, Motion, watchdog sensitivity".

The error counters can be read via the parameters "C-0-0421, Motion, absolute error counter" and "C-0-0422, Motion, number of successive errors" and can be reset via the command C-0-1052, Command: Reset parameter C-0-0421 and C-0-0422. These parameters are also displayed via the context menu item "Cycle Times" of the Motion kernel (this functionality is only available when using Sercos III).

The two main tasks of the Motion kernel are:

- **Actual value detection** (part 1 of the Motion kernel, also referred to as MK1)
- **Command value generation** (part 2 of the Motion kernel, also referred to as MK2)

Actual value detection Recording and conversion of the actual value data of all Motion objects is executed in the first part of the Motion kernel.

The statuses of all Motion objects and the pending Motion commands are generated by the Motion kernel.

For example, the axis status A-0-0021 is generated here.

Command value generation The second part of the Motion kernel generates and outputs the command value.

MK2 interprets all new Motion commands and processes all Motion commands in each cycle.

If the option "Interpolation in control" has been selected (in the drives' "Configuration" dialog), the command values for the drives are calculated.

For example, the operating state switching takes place if new commands were issued.

The calculation time of the Motion kernel depends on the number of configured drives. The currently required time can be read via the parameter "C-0-0412, List of current time slot measurements". The required maximum time can be read via the parameter "C-0-0413, List of maximum time slot measurements" and the required minimum time via the parameter "C-0-0414, List of minimum time slot measurements".

By executing the command "C-0-1050, Command: Reset parameter C-0-0413 and C-0-0414", the minimum and maximum times can be reset.

The times that can be read via the parameters contain the time required to write the bus data into the local memory in each Sercos cycle.

These parameters are displayed via the context menu item "Cycle Times" of the Motion node.

If the Motion kernel is not completely processed in the set Motion cycle, an error reaction is executed.

This can have two reasons:

1. The time the Motion kernel requires is longer than one Motion cycle.
2. A task with a higher priority was processed before the Motion kernel.

Furthermore, there are two different error types:

1. The **Actual value detection** could not be performed in one cycle.
2. The **Command value generation** could not be performed in one cycle.

In the case of the **Actual value detection**, the error "F5180006, Calculation of actual values exceeded cycle time" is generated.

In case of the **command value generation**, the error reaction depends on the set sensitivity of the Motion kernel C-0-0420, Motion, watchdog sensitivity. Either error "F0180008, Motion kernel exceeded control cycle time" or [F5180005](#), Motion kernel exceeded control cycle time is generated depending on fact whether the number is smaller or greater than the set sensitivity.

Error "Timeout cycle time of actual value detection" due to blocking by a higher priority PLC task:

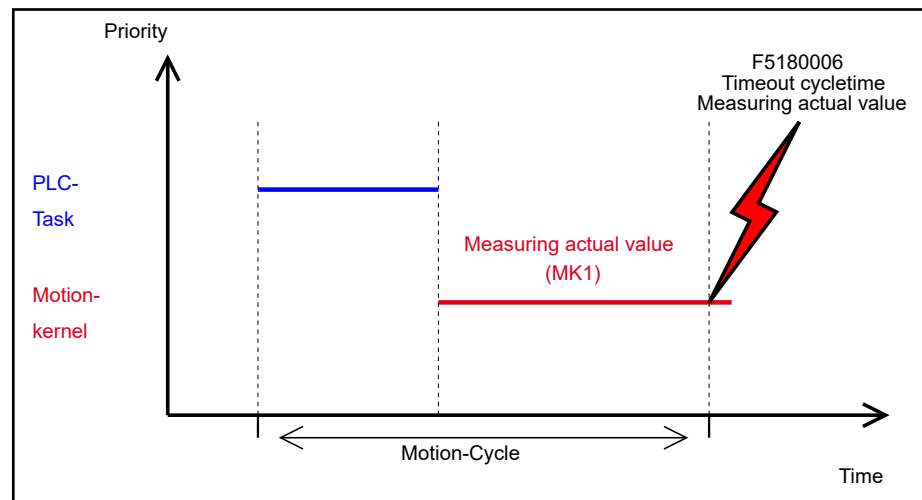


Fig. 5-24: Actual value detection blocked by a higher priority PLC task

Error "Timeout cycle time of Motion kernel" was triggered since the Motion kernel could not be completely processed:

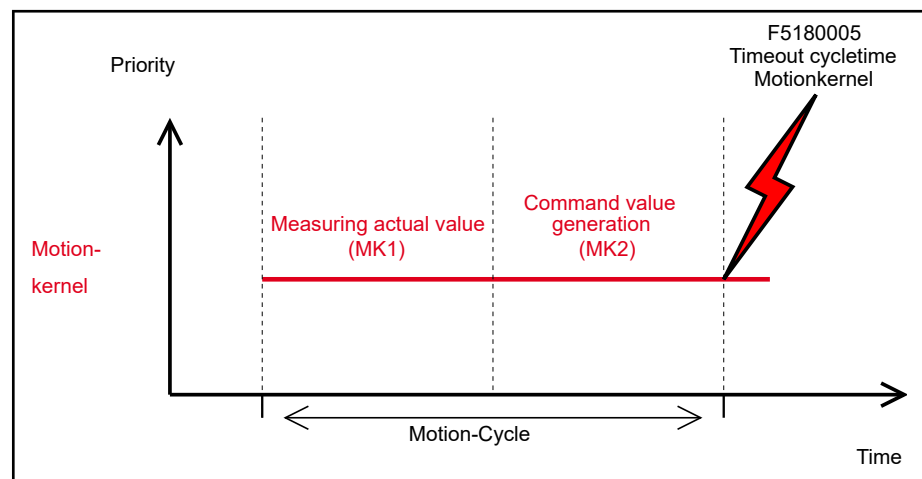


Fig. 5-25: Motion kernel not completely processed

There are several possibilities to adjust the task system to the different requirements.

A correct configuration of the Motion kernel is essential for all applications whose behavior can be influenced in different ways (see [chapter 5.4.5 "Task list/configuration" on page 338](#)).

Adjust the following settings to the requirements of each application:

- **Cycle time:** The Motion cycle time set via the parameter "C-0-0400, Motion, cycle time, command value" specifies in which temporal order the Motion kernel is processed. The shorter the time selected, the higher the CPU load. Consequently, the time in which the Motion kernel has to be processed is also reduced. Due to this reason, ensure that the actually required cycle time is set for the application
- **Priority:** In the set priority of the Motion kernel, the importance of the Motion calculation for an application can be set via the parameter "C-0-0403, Motion, priority calculation". Each task with a higher priority than the Motion kernel blocks the running Motion kernel (system tasks). Consequently, ensure that only the tasks with a priority higher than the priority of the Motion kernel are configured and whose runtime is not that long and for which it is required (e.g. to implement short turn around times)
- **Sensitivity:** The Motion kernel sensitivity (C-0-0420, Motion, watchdog sensitivity) is 1 by default, i.e. an F5 error is triggered when the cycle time is exceeded and all axes are set to standstill (F5 error, error reaction)



If the sensitivity is increased and an error occurs during the axis motion, the drive calculates the non-existent command value. However, this value can slightly differ from the actual command value. Thus, minor inaccuracies can occur!

Selecting the correct Sercos cycle time (C-0-0503, sercos master, cycle time) is also important. Reducing the Sercos cycle time as well as reducing the Motion cycle time results in a considerable increase of the CPU load, as the processing of real-time data requires time for copying in each cycle.

If there are only drives in the Sercos bus, the Sercos cycle time is also equal to the Motion cycle time. A faster Sercos cycle time than the cycle time of the Motion results in the data being transmitted more often. However, this data is only processed and prepared in the Motion cycle of the Motion kernel.

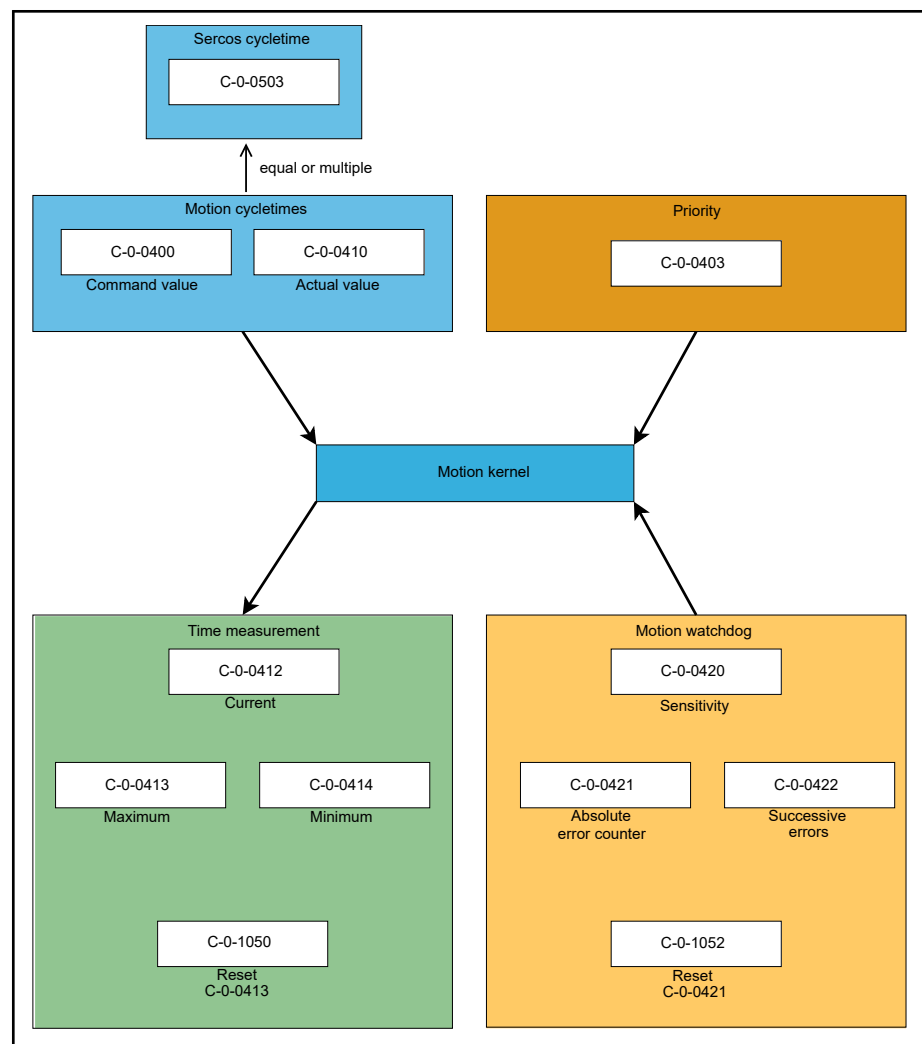


Fig. 5-26: Configuring the Motion kernel

5.4.9 CPU load of the control

The CPU load of the control results from the computing time of all tasks running in the system. These tasks can be system as well as PLC tasks.

Each task to be processed increases the CPU load. Approximately 80 system tasks are processed on the control in the current version. These tasks accept the different control jobs (PLC tasks, motion interpolation, monitoring, communication, field buses, parameter handling, error reaction, control display, HMI communication,...). Depending on the application, the number of tasks can even increase further.

CPU load factors The most important factors are:

- Cycle times of the PLC tasks
- Scope of the PLC programs
- Cycle times (Motion and Sercos)
- Number of axes
- Number of kinematics
- C2C devices / number of master axes
- HMI communication

Diagnostic options

- **Control parameter C-0-0415, CPU load, current**

The current CPU load can be read via the control parameter C-0-0415. The parameter displays the time (in percent) the system is not in "idle mode". The control is in idle mode when the task with the lowest priority is running. This task can only run if no other task is running due to its priority

- **Task Viewer**

The CPU load contains all tasks. In the Task Viewer ([chapter 5.4.6 "Task viewer" on page 340](#)), only the high priority Sercos copying routines, the motion computation and PLC tasks are displayed. Thus, the system is loaded by low-priority tasks shown in the Task Viewer as background.

For the "Task Viewer", go to the context menu of the control (**Diagnostics ► Task Viewer**). The control has to be switched to online

Both diagnostic options display different values. The CPU load of the C-0-0415 contains all tasks. In contrast, only the high priority Sercos copying routines, the Motion computation and PLC tasks can be displayed in the Task Viewer. Thus, the system is loaded by low-priority tasks shown in the Task Viewer as background.

Basic CPU load

The basic load is the CPU load of the control after the initial switch-on with a default PLC project (control state: BB RUN).

All components are created at control startup. These components create the required tasks. Some of these tasks are cyclically called and it is checked whether relevant data exists. Thus, up to 15 tasks, which have to be processed, are called in each system cycle (each millisecond). Even if the runtime is very short for the individual tasks, it sums up and affects the CPU load. The default cycle times of the control are 2 ms. Sercos as well as Motion data have thus to be computed every 2 ms. Furthermore, the MotionTask of the PLC is thus also processed in this cycle.

CPU load

A permanent CPU load of the control of 100 % is to be avoided and an average load of 90-95 % is not to be exceeded. The Motion computation and the PLC-IEC tasks are not to require more than 75 % of the computation time. Depending on the requirements for the control, these values can vary.

The CPU load is not the mandatorily decisive factor in this case. The computation time required for the high priority tasks is the decisive factor.

The time available for the background tasks can be read using the Task Viewer. This time is available as computation time for Motion and PLC. Background tasks can be suppressed for a specified amount of time. Additionally, a time span that can be set for background tasks is reserved in each cycle. During this period, these tasks cannot be suppressed by high priority tasks. Depending on the tasks to be performed, the runtimes of all tasks are subject to fluctuations. Thus background tasks are dynamically suppressed and processed. If the available computation time is nearly completely loaded due to the Motion computation and the PLC-IEC tasks, the executed tasks can be slowed down due to the background tasks (communication, data transfer, parameter queries, display).

If there is still sufficient time, more axes can be added or the PLC program can be extended.

To adjust the system the best possible to the desired requirements, take the following factors into account:

- Motion and Sercos cycle times
- Cycle times and task priorities of the PLC-IEC tasks

5.5 I/O access

To use an I/O address, A PLC variable that accesses this address has to be defined. This process is known as "mapping".

The PLC allows two different methods to map a PLC variable to an external input or output:

- I/O access via the "AT" operator
- I/O definition via the "I/O Mapping" dialog of the respective I/O device editor

Both variants map a PLC variable to the memory address of an external input or output. When the variable is accessed, the hardware is accessed. All I/O devices are entered into the memory mapping in the order of their definition in the project. The address of an I/O can be read in the I/O devices "I/O Mapping" dialog.

IndraWorks automatically specifies the addresses. The addresses can also be specified manually (see [fig. 3-85 "Labeling fixedly specified address" on page 131](#)).

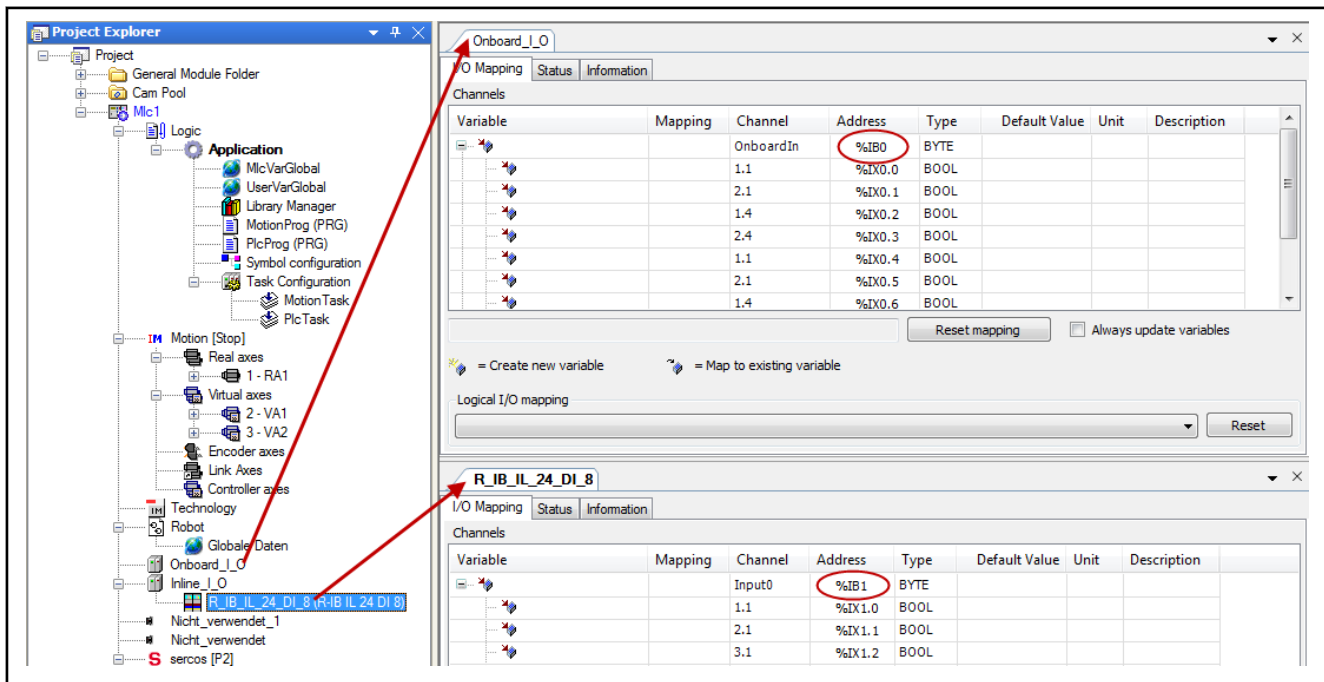


Fig. 5-27: Addresses of an I/O device

The hardware addresses of the I/Os are displayed via the % operator.

Syntax: %<RangePrefix><SizePrefix><number.number>

The following range prefixes are supported:

I	Input
Q	Output
M	Memory location

The following prefixes are supported for the sizes:

X	Single bit
None	Single bit
B	Byte (8 bits)
W	Word (16 bits) [word (16 bits)]

D Double word (32 bits)
L Long word (64 bits)

Examples:

%QX7.5 Output bit 7.5

or

%Q7.5

%IW215 Input word 215

%QB7 Output byte 7

%MD48 Double word at memory location 48 in flag area

Declaration via "AT" operator

The variable can be mapped to an I/O address in a variable declaration. This is performed via the "AT" operator.

Syntax: <Identifier> AT %<I|O><I/O address>:<DataType>

Example:

```
VAR_CONFIG
  PLC_PRG.locioVar1.xLocIn AT %IX1.0 : BOOL;
  PLC_PRG.locioVar1.xLocOut AT %QX0.0 : BOOL;
  PLC_PRG.locioVar2.xLocIn AT %IX1.0 : BOOL;
  PLC_PRG.locioVar2.xLocOut AT %QX0.3 : BOOL;
END_VAR
```

Declaring via I/O mapping

The second option to map a PLC variable to an I/O is the I/O mapping of an I/O module. In contrast to variable mapping via the AT operator, the variable is not defined in the source text of the PLC program, but graphically in the "I/O Mapping" dialog of the corresponding I/O module.

The PLC variable can be specified in the "Variable" column.

The "Mapping" column specifies whether a new variable is declared or mapped on an existing variable:



It is mapped on an existing PLC variable



A new PLC variable is created

Left-click on the symbol to switch between the two mapping methods.

Bus cycle task

The bus cycle task is the PLC task. At its beginning or end, the input or output data is copied from the I/O. This ensures data consistency and allows short simultaneous latency times.

The bus cycle task can either be set centrally at the control or separately for each I/O master. The setting at the I/O master has a priority higher than the setting at the control.



If no bus cycle task was determined, the fastest cyclic task was automatically used. This is the PLC task in the preset task configuration.



If other PLC tasks access these I/Os, the tasks can be stopped until the I/O mapping is completed.



Set the bus cycle time to the fastest PLC task accessing the corresponding I/O device.

Central determination of the bus cycle task at the control:

1. Double-click on the "Control" node in the Project Explorer.

The setting window of the control opens.

2. Open "PLC Settings".
3. Set the bus cycle task under "Bus Cycle Options".

Determining the bus cycle time for each I/O master:

1. Double-click on the corresponding "I/O Master" node in the Project Explorer.

A setting window of the corresponding I/O master opens.

2. Open "I/O Image".
3. Set the bus cycle task under "Bus Cycle Options".

For details refer to [chapter 5.4.7 "I/O turn-around times" on page 341](#).

5.6 Memory organization and pointer programming

5.6.1 Memory alignment

The memory alignment describes the alignment of data (variables, structures) in the memory.

The alignment methods are distinguished as follows:

- **Byte, word and double word alignment:**
The variables are aligned irrespective of the data type to byte, word and double word limits. Empty memory locations are filled with so-called fill bytes. The special case "byte alignment" is also called "packed". With this method, all variables are continuously stored in the memory (without gaps) irrespective of the data type.
- **Natural alignment:**
The variables are saved in the memory according to the data width. In this method, word variables are always stored on even addresses and double word variables on addresses divisible by 4. If variables or structures containing elements with different data types are created, the compiler adds hidden fill bytes.

Whereas data is stored in a memory-optimized manner, i.e. without gaps (fill bytes) with the "byte aligned" (packed) method, natural alignment presents an improvement in terms of memory access times.



"Natural Alignment" is set as default for the controls of the IndraLogic XLC/IndraMotion MLC system.

By specifying the compiler pragma "pack_mode" in the variable definition, selected data ranges in the PLC program can optionally also be stored as packed.

Alignment example

The following example illustrates the differences between the two alignment methods "Byte-aligned" (packed) and "Natural-aligned".

Program:

```
STRUCT
    Out01 : BYTE 1;
    Out02 : WORD;
    Out03 : BYTE 2;
    Out04 : DWORD;
END_STRUCT
END_TYPE
```

Address	Packed (byte alignment)	Natural alignment
ADR 10000	Out01 : BYTE_1	Out01 : BYTE_1
ADR 10001	Out02 : WORD (0)	Fill byte
ADR 10002	Out02 : WORD (1)	Out02 : WORD (0)
ADR 10003	Out03 : BYTE_2	Out02 : WORD (1)
ADR 10004	Out04 : DWORD (0)	Out03 : BYTE_2
ADR 10005	Out04 : DWORD (1)	Fill byte
ADR 10006	Out04 : DWORD (2)	Fill byte
ADR 10007	Out04 : DWORD (3)	Fill byte
ADR 10008	-	Out04 : DWORD (0)
ADR 10009	-	Out04 : DWORD (1)
ADR 1000A	-	Out04 : DWORD (2)
ADR 1000B	-	Out04 : DWORD (3)

Tab. 5-4: Memory allocation depending on alignment

5.6.2 Byte order

The "byte order" describes the memory organization for simple numerical values (e.g. integer values).

It is distinguished between two basic methods:

- Big endian:
High byte first. This is also called "Motorola format"
- Little endian:
Low byte first. This is also called "Intel format"

Example of byte order

Integer value 439,041,101 as 32-bit integer variable from memory address 10000

Value in hexadecimal representation: 1A 2B 3C 4D

Value in binary representation: 00011010 00101011 00111100 01001101

Address	Big endian		Little endian	
	Hex	Binary	Hex	Binary
ADR 10000	1A	00011010	4D	01001101
ADR 10001	2B	00101011	3C	00111100
ADR 10002	3C	00111100	2B	00101011
ADR 10003	4D	01001101	1A	00011010

Tab. 5-5: Memory allocation depending on the byte order



Numerical values are stored in "big endian" format in the controls of the IndraLogic XLC/IndraMotion MLC system.

5.6.3 Pointer addressing



Memory alignment and byte order have to be considered when addressing variables via pointers.

Pointer access to single variable or array

When accessing individual variables or arrays, one pointer should either point to the respective data type of the variable or the array elements. When using a deviating pointer type, e.g. byte pointer to a word or double word variable, observe the byte order.

Example of pointer access

Program:

```
Variable_01 : WORD;
Array_01 : ARRAY [0..10] of DWORD;
ptr_Var_01 : POINTER TO WORD;
ptr_arr_01 : POINTER TO DWORD;
ptr_Var_01 := ADR (Variable_01);
ptr_arr_01 := ADR (Array_01)
```

Pointer access to a structure

If a structure was created according to the "Natural Alignment" method, addressing structural elements via pointers calculated via the basic address of the structure and a corresponding offset at runtime is not permitted.

The offset generation to address a structural element is not safely possible, as the basic address of the structure and thus the number of fill bytes can change if changes are made in the application.

With "Natural Alignment", the compatible use of the structures provides a direct addressing of the elements via the point operator:

StructureName.ElementName := ElementValue;

If the address of a structure is applied via a pointer to subordinate functions, addressing elements is also only permitted with offset calculation by the compiler: StructurePointer^.ElementName := ElementValue;

Example (natural alignment)

```
TYPE OutStruct :
STRUCT
Out01 : BYTE;
Out02 : WORD;
Out03 : BYTE;
Out04 : DWORD;
END_STRUCT
END_TYPE
StructInst : OutStruct; (* Declaration structure instance *)
pt : POINTER TO StructInst; (* Declaration pointer to structure instance *)
pt2 : POINTER TO BYTE; (* Declaration pointer to BYTE *)
pt^.Out02 := 16#FF00; (* Access to structure element with pointer *)
```

Valid addressing

```
StructInst.Out03 := 2#11110000; (*Access to structure element *)
pt := ADR (StructInst); (* Pointer initialization *)
pt^.Out02 := 16#FF00; (* Access to structure element with pointer *)
```

Invalid addressing

```
pt2 := ADR (StructInst.Out01); (* Pointer initialization *)
pt2 := pt + 3; (*Offset calc. for 3rd struct. element Out03*)
pt2^:= 2#11110000; (* Access to struct. element with pointer *)
```

Byte alignment (packed):

The "Byte-Aligned" (packed) alignment method can be forced for controls of the IndraLogic XLC/IndraMotion MLC system for selected data ranges by a corresponding compiler instruction ("pack_mode" pragma) with structural declaration.

"pack_mode" compiler instruction example

Program:

```
{Attribute 'pack_mode' := '1'}
TYPE mystruct:
STRUCT
Enable : BOOL;
Counter : INT;
Maxsize : BOOL;
```

```
MaxSizeReached : BOOL;  
END_STRUCT  
END_TYPE
```

In this case, the structure is stored as packed in the memory (that is without fill bytes).

With a packed structure, pointer addressing with address calculation at run-time is possible via the basic address of the structure and a corresponding offset.



Packing structures using the compiler instruction {pack_mode} causes the PLC program processing in the control to slow down, as access to word and double word operands is always performed byte by byte.

6 Axes

6.1 Introduction and overview

Axis types

The IndraLogic XLC/IndraMotion MLC controls provide several axis types. All axis types are provided with a uniform interface with a functional scope differing according to the axis type. The axes are generally accessed via A-parameters.

The following axis types are distinguished:

- **Real axis**
 - **IndraDrive with interpolation in the drive**
Rexroth IndraDrive MPH0x, MPB0x, MPD0x, MPB1x and MPH1x drives. The axis motion is calculated in the drive
 - **IndraDrive with interpolation in the control**
Rexroth IndraDrive MPH0x, MPB0x, MPD0x, MPB1x and MPH1x drives. The axis motion is calculated in the control. Depending on the operation mode, only position or velocity command values are applied to the drive
 - **HydraulicDrive (only IndraMotion MLC), with interpolation in the control**
Rexroth HydraulicDrive HNC100-3X and IAC drives. The axis motion is calculated in the control. Depending on the operation mode, only position or velocity command values are applied to the drive
 - **HydraulicDrive (only IndraMotion MLC, with interpolation in the drive)**
Rexroth HydraulicDrive HNC100-3X and IAC drives. The axis motion is calculated in the drive
 - **SercosDrive**
PackProfile-compatible drives. The axis motion is calculated in the control and only the position command values are applied to the drive
- **Virtual axis**
The axis only exists in the control and is not assigned to any real drive. This axis type is often used for virtual master axes (vertical shaft)
- **Controller axis (only IndraMotion MLC)**
Axis whose controllers are implemented into the PLC. This can for example be the case for hydraulic axes
- **Link axis (only IndraMotion MLC)**
Axis providing position values of an axis to another control via the Sercos cross link
- **Encoder axis**
Axis only providing actual values (e.g. from an additional drive encoder)

The different axis types provide a variety of functionalities:

Functions of the axis types

	Real axis	Virtual axis	Controller axis*	Link axis *	Encoder axis
Commanding	X	X	X		
Use as master axis	X	X	X	X	X
Use as slave axis	X	X	X		
Use as axis for a kinematics *	X	X	X		

* Only IndraMotion MLC

Tab. 6-1: Overview on the functional scope of the axis types

Real axes Real axes are divided into the following types:

- **IndraDrive**
Creating electric drives is described in section [chapter 6.3.3 "Creating a real axis" on page 370](#)
- **SercosDrive**
Creating a real axis is described in section [chapter 6.3.3 "Creating a real axis" on page 370](#)
- **Hydraulic drives (only IndraMotion MLC)**
The following hydraulic drive designs are supported:
 - HydraulicDrive, HNC
 - HydraulicDrive, IAC
 - HydraulicDrive, central ControllerAxis
 Creating real HydraulicDrive axis is described in section [chapter 6.3.3 "Creating a real axis" on page 370](#)

Virtual axes The virtual axis can also be used as master axis. The virtual axis patterns the behavior of a real axis in a mathematically ideal way.

Creating a virtual axis is described in section [chapter 6.4.2 "Creating a virtual axis \(virtual master axis\)" on page 391](#).

Encoder axes The encoder axis can be used as real master axis.

Real master axis data is calculated based on the measuring results of the encoder.

Creating an encoder axis is described in section [chapter 6.7.2 "Creating an encoder axis \(real master axis\)" on page 427](#).

Link axes with Sercos II Cross-Comm

This axis type is only available for the IndraMotion MLC L45/L65/L75 with Sercos II cross link.

Link axes exchange data between several controls. Axis data is applied via Sercos II cross link connected to a Sercos II (CFL01.1-Q2) function module.

Each control can define up to two axes (real, virtual, or encoder axes) as globally usable - i.e. usable on the other controls - master axis. The synchronously exchanged data is assigned to a link axis on each of the controls.

Creating a link axis is described in section [chapter 6.6.2 "Creating a link axis" on page 422](#).

Link axes with Sercos III C2C

This axis type is only available for the IndraMotion MLC L45/L65/L75 with Sercos III C2C.

Link axes exchange data between several controls. Axis data is applied via Sercos C2C cross link connected to a CrossComm Sercos III CFL01.1-R3 function module.

Each control can use up to 128 axes of other controls in the C2C link as master axis. This axis type is neither defined nor displayed in the user interface.

Maximum number of axes Different maximum stages of expansion are possible depending on the control and the field bus used. Depending on the control variant, different field buses are used.

Hardware	Sercos II (only IndraMotion MLC)	Sercos III
IndraControl L45	32*	32
IndraControl L65	42*	64
IndraControl L75	-	64
IndraControl VPB	-	99

* Only with function module Sercos II (CFL01.1-Q2)

Tab. 6-2: Maximum number of axes per control

In addition to the above mentioned number of axes, drives can also be integrated as PLC device. There is no Motion functionality available for these drives. The drives are freely programmed in the PLC (see [chapter 6.9 "Drive as PLC device" on page 500](#)).

Field buses for real axes Real axes can be controlled via the field buses Sercos II (only IndraMotion MLC), Sercos III and Profibus. To connect via Sercos II and Sercos III, dialogs are available in the interface.

Sercos II (only IndraMotion MLC)

Sercos II is an optical fiber-based field bus with a maximum transmission rate of up to 16 MBit/s.

Sercos III

Sercos III is based on the Ethernet and transmits a data rate of 100 MBit/s.

Profibus DP

Profibus is supported with a twisted two-wire line. The data rate is up to 12 MBit/s.

6.2 Axis overview

The "Axis Overview" dialog provides an overview and is used to edit axis properties. Axes can also be added, duplicated or deleted.

Open the dialog via the "Axis Overview..." command in the context menu of the following nodes in the tree:

- Motion
- Real axes
- Virtual axes
- Encoder axes
- Link axes (only MLC based on the IndraControl Lxx hardware)
- Controller axes (only for MLC)

In the dialog, the axes are listed with their properties in a table. Data can be edited after selecting the cell. Cells, which cannot be edited, are grayed out. The currently selected axis is highlighted in color.

Axes

All changes in the overview are applied with **Apply** or **OK**.

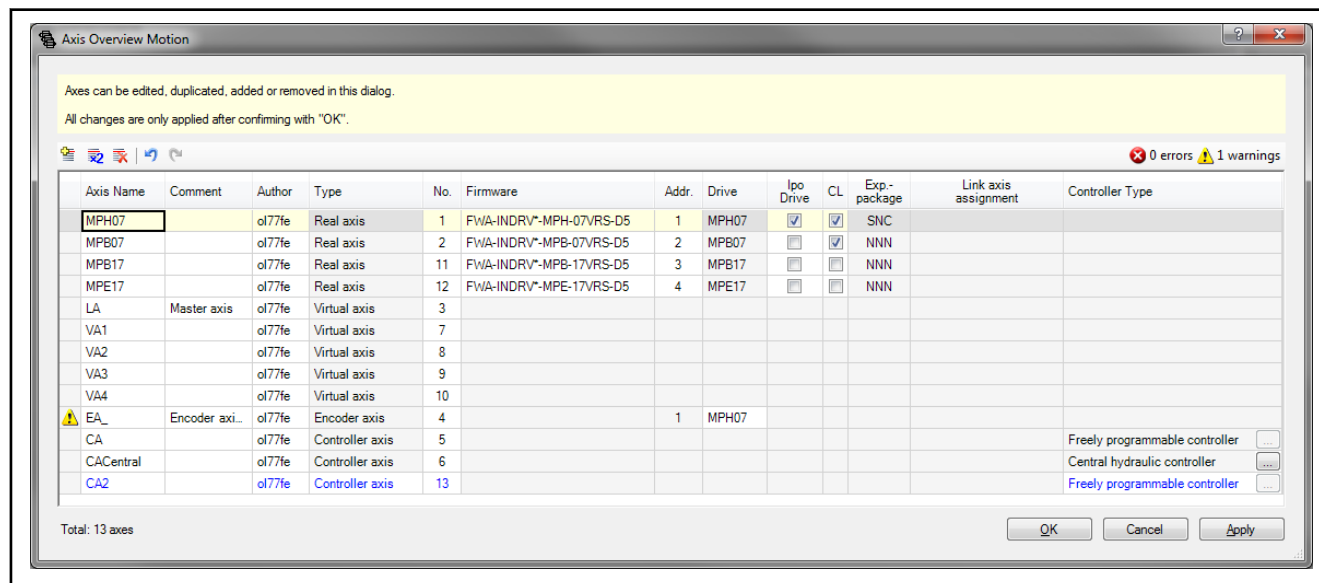


Fig. 6-1: Axis overview

There is a toolbar above the table. It provides the following functions:

Icon	Name	Hotkey	Description
	Adding axis	Ctrl+I	Use this function to create a new axis. If an axis has been already created, the latest settings selected are applied as template. For this axis type, this applies to all axes, firmware, interpolation type and the basic package for real axes as well as for the selected controller type for controller axes. The newly added axis is subsequently selected and displayed in blue until the changes are applied
	Duplicate axis	Ctrl+D	If an axis was selected in the table, this function can create a duplicate of this axis. All axis properties including the parameters stored in the project are applied by the source. The duplicated axis is subsequently selected and displayed in blue until the changes are applied
	Delete axis	Ctrl+Del	If an axis is selected in the table, use this function to delete it
	Undo	Ctrl+Z	If changes were made in the table, use this function to undo them step by step. This function is not provided to change properties of the controller type for controller axes. This function is disabled after applying the changes with Apply
	Repeat	Ctrl+Y	If the changes were undone, they can be restored step by step using this function. This function is not provided to change properties of the controller type for controller axes. This function is disabled after applying the changes with Apply

Icon	Name	Hotkey	Description
	Errors		Data in the table is checked for validity. The number of errors found is displayed. The axes with errors are labeled by the same icon in the first column of the table. If at least one error is present, changes cannot be applied and the dialog cannot be closed with OK
	Warnings		Data in the table is checked for validity. The number of warnings found is displayed. The axes with warnings are labeled by the same icon in the first column of the table

Tab. 6-3: Toolbar functions

Depending on the node the dialog is opened from, only columns valid for the displayed axes, are shown. If the dialog is for example opened at the "Virtual axes" node, only the following properties are displayed: Axis name, comment, author, type and no.

Data in the table is checked for validity. Errors and warnings can result indicated by a respective icon in the first column. The tooltip on the icon shows the error and warnings. If at least one error is present, changes cannot be applied with **Apply** and the dialog cannot be closed with **OK**.

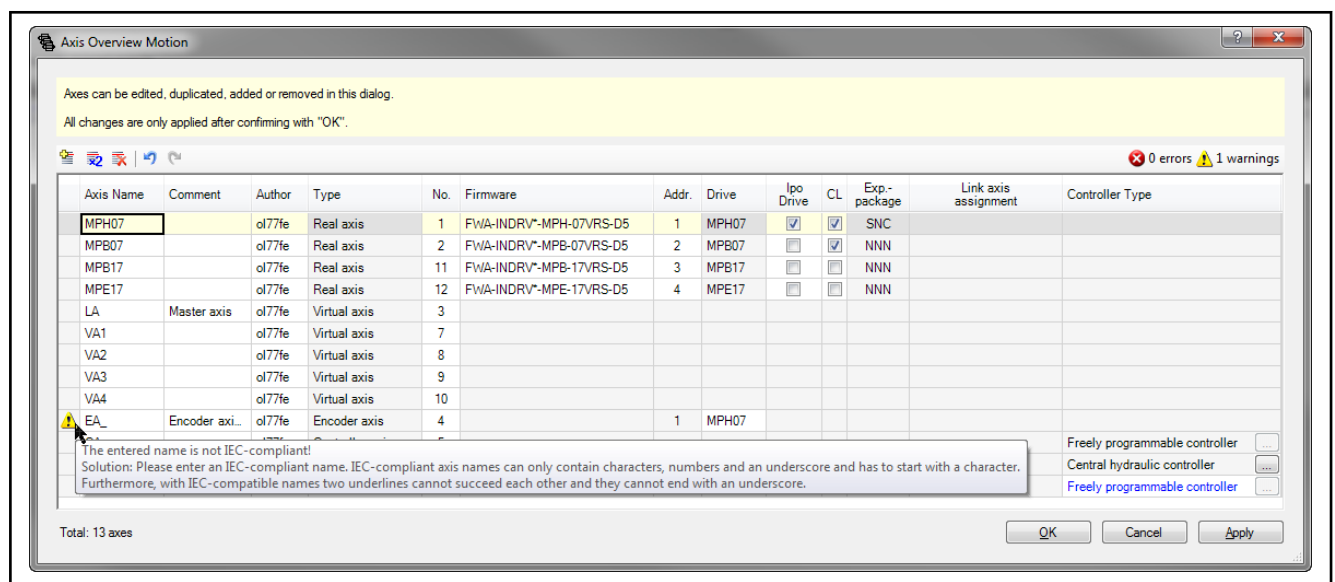


Fig. 6-2: Axis overview with a warning displayed

Apart from the hotkeys for the toolbar functions, more hotkeys are supported:

Hotkey	Name	Description
Ctrl+Home	Jump to beginning of table	Use this function to move to the first cell in the first column and the first line at the upper left in the table
Pos1	Jump to beginning of line	Use this function to jump to the cell in the first column in the currently selected line
Ctrl+End	Jump to end of table	Use this function to move to the first cell in the first column and the last line at the lower left in the table.
End	Jump to end of line	Use this function to jump to the cell in the last column in the currently selected line

Hotkey	Name	Description
Alt+K	Exit dialog with "OK"	The changes are applied and the dialog is subsequently closed. This function is only available if no error is present
Alt+B	Apply changes	Changes are applied using this function. This function is only available if no error is present

Tab. 6-4: Hotkeys

Note the following when editing the following properties:

Property	Note
Type	The axis type can only be changed or selected for axes newly created in the overview and if the changes are not yet applied to the project. Changing the axis type subsequently, when the axis is already created in the project, is not supported.
Firmware	If the axis was newly created in the overview and not yet applied to the project, the firmware can be selected drive type-comprehensively. The firmware of an IndraDrive can thus be changed to one of the Hydraulic-Drive. If the axis was applied to the project, the firmware can only be changed within the drive family. Changing the firmware may not change the number of axes of the drive
Controller type	After selecting a controller type (except for freely programmable controllers), a wizard to enter controller type-specific settings starts. To subsequently change the settings, press the  button next to the name of the controller type. Changing the controller type subsequently, when the axis is already available in the project, is not supported.

Tab. 6-5: Notes on how to edit properties

6.3 Real axis

6.3.1 General information

The real axis maps physically existing drives at the machine. The group of real axes is divided again and listed according to the hardware used or the mode of operation the hardware is to be operated.

The following features can be distinguished:

- **SercosDrive**

The functional scope of the Sercos interface specified in the Sercos PackProfile (see www.sercos.com under Technology ⇒ Sercos Packaging Profile) is used as Sercos interface between drive and axis. Sercos PackProfile defines an application profile for the continuous interoperability in packaging machines. This operating mode of the real axis guarantees the highest compatibility possible with the very different drive controllers and allows the operation of drive controllers from third-party manufacturers also supporting the Sercos PackProfile. When operating as SercosDrive, the drive is only controlled in all operation modes and motion commands via the cyclic position command value interface in the position control. The command value is centrally interpolated by the control. Device-specific dialogs are not displayed.



The technology function blocks (winder, register controller, tension controller...) are not supported for a SercosDrive.

IndraDrive with interpolation in the control or drive is required.

- **IndraDrive, interpolation in the drive**

Devices of the IndraDrive family are provided with a higher performance and more extended functional scope as specified in the Sercos Pack-Profile. For an optimum hardware support, the control provides an individual operating mode for IndraDrive devices. This operating mode is characterized for example by a comprehensive telegram structure, additional operation modes (velocity control, torque control), improved diagnostic options and adapted dialog support in IndraWorks. The command values are calculated in this operating mode by the drive controller. Thus, a decentral calculation. The control forwards the commanded motion commands to the drive

Based on IndraDrive (function package: "Synchronous package") real axes can be created using the following firmware:

- FWA-INDRV*-MPH-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-06VRS-D5-1-SNC-NN ¹⁾
- FWA-INDRV*-MPC-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPH-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-07VRS-D5-1-SNC-NN ¹⁾
- FWA-INDRV*-MPH-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-08VRS-D5-1-SNC-NN ¹⁾
- FWA-INDRV*-MPB-16VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-19VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-20VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-21VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-20VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-21VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-19VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-20VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-21VRS-D5-1-SNC-NN

¹⁾ - the minimum Sercos cycle time allowed is **2 ms** for the drives of the MPB-06VRS-, MPB-07VRS-, MPB-08VRS family. If a lower value is set, the error message "C0171 Maximum length for connection exceeded" is displayed.

Additionally, It is differentiated whether the drive is to be operated with (closed-loop) or without (open-loop) position feedback.

Without position feedback (open-loop), the PLCopen function blocks are only provided with limited support (only speed control possible), see [tab.](#)

[6-7 "Function blocks in IndraLogic XLC/IndraMotion MLC" on page 367](#). Thus, only a limited number of axis parameters is synchronized with the drive parameters.

- **IndraDrive, interpolation in the control**

This operating mode combines efficiency and simplicity of the central interpolation in the control with the advantages and the extended functional scope of the IndraDrive hardware. The command values are interpolated for all operation modes in the control. Depending on the motion command, it is commanded to the drive as cyclic position, velocity and torque command values via a telegram adapted to the IndraDrive.

The motions in the drive are exclusively specified via the following operating states:

- "Position control with cyclic command value specification"
- "Velocity control with cyclic command value specification"
- "Torque/force control"

Based on IndraDrive (function package: "Synchronous package") real axes can be created using the following firmware:

- All drives listed under the point "IndraDrive, Interpolation in the drive"
- FWA-INDRV*-MPE-16VRS-D5-1-NNN-NN
- FWA-INDRV*-MPE-17VRS-D5-1-NNN-NN
- FWA-INDRV*-MPE-18VRS-D5-1-NNN-NN
- FWA-INDRV*-MPE-20VRS-D5-1-NNN-NN
- FWA-INDRV*-MPE-21VRS-D5-1-SNC-NN

Additionally, It is differentiated whether the drive is to be operated with (closed-loop) or without (open-loop) position feedback.

Without position feedback (open-loop), the PLCopen function blocks are only provided with limited support (only speed control possible), see [tab. 6-7 "Function blocks in IndraLogic XLC/IndraMotion MLC" on page 367](#). Thus, only a limited number of axis parameters is synchronized with the drive parameters.

- **HydraulicDrive, interpolation in the drive (only MLC)**

Since this is also an IndraDrive-based device, the same characteristics as described above apply to this hardware.

The synchronization modes are not supported.

HydraulicDrive axes IAC-R with permanently installed valve with the firmware:

(Function package: "Servo package")

- FWA-HYDRV*-HDB-20

HydraulicDrive axes HMC-R (control cabinet device with freely selectable valve that can be connected via analog channel) with the firmware:

- FWA-HYDRV*-HDC-20
- FWA-HYDRV*-HDM-20

- **HydraulicDrive, interpolation in the control (only MLC)**

Since this is also an IndraDrive-based device, the same characteristics as described above apply to this hardware.

HydraulicDrive axes IAC-R with permanently installed valve with the firmware:

- FWA-HYDRV*-HDB-20

HydraulicDrive axes HMC-R (control cabinet device with freely selectable valve that can be connected via analog channel) with the firmware:

- FWA-HYDRV*-HDC-20
- FWA-HYDRV*-HDM-20



Whether the real axis is to be interpolated in the drive or the control has to be specified when creating the axis.

Motion functionality

Functionality	IndraDrive and HydraulicDrive* with interpolation in the drive	IndraDrive and HydraulicDrive* with interpolation in the control	SercosDrive
Position limit value monitoring in the control	Yes	Yes	Yes
Position limit value monitoring in the drive	Yes	Yes	No
Jerk limitation	Implemented as filter	Analytical in path calculation	Analytical in path calculation
Scaling	Can be freely selected	Only preference scaling for position, velocity and acceleration Can be freely selected for force	Preference scaling only

* only for MLC

Tab. 6-6: Overview on the Motion functionality

Function block	Real axes					Virtual axes	Encode/link* axis	Controller axis * ³⁾
	IndraDrive		HydraulicDrive*		Sercos-Drive			
	Interpolation Drive	Interpolation Control	Interpolation Drive	Interpolation Control				
MB_ChangeCamData	X	X	-	X	X	X	-	X
MB_ChangeFlexEventSet	-	X	-	X	X	X	-	X
MB_ChangeFlexProfilSet	-	X	-	X	X	X	-	X
MB_ChangeProfilSet	-	X	-	X	X	X	-	X
MB_ChangeProfilStep	-	X	-	X	X	X	-	X
MB_GearInPos	X	X	-	X	X	X	-	X
MB_Home	X	X	X	X	X	X	-	X
MB_MotionProfile	-	X	-	X	X	X	-	X
MB_Phasing	X ¹⁾	X	X	X	X	X	-	X
MB_PhasingSlave	X ¹⁾	X	X	X	X	X	-	X
MB_SetPositionControlMode ⁵⁾	X	X	-	-	-	-	-	-
MC_AddAxisToGroup * ⁴⁾	X	X	X	X	X	X	-	X
MC_CamIn	X	-	-	-	-	-	-	-

Axes

Function block	Real axes					Virtual axes	Encode/ link* axis	Controller axis * ³⁾
	IndraDrive		HydraulicDrive*		Sercos- Drive			
	Interpolation Drive	Interpolation Control	Interpolation Drive	Interpolation Control				
MC_CamOut	X	-	-	-	-	-	-	-
MC_GearIn	X ²⁾	X ²⁾	-	X	X	X	-	X
MC_GearOut	X ²⁾	X ²⁾	-	X	X	X	-	X
MC_MoveAbsolute	X	X	X	X	X	X	-	X
MC_MoveAdditive	X	X	X	X	X	X	-	X
MC_MoveRelative	X	X	X	X	X	X	-	X
MC_MoveVelocity	X ²⁾	X ²⁾	X	X	X	X	-	X
MC_Power	X ²⁾	X ²⁾	X	X	X	-	-	X
MC_RemoveAxisFromGroup * ⁴⁾	X	X	X	X	X	X	-	X
MC_Reset	X ²⁾	X ²⁾	X	X	X	X	-	X
MC_Stop	X ²⁾	X ²⁾	X	X	X	X	-	X
MC_TorqueControl	X ¹⁾	X	X	X	X	-	-	X
ML_FlexProfile	-	X	-	X	X	X	-	X
ML_OpenCyclicAnalogChannel	-	-	X	X	-	-	-	X
ML_OpenCyclicPositionChannel	X	X	X	X	X	X	-	X
ML_OpenCyclicTorqueChannel	X	X	X	X	-	-	-	X
ML_OpenCyclicVelocityChannel	X	X	X	X	-	-	-	X
ML_WriteCyclicAnalog	-	-	X	X	-	-	-	X
ML_WriteCyclicPosition	X	X	X	X	X	X	-	X
ML_WriteCyclicTorque	X	X	X	X	-	-	-	X
ML_WriteCyclicVelocity	X	X	X	X	-	-	-	X
ML_ControlOff	X	X	X	X	X	X	-	X
ML_ControlOn	X	X	X	X	X	X	-	X
ML_ControlWriteActualData	-	-	-	-	-	-	-	X
ML_OpenCyclicAnalogChannelCtrl	-	-	X	X	-	-	-	X
ML_OpenCyclicPositionChannelCtrl	X	X	X	X	X	X	-	X
ML_OpenCyclicTorqueChannelCtrl	X	X	X	X	-	-	-	X
ML_OpenCyclicVelocityChannelCtrl	X	X	X	X	-	X	-	X
ML_WriteCyclicAnalogCtrl	-	-	X	X	-	-	-	X
ML_WriteCyclicPositionCtrl	X	X	X	X	X	X	-	X
ML_WriteCyclicTorqueCtrl	X	X	X	X	-	-	-	X
ML_WriteCyclicVelocityCtrl	X	X	X	X	-	X	-	X

* only for MLC

- 1) Not MPx03
- 2) Also with OpenLoop
- 3) Depending on the controller implementation or the functional scope of the device whose actual values are transferred to the controller axis (ML_ControlWriteActualData with link)
- 4) As of 13VRS
- 5) As of 13VRS and > MPx06

Tab. 6-7: Function blocks in IndraLogic XLC/IndraMotion MLC



Open loop

Only function blocks without position control are possible for real axes without position feedback (open-loop).

Real axes without position feedback are only possible for IndraDrive.

Drive operating states used

Operating state	IndraDrive with interpolation in the drive	HydraulicDrive * with interpolation in the drive	IndraDrive with interpolation in the control	HydraulicDrive with interpolation in the control	SercosDrive
Torque/force control	Yes	Yes	Yes	Yes	No
Velocity control	Yes	Yes	Yes	Yes	No
Position control with cyclic command value specification	Yes	Yes	Yes	Yes	Yes
Drive-controlled positioning	Yes	Yes	No	No	No
Velocity synchronization with virtual master axis	Yes	No	No	No	No
Phase synchronization with virtual master axis (position synchronization with virtual master axis)	Yes	No	No	No	No
Cam table with virtual master axis (position synchronization with virtual master axis)	Yes	No	No	No	No
MotionProfile with virtual master axis (position synchronization with virtual master axis)	Yes	No	No	No	No
Direct valve control	No	Yes	No	Yes	No

* only for MLC

Tab. 6-8: Overview on the drive operating states used

6.3.2 Error reaction of axis

Set the axis parameter A-0-0651 Bit 0 = 1 and all drive errors of state class 1 (F2...F8) become the control error F00B0165. There is no error reaction on the control.

For details, refer to the parameter description A-0-0651 in the documentation "IndraLogic XLC IndraMotion MLC 14VRS Parameters" and [chapter 6.8.14 "Error response" on page 456](#).

6.3.3 Creating a real axis



An axis can only be created in offline mode!

All real axes (IndraDrive, HydraulicDrive (only MLC) and SercosDrive) can thus be created. A real axis is created according to the drag&drop principle. Drag the required device "IndraDrive" from the library and

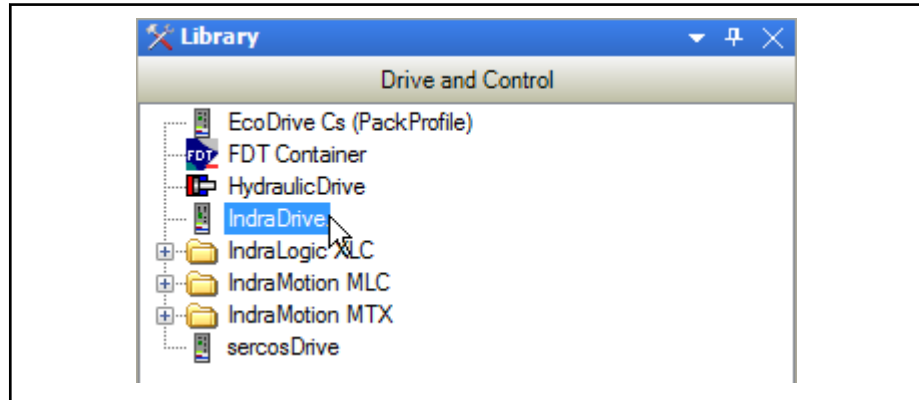


Fig. 6-3: Creating a real axis - Dragging from the library
drop the device to the desired bus, in this case Sercos.

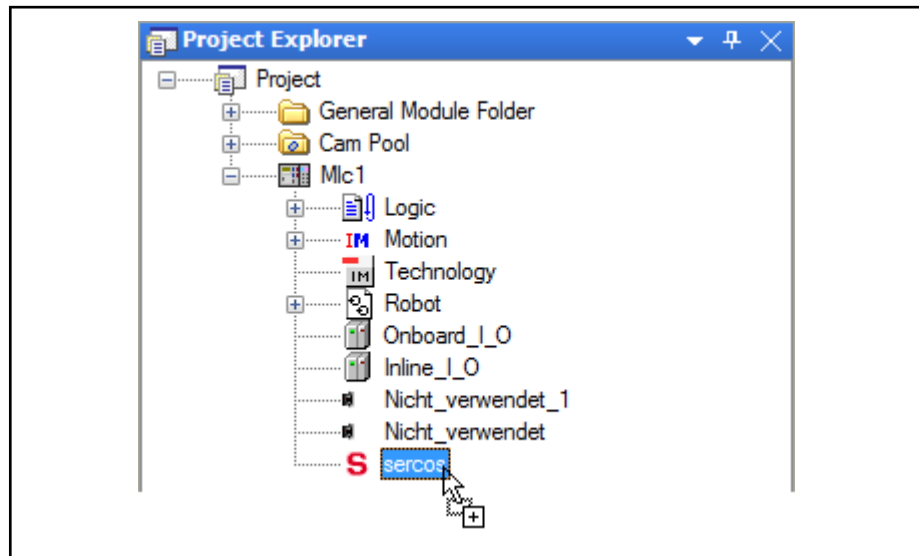


Fig. 6-4: Creating a real axis - Dropping to the Project Explorer

Dialogs to create a real axis

The creation of a real axis is supported by a wizard with two dialog boxes. These windows look similar for all drive types.

Fig. 6-5: Creating a real axis (IndraDrive) - General Settings

In the "General settings" step, device name, comment on this device and author are entered.

Select a template for the following settings via **Select Template...** (see [chapter 3.11 "Creation based on templates" on page 119](#)). Either an already existing real axis in the project or the parameter backup of a real axis can be selected as template.

Apply or change the preset values.

Fig. 6-6: Creating a real axis (IndraDrive) - Configuration

Configuring the real axis (axes)

Use the "Firmware" setting to select from two different software states, here MPH-08. Permitted firmware versions are listed in [chapter 6.3.1 "General information" on page 364](#).

Under "Axis", the address of the drive **has to** be set in the Sercos bus (address in the drive configuration, in this case 1). Otherwise, communication with the drive is not possible.

With the "Interpolation in drive" option, the drive automatically calculates its position command values for the operating state selected, e.g. synchronization or cam. Otherwise, the control provides the drive with position command values.

If the checkbox is deselected, the control provides position command values to the drive. This is a default setting for Sercos and EcoDrives.

The "Closed Loop" option is used for an axis with position feedback. If the checkbox is deselected, an axis without position feedback (open loop) is used.

In this case (open loop), only a limited functional scope is available (position-controlled operation modes are not possible; axis parameters for position-controlled operation modes are not synchronized with the drive).

Drive configuration

To parameterize a drive offline, configure it first.

If "Subsequently start wizard to configure the drive" is selected, a dialog to enter the required data is displayed. The drive including its parameters is generated from the entries.

Fig. 6-7: Creating a real axis (IndraDrive) - Configuration of the drive

If the option is not selected, the drive can only be parameterized online at first. It can be subsequently configured:

1. Open "Parameters -- Compare parameters" in the context menu of the control or the real axis or drives in case of an established online connection.
2. Select "Subsequently start wizard to configure the drive" in the "Properties" dialog of the real axis.

Software states and function packages

Axis assignment

Refer to [chapter 6.3.1 "General information" on page 364](#).

To address the axis, the PLC uses the axis number and axis name (here "1" or "RA1").

Overview in the Project Explorer

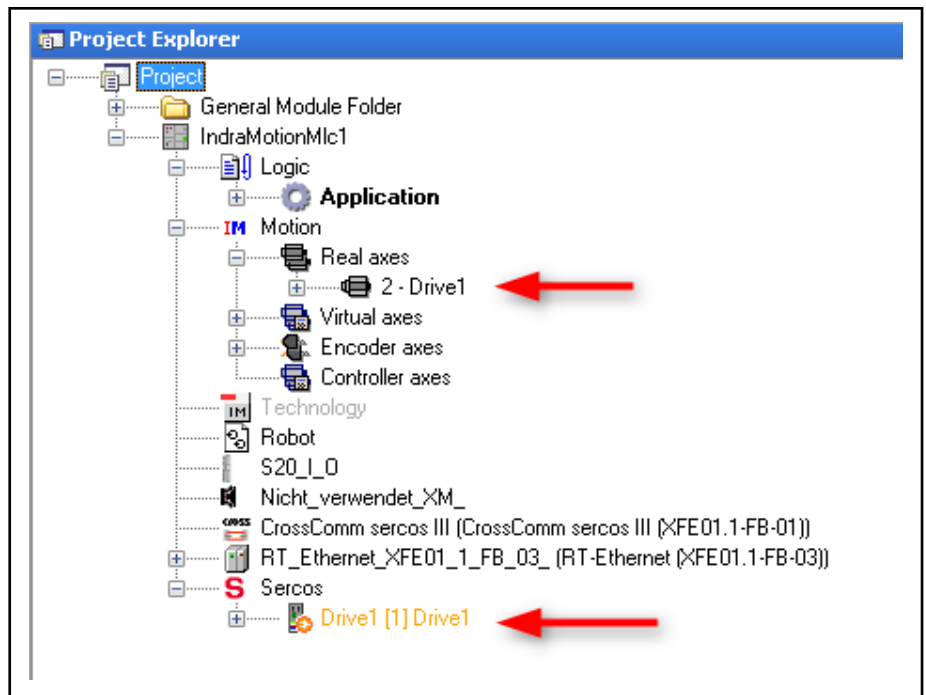


Fig. 6-8: Creating a real axis - Overview in the Project Explorer

In the Project Explorer, the real axis is displayed below "Motion -- Real axes". The drive is displayed below the "Sercos" node.

6.3.4 Real axis – Dialogs

Overview on dialogs

Open the folder of the real axis in online mode and the dialogs for this axis is displayed.

First, it is assumed that the presettings cover a wide range of applications and that a modification is only required in exceptional cases.

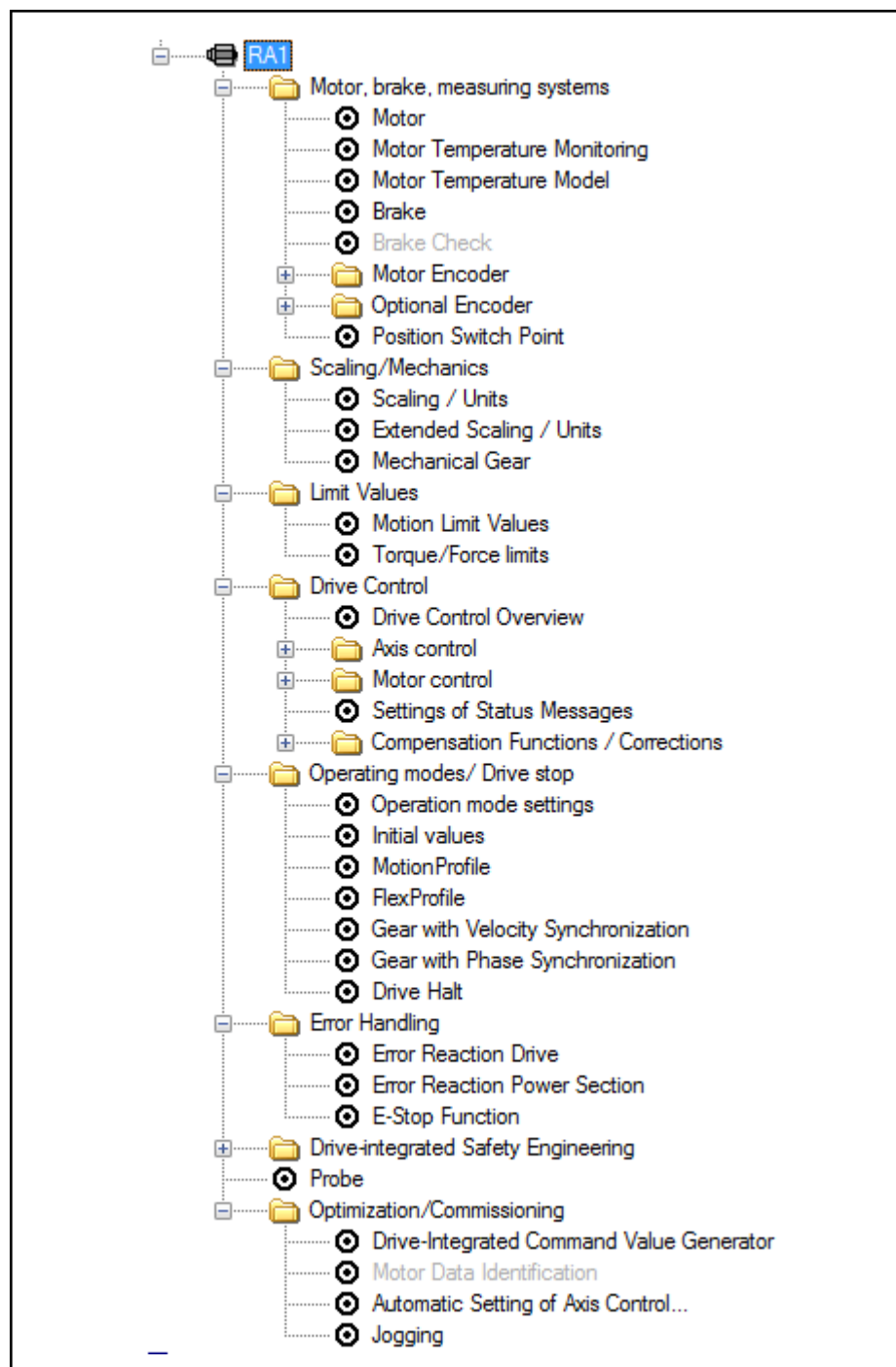


Fig. 6-9: Dialogs of a real axis (IndraDrive)



If IndraDrive drive units are disabled at "Interpolation in the Drive", EcoDrive CS and SercosDrive, the drive is controlled via PackProfile (refer to the following figure).

As the IndraDrive and EcoDrive CS devices are drive devices specified in detail - in contrast to the SercosDrive - device-specific dialogs are provided for commissioning.

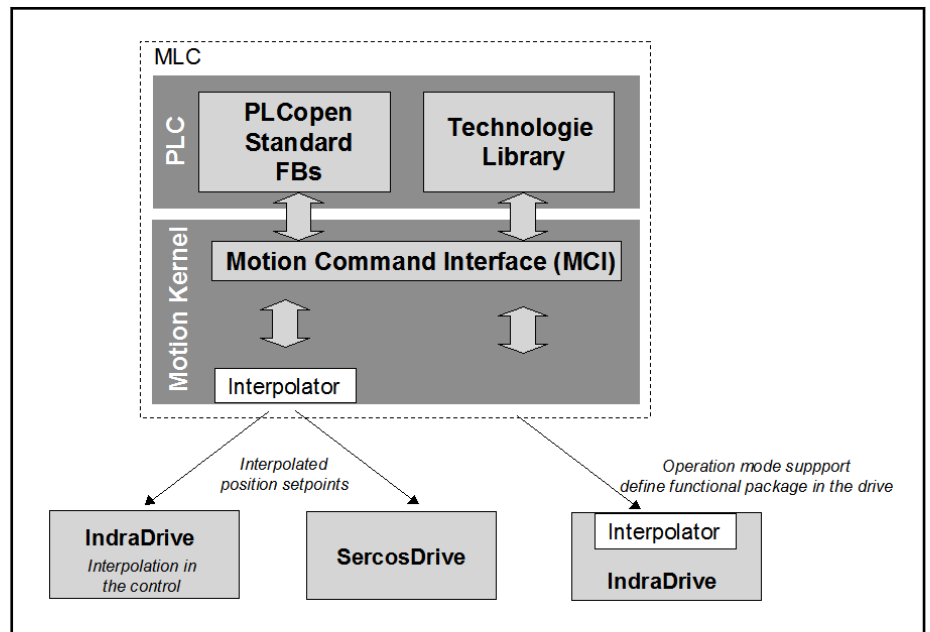


Fig. 6-10: Control principle for different drives



For a real axis without position feedback (open loop), only the operation modes without position feedback are shown.

- [chapter 6.8.3 "Motor" on page 443](#)
- [chapter 6.8.4 "Motor temperature monitoring" on page 444](#)
- [chapter 6.8.5 "Brake" on page 445](#)
- [chapter 6.8.6 "Measuring systems" on page 445](#)
- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.9 "Mechanical gear" on page 451](#)
- [chapter 6.8.10 "Closed-loop control" on page 452](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)
- [chapter 6.8.12 "Drive halt" on page 454](#)
- [chapter 6.8.13 "Establishing dimensional reference" on page 455](#)
- [chapter 6.8.14 "Error response" on page 456](#)
- [chapter 6.8.15 "E-Stop function" on page 459](#)
- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)
- [chapter 6.8.18 "Compensation functions/corrections" on page 463](#)
- [chapter 6.8.19 "Drive-integrated command value generator" on page 465](#)
- [chapter 6.8.20 "Cam table" on page 465](#)
- [chapter 6.8.21 "MotionProfile" on page 471](#)
- [chapter 6.8.22 "FlexProfile" on page 478](#)
- [chapter 6.8.23 "Gear with velocity synchronization" on page 485](#)
- [chapter 6.8.24 "Gear with phase synchronization" on page 489](#)
- [chapter 6.8.26 "Drive-integrated safety engineering" on page 495](#)

- [chapter 6.8.27 "Position switching point" on page 496](#)

The values in the dialogs are partially calculated from multiple parameters. If there is a clear assignment, it is specified.



Dialogs exclusively referring to internal drive data are only described by a reference to the original product manuals.

6.3.5 Real axis – Context menu

Overview on menu items

The context menu of a real axis contains the following menu items:

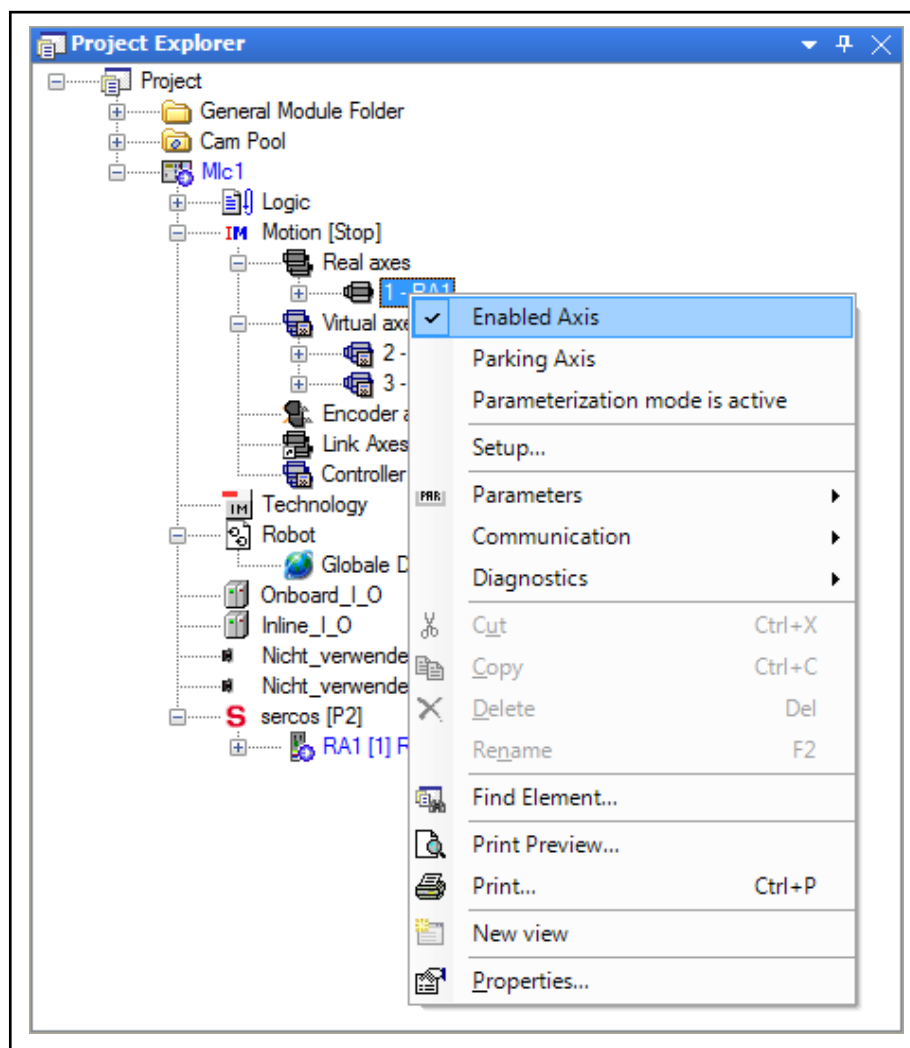


Fig. 6-11: Context menu of a real axis (IndraDrive) in online mode

The context menu of a real SercosDrive axis corresponds to the context menu of a real IndraDrive axis, except that it does not contain the menu item **Parking Axis**.

- Possibility to switch between the operating states **Activated Axis/ Deactivated Axis** and **Parking Axis** of the drive using the options of the IndraDrive drive (see also [chapter 7.7 "Axis modes" on page 535](#))
- **Command Value Decoupling Active** - It is only displayed if the command value decoupling is active, see [chapter 7.7.4 "Command value decoupling" on page 537](#)

- **Parameterization Mode Active** - Switch on/off the parameterization mode of the axis. For more information on the parameterization mode, refer to [chapter 7.5 "Parameterization level" on page 522](#)
- **Setup...** - Commissioning cycle of the real axis (IndraDrive), see [chapter "Initial Commissioning" on page 377](#)
- **Parameters**
 - [chapter "Parameter editor" on page 222](#)
 - [chapter "Parameter group" on page 224](#)
 - [chapter "Finding parameters" on page 226](#)
 - [chapter "Loading basic parameters" on page 378](#)
 - [chapter "Parameter adjustment" on page 226](#)
 - [chapter "Parameters - Export" on page 231](#)
 - [chapter "Parameters - Import" on page 232](#)
 - [chapter "Drive password - Change password" on page 379](#), only IndraDrive and HydraulicDrive
 - [chapter "Save mode" on page 380](#), only IndraDrive and HydraulicDrive
 - [chapter "Saving parameters in the drive" on page 380](#), only IndraDrive
- [chapter "Communication" on page 380](#)
- [chapter "Diagnostics" on page 385](#)
- **Delete** - Deletes the complete axis from the project in **offline mode**
- **Rename** - Changes the axis name in **offline mode**



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- **Find Element...** - Allows scanning for elements in the project
- **Print Preview...** - Selects whether to print the projected properties, the parameters or both of the real axis. There is a print preview before printing
- **Print...** - Selects whether to print the projected properties, the parameters or both of the real axis
- **New View** - Displays the axis in an individual window
- **Properties...** - Refer to [chapter "Axis properties" on page 389](#)

Deactivating an axis - Real axis (IndraDrive)



Deactivating a real axis, its drive, its electronics, results in the deactivation of the encoder axis whose encoder is connected to this electronics.

Initial Commissioning

For the initial commissioning of an axis, the following dialogs are processed by a wizard:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
chapter "Loading basic parameters" on page 378	x	x	x	x	x	x	x
chapter "Motor encoder" on page 445	x	x	x				
chapter "Optional encoder" on page 446	x	x	x			x	
chapter 6.8.7 "Scaling/units settings" on page 447	x	x	x	x	x		x
chapter 6.8.8 "Scaling/units extended" on page 449	x	x	x				x
chapter 6.8.9 "Mechanical gear" on page 451	x	x	x				
chapter 6.8.5 "Brake" on page 445	x	x	x				
chapter 6.8.16 "Motion limit values" on page 460	x	x	x		x		
chapter 6.8.17 "Initial values" on page 462	x	x	x	x	x		
chapter 6.8.15 "E-Stop function" on page 459	x	x	x				
chapter "Communication" on page 380	x	x	x				
chapter 6.8.11 "Settings of status messages" on page 453	x	x	x	x	x		
chapter 6.8.25 "Axis configuration" on page 493						x	

* only for MLC



Data changed while editing in the dialog is directly applied to the control/drive, irrespective of whether a subsequent date is still changed or the dialog is exited with **Next** or **Cancel**.

Parameters

Loading basic parameters

Restore the basic function of a drive with "Load basic parameters".

Practically, the axis is removed and newly created. All parameters directly located in the axes (stored in the S- and P-parameters of the drive) are assigned with default values like all other A-parameters in the control.

Creating a new axis

When creating a new axis, note that the drive as well as the control have to have certain presettings.

1. Creating new axis (completely new)

- Dragging drive to the Project Explorer
- Going online
- Load the basic parameters for the drive via the context menu items "Setup" or "Parameters"⇒"Load Basic Parameters..."

- A-0-1000, Command: Load basic axis parameters: sets the required A-parameters for the drive to default values
Triggering: 0x11, parameter is reset automatically
 - P-0-4090, Configuration of default values, S-0-0262, C07_x
Command "Initial Loading"
Triggering: P-0-4090 0x1, S-0-0262 0x11; P-0-4090 0x0, S-0-0262 0x00
2. Creating new axis (drive already optimized)
- Dragging drive to the Project Explorer
 - Going online
 - Load the basic parameters for the drive via the context menu items "Setup" or "Parameters"⇒"Load Basic Parameters..."
 - A-0-1000, Command: Load basic axis parameters: sets the required A-parameters for the drive to default values; not the S- and P-parameters.
Triggering: 0x11, parameter is reset automatically
3. Creating a new axis (axis was deleted before)



This procedure is not recommended!

- Dragging drive to the Project Explorer
- Going online
- "Load basic parameter" is not executed
All old parameter assignments are applied

Drive password - Change password

IndraDrive control units allow to protect parameter values from unintended or unauthorized password change.

Based on a default or known password, this menu item allows to enter a new changed customer password and to confirm it with the second input.

Regarding the write protection, there are three groups of writable parameters:

- The parameters that are always write-protected, such as motor parameters, hardware identification parameters, encoder parameters, error memory, etc. ("Management parameters") The values of these parameters ensure the correct functioning and performance of the drive
- Parameters which can be grouped by the user and protected with a customer password. It is thus possible to protect parameter values used to adapt the drive to the axis after their definition
- All remaining writable parameters which are not included in one of the mentioned groupings. The parameters are not write-protected

Password types:

The drive firmware allows to activate or deactivate the write protection for parameter values by three hierarchically different passwords:

- Customer password - The values of the parameters of a user-defined parameter group can be protected
- Control password - Parameters protected by a customer password are writable. "Administration parameters" remain write-protected

- Master password - All writable parameters, including "Administration parameters" and parameters protected by customer password can be changed

Save mode

IndraDrive drives allow different save modes after a parameter value change. The dialog for the menu item allows presetting the mode, including the loading, saving and selective backing up of the user memory as well as the composition of lists for special handling.

The basics about the "loading, saving and backing up parameters" are described product-specifically in the manuals "Rexroth IndraDrive Firmware for Drive Controllers" or "Rexroth IndraDrive MPx-20 Functions", chapter "Loading, saving and backing up parameters" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Support is provided by the implemented online help.

Saving parameters in the drive

Via this menu item, saving the content (parameter values) of the volatile user memory in the non-volatile Flash memory of the drive can be triggered at any point in time.

The basics about the "loading, saving and backing up parameters" are described product-specifically in the manuals "Rexroth IndraDrive Firmware for Drive Controllers" or "Rexroth IndraDrive MPx-20 Functions", chapter "Loading, saving and backing up parameters" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Communication

Cyclic Sercos channel



This dialog is available for IndraDrive for interpolation in the drive and in the control.

All drives in the Sercos ring communicate with the control in each Sercos cycle. The most important components are the "master data telegram" (MDT) and the "drive telegram" (AT).

The MDT is the control telegram. Command values are specified in MDT. The AT is the response telegram. Actual values are received in AT. Both telegrams have a specified number of places for the parameter specification. The majority of these places is covered by the control firmware to control the drives. However, six places each can be freely assigned.

The term "Cyclic Sercos channel" is thus to be understood as an option to modify the content of the MDT and the AT to a certain extent, i.e. to be able to transfer selected parameters into the Sercos cycle. Find these parameters in the PLC program via the "functional variables" of each axis.

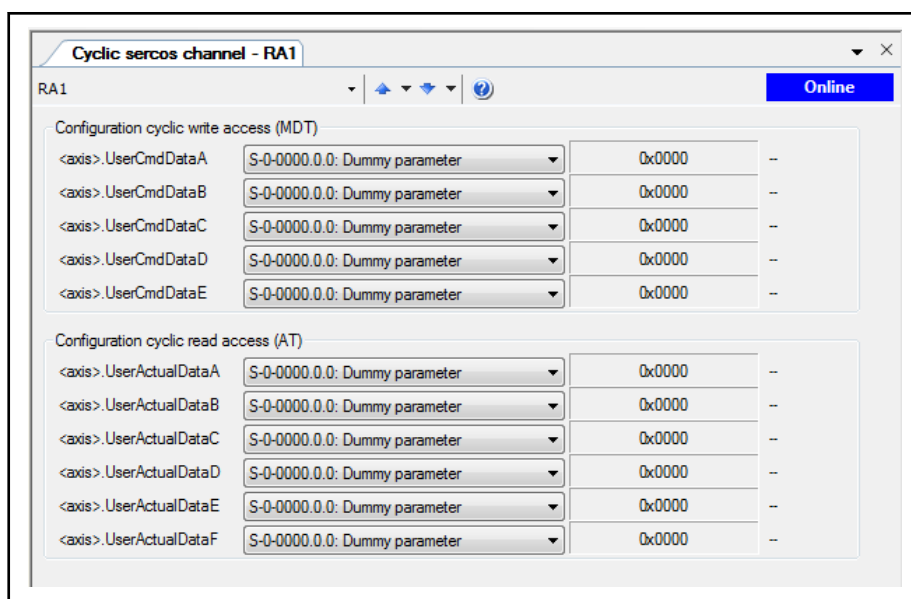


Fig. 6-12: "Cyclic Sercos channel" dialog

In the selection lists of the dialog, one parameter each can be chosen for the six available places. Only reasonable parameters are provided. The only restriction: Ensure not to assign the same parameter more than once.

If a parameter is selected, its value and - if required - its unit are displayed on the right.



Settings in this dialog can only be made in the parameterization mode. If settings are changed, switching to parameterization mode might be provided.

Example: Access to the parameter data in the PLC program

In the PLC program, the parameters can be accessed (read/write) (for MDT) via the specified functional variables.

In the following example, the value for the feedrate override parameter (S-0-0108) is increased by 5 for the axis "RA1" with the axis number "1":

The variables can be retrieved as index in an array under the respective axis number.

The data set is a structure of the "ML_AXISDATA_SM" type.

Example:

AxisData[1].dwUserCmdDataB_q.INT ⇒ axis 1, MDT data container B, interpreted as an INT.

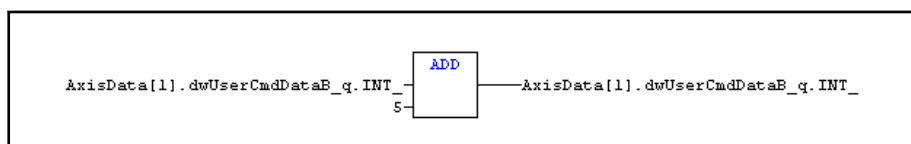


Fig. 6-13: Using the cyclic Sercos channel for writing

Another option from the PLC program is the use of the function blocks and functions for the cyclic data exchange (MB_GetCyclicParameterHandle, MB_ReadCyclicParameter, MB_ReadCyclicRealParameter of the PLC library ML_TechBase).

The following parameters are used to exchange data:

Write access

- A-0-0500, Configuration of user-defined command value A
- A-0-0502, Configuration of user-defined command value B
- A-0-0504, Configuration of user-defined command value C
- A-0-0506, Configuration of user-defined command value D
- A-0-0508, Configuration of user-defined command value E
- A-0-0510, Configuration of user-defined command value F

Read access

- A-0-0520, Configuration of actual user-defined value A
- A-0-0522, Configuration of actual user-defined value B
- A-0-0524, Configuration of actual user-defined value C
- A-0-0526, Configuration of actual user-defined value D
- A-0-0528, Configuration of actual user-defined value E
- A-0-0530, Configuration of actual user-defined value F



Use the documented access via AxisData[n] for the axis with the logical axis number "n".

Access via direct variable

<AxisName>_DAT.dwUserCmdDataB_q requires approx. the ten-fold access time (15 µs) and is therefore to be avoided!

Signal status word

This dialog is available for IndraDrive for interpolation in the drive and in the control.

The "Signal Status Word" dialog is part of the master communication. It is possible to define up to four bit queries which are read in each Sercos cycle.

The bit values can be accessed in the PLC program via the "functional variables" of the axis.

In order to define a bit query, it is usually necessary to determine a parameter and a bit from its value.

To ensure that these window settings can be transferred consistently to the control, the values are not immediately transferred after editing, but only after the explicit command to accept them with **Apply**. All settings changed, but not yet applied, are highlighted in blue.

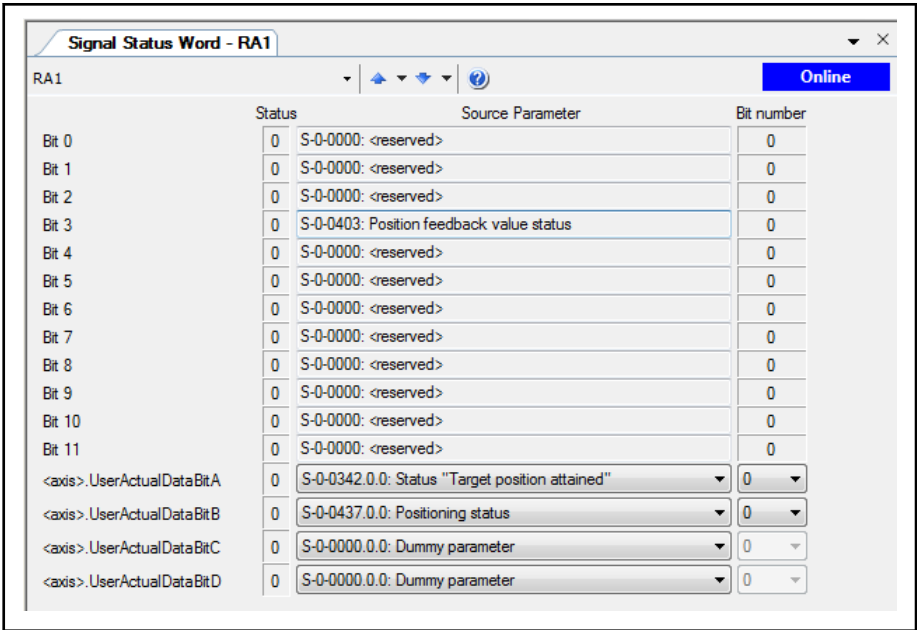


Fig. 6-14: "Signal Status Word" dialog

In addition to the freely configurable four bit queries, this dialog also displays the other bit queries preconfigured by the control firmware. (Incorrect) multiple definitions of the same bit queries can thus be avoided.



When selecting the bit number, a selection 0..31 is always provided. However, according to the parameter, it is possible that the real bit width is only 0..15.

No test regarding a valid bit number is executed.

Example: In the PLC program, the bit values can be accessed in read-only mode via the specified "functional variables". In the following example, it is determined whether the value "S-0-0342, Target position reached (Bit 0)" is set.

The variables can be retrieved as index in an array under the respective axis number.

The data set is a structure of the "ML_AXISDATA_SM" type.

Example:

AxisData[1].wUserActualDataBitA_i⇒ axis 1, data container A, WORD.



In order to receive a Boolean value, the functional (WORD) variable has to be masked with 0x0001:

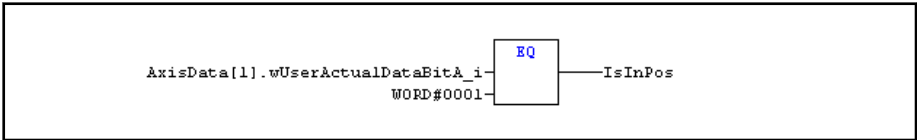


Fig. 6-15: Using the signal status word for reading

Another option from the PLC program is the use of the function blocks and functions for the cyclic data exchange (MB_GetCyclicParameterHandle, MB_ReadCyclicParameter, MB_ReadCyclicRealParameter of the PLC library ML_TechBase).

Task	Container A	Container B	Container C	Container D
Defines the drive parameter	A-0-0560	A-0-0563	A-0-0566	A-0-0569
Defines the bit in the drive parameter	A-0-0561	A-0-0564	A-0-0567	A-0-0570
Contains the value read from the parameter bit	A-0-0562	A-0-0565	A-0-0568	A-0-0571

Tab. 6-9: Parameters of the signal status word used



Use the documented access via AxisData[n] for the axis with the logical axis number "n".

Access via direct variable

<AxisName>_DAT.wUserActualDataBitA_i requires approx. the tenfold access time (15 µs) and is therefore to be avoided!

Signal control word



This dialog is available for IndraDrive for interpolation in the drive and in the control.

The "Signal Control Word" dialog is part of the master communication. It is possible to define up to four bit in parameters written in each Sercos cycle.

In the PLC program, the bit values can be accessed (read/write) via the "functional variable" of the axis.

In order to define such a cyclically written bit value, it is necessary to determine a parameter and a bit in its value.

To ensure that these window settings can be transferred consistently to the control, the values are not immediately transferred after editing, but only after the explicit command to accept them with **Apply**. All settings changed, but not yet applied, are highlighted in blue.

Bit	Status	Source Parameter	Bit number
Bit 0	0	S-0-0520: Axis control word	0
Bit 1	0	S-0-0520: Axis control word	1
Bit 2	1	S-0-0520: Axis control word	2
Bit 3	0	S-0-0000: <reserved>	0
Bit 4	0	S-0-0000: <reserved>	0
Bit 5	0	S-0-0000: <reserved>	0
Bit 6	0	S-0-0000: <reserved>	0
Bit 7	0	S-0-0000: <reserved>	0
Bit 8	0	S-0-0000: <reserved>	0
Bit 9	0	S-0-0000: <reserved>	0
Bit 10	0	S-0-0000: <reserved>	0
Bit 11	0	S-0-0000: <reserved>	0
<axis>.UserCmdDataBitA	0	P-0-0028.0.0: Oscilloscope: Control word	0
<axis>.UserCmdDataBitB	0	P-0-0036.0.0: Oscilloscope: External trigger signal	0
<axis>.UserCmdDataBitC	0	S-0-0000.0.0: Dummy parameter	0
<axis>.UserCmdDataBitD	0	S-0-0000.0.0: Dummy parameter	0

Fig. 6-16: "Signal Control Word" dialog

In addition to the freely configurable four bit values, this dialog also indicates the other bit values preconfigured by the control firmware. (Incorrect) multiple definitions of the same bit values can thus be avoided.



When selecting the bit number, a selection 0..31 is always provided. However, according to the parameter, it is possible that the real bit width is only 0..15.

No test regarding a valid bit number is executed.

Example: In the PLC program, the parameters can be accessed (read/write) via the specified "functional variables".

The variables can be retrieved as index in an array under the respective axis number.

The data set is a structure of the "ML_AXISDATA_SM" type.

Example:

AxisData[1].wUserCmdDataBitA_q → axis 1, data container A, WORD.

In the following example, the oscilloscope recording starts program-controlled (bit 0 of P-0-0028 is set to 1):

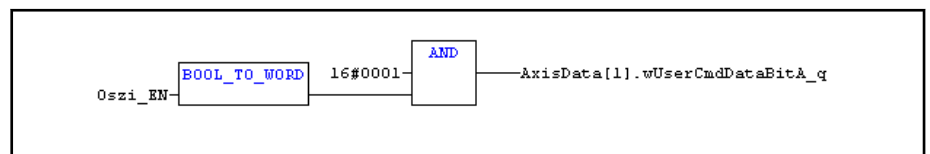


Fig. 6-17: Using the signal control word for writing

Another option from the PLC program is the use of the function blocks and functions for the cyclic data exchange (MB_GetCyclicParameterHandle, MB_ReadCyclicParameter, MB_ReadCyclicRealParameter of the PLC library ML_TechBase).

Task	Container A	Container B	Container C	Container D
Defines the drive parameter	A-0-0540	A-0-0543	A-0-0546	A-0-0549
Defines the bit in the drive parameter	A-0-0541	A-0-0544	A-0-0547	A-0-0550
Contains the value to be written to the parameter bit	A-0-0542	A-0-0545	A-0-0548	A-0-0551

Tab. 6-10: Parameters of the signal control word used



Use the documented access via AxisData[n] for the axis with the axis number "n".

Access via direct variable

<AxisName>_DAT.wUserActualDataBitA_i requires approx. the tenfold access time (15 µs) and is therefore to be avoided!

Diagnostics

Status



This dialog is available for all axis types.

This dialog shows the status information on the respective axis. In the given example, this is a real axis in an endless motion. The window is split in two, the upper half contains general information, whereas the lower half contains detailed supplements.

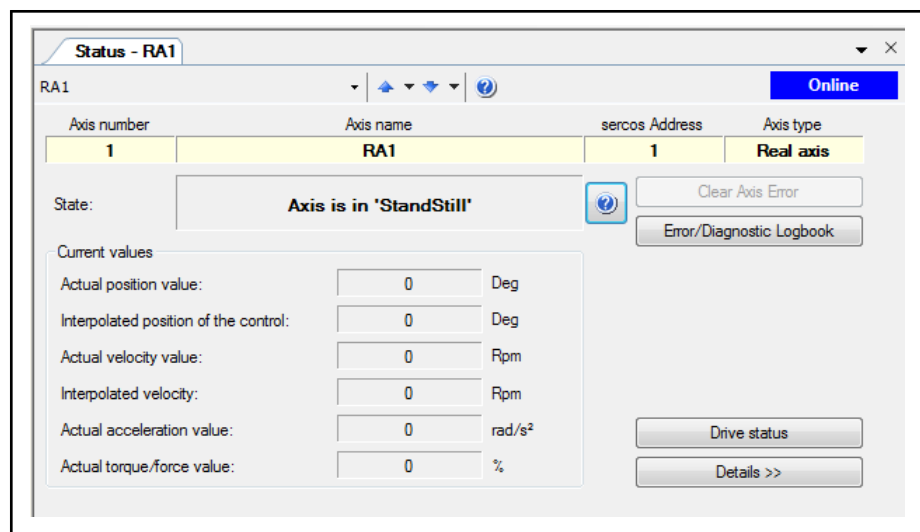


Fig. 6-18: "Status" dialog – Axis status of a real axis

To identify the axis:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Axis ID	x						
Logic axis number	A-0-0001						
Axis name, axis name	A-0-0002						
Axis type	A-0-0004 Bit 3 - Real axis, IndraDrive or HNC device Bit 4 - Virtual axis Bit 5 - Encoder axis Bit 6 - Link axis* Bit 7 - Controller axis*						
Drive address, here: Sercos address of the drive	A-0-0005					A-0-0005	
Link axis, master axis selection							A-0-0008
Axis diagnostic message	A-0-0020						
Command: Clear all axis errors	A-0-1030						
Current values	x						
Actual position value	A-0-0100						
Actual velocity value	A-0-0102						
Actual acceleration value	A-0-0103						
Actual torque/force value	A-0-0110						
Axis status	A-0-0021						
Extended axis status	A-0-0022						

*

only for MLC



The **Drive Status** button starts the status display for the drive belonging to the axis (see online help of the drive).



Double-click on the axis in the "Device status" of the control to open the "Axis status" dialog.

IDN list of invalid operating data



This dialog is available for IndraDrive for interpolation in the drive and in the control.

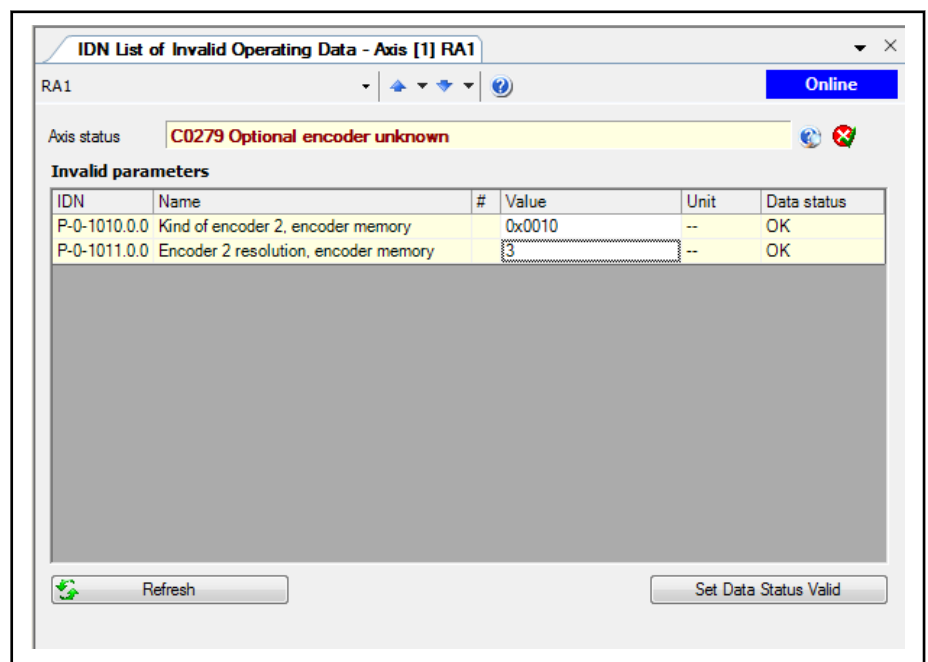


Fig. 6-19: "IDN List of Invalid Operating Data" dialog

When switching to phase 4, the drive parameters are checked and converted. If errors occur, the incorrect parameters are labeled as "configuration invalid or not permitted". The detected parameters are then listed in the dialog "IDN list of invalid operating data".

Using this dialog, the data status of parameters identified as invalid can be set to valid or the parameter value can be corrected.

Clearing Errors



This dialog is available for all axis types.

Enabling the context menu item, triggers "A-0-1030, Command: Clear all axis errors" and deletes the axis error in the drive and on the control.

Error/diagnostic memory



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis (only for MLC).

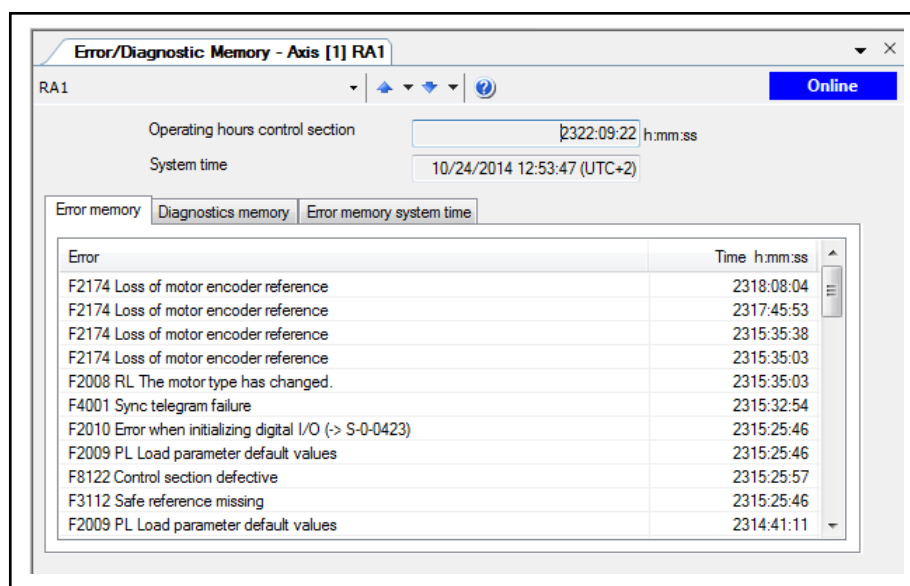


Fig. 6-20: "Error/Diagnostic Memory" dialog

The dialog displays the operating hour counter and the error memory/diagnostic memory of the drive belonging to the axis.

Double-click on the respective error line/diagnostic line to open the help for the error/warning or message.

Average value filter display



This dialog is available for IndraDrive for interpolation in the drive and in the control.

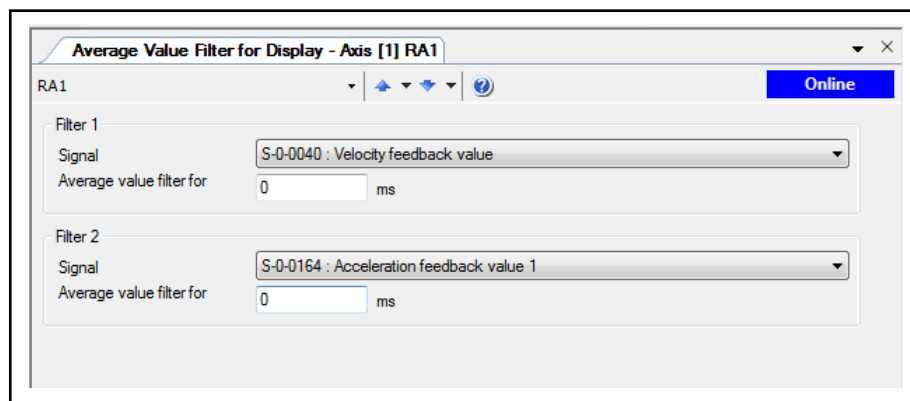


Fig. 6-21: "Average Value Filter for Display" dialog

In the dialog, it is possible to select two drive signals from the parameter "P-0-0396, Average value filter display: Signal selection list" for the parameter "P-0-0395, Average value filter display: Signal selection".

The function is disabled if "S-0-0000" is selected as signal.

Both the filters are not interconnected and can therefore be separately enabled or disabled. The parameter is of the Ident number list type and is provided with exactly two values (Ident numbers) for both filters.

Axis properties



Note: For the oscilloscope, etc., the parameterization sequences have to be followed!

If the signal for the average value filter display is preset first and if the same signal is then selected as measuring signal in the oscilloscope, the filtered value is recorded in the oscilloscope.

If the sequence is reversed, the value not filtered is recorded.

If the signal for the average value filter display is changed or deleted, there is no automatic switching to the oscilloscope function. The signal has to be selected again as measuring signal.

The basics are described with the corresponding products "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20/21 Functions", chapter "Velocity controller" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

The "Properties" dialog has two tabs. For controller axes (only MLC), more tabs can be displayed irrespective of the controller type.

"General" tab

The following settings can be changed for all axis types on the tab:

- Name: This name has to be unique and IEC-compliant. Otherwise, a warning is displayed



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- Comment: This text is displayed as tooltip on the axis if neither a warning nor an error is present for the axis.
- Author: The latest editor of an axis property can be entered in this field.

"Configuration" tab

The following settings - depending on the axis type - can be changed on the tab:

- For the virtual axis:
 - Axis number: The axis number has to be unique. Otherwise, a warning is displayed
- For the real axis:
 - Axis number(s): The axis number has to be unique. Otherwise, a warning is displayed The axis numbers in a drive have to be unique for drives with multiple axes. Otherwise, an error is displayed
 - Firmware: The selected firmware can be changed in the selected drive family (e.g. IndraDrive) as long as the number of axes does not change



If the derivative of the drive changes when changing the firmware (e.g. from MPB to MPH), the parameters of the drive available in the project might be lost ("Offline Parameters").

- Sercos address(es): The Sercos address has to be unique. Otherwise, a warning is displayed The Sercos addresses in a drive have

to be unique for drives with multiple axes. Otherwise, an error is displayed

- Axis name: The axis name can only be changed for multiple axis drives. This name has to be unique and IEC-compliant. Otherwise, a warning is displayed
- Interpolation method: Some drives only support the interpolation in the control. In this case, this setting cannot be changed



When changing the interpolation type of the axis, the interface to the respective drive is changed. Thus, we recommend to apply basic parameters to the drive after a change (see [chapter "Loading basic parameters" on page 378](#)).

It is recommended not to import a parameter file with S-/P-parameters of the drive with the associated different interpolation type (e.g. parameter file with "interpolation in the drive" to the drive with "interpolation in the control").

- Position feedback:
 - Checkbox enabled "Closed Loop" with position feedback (encoder)
 - or
 - Checkbox no enabled "Open Loop" without position feedback (without encoder)



Without position feedback (open loop), only a limited functional scope is available (position-controlled operation modes are not possible; axis parameters for position-controlled operation modes are not synchronized with the drive).

- If the drive was not yet configured, it can be subsequently configured with "Perform configuration for the drive". In reverse case, subsequently change the drive configuration with "Display configuration of the drive". In both cases, a dialog to enter the required data is displayed.
- For the encoder axis:
 - Axis number: The axis number has to be unique. Otherwise, a warning is displayed
 - Drive assignment
- for link axis (only MLC)
 - Axis number: The axis number has to be unique. Otherwise, a warning is displayed
 - Assigning the link axis
- for controller axis (only MLC)
 - Axis number: The axis number has to be unique. Otherwise, a warning is displayed

After the changes, apply the settings with **OK**.



The properties of a control can only be edited if there is no connection to the control (the control is neither online nor logged in).



After a property has been changed (e.g. axis number) and the subsequent online going of the control, messages might be displayed in the diagnostic memory of the control showing that the corresponding axis was deleted and created again. These messages show the internal procedure of a change (axis is deleted and created again with new properties) and can be ignored.

6.4 Virtual axis

6.4.1 General information

The virtual axis is among the core functions of the control. The virtual axis provides the master value to synchronize drives or other virtual axes. The master value is applied to all slave axes at the same time. The master-slave relationship can be established using the following function blocks:

- Gear functions
MC_GearIn, MB_GearInPos
- ML_FlexProfile
- MB_MotionProfile

Virtual axes can be commanded via function blocks. Virtual axes can also follow other axes. The calculation sequence for the individual axes is always arranged to ensure that master axes are always calculated before slave axes. This prevents dead times. Recursive master-slave relationship (e.g. axis 1 follows axis 2 and axis 2 follows axis 1) are identified and rejected.

If the following prerequisites are met, a dimensional reference can be set via the parameter A-0-2807 "Command: Set absolute position" and A-0-2806 "Reference position":

- Axis in operating mode (phase 4)
- Axis is standstill

This allows to start the virtual axis from a position unequal to zero.

The status message "Actual position value is homed" is always set for a virtual axis in the parameter A-0-0021 "Axis status".

6.4.2 Creating a virtual axis (virtual master axis)

Creating the virtual axis

For a virtual master axis, the master axis position is generated according to the preset velocity command value. Thus, the following restrictions are taken into account:

- A-0-0032, Velocity limit value, positive
- A-0-0033, Velocity limit value, negative
- A-0-0034, Acceleration limit value, bipolar
- A-0-0036, Jerk limit value, bipolar
- A-0-0224, Rapid stop deceleration



An axis can only be created in offline mode!

A virtual axis is created in the Project Explorer, in the **Motion -> Virtual Axes** folder of the control. For this purpose, the context menu has to be enabled (right-click or <Shift>+<F10>).

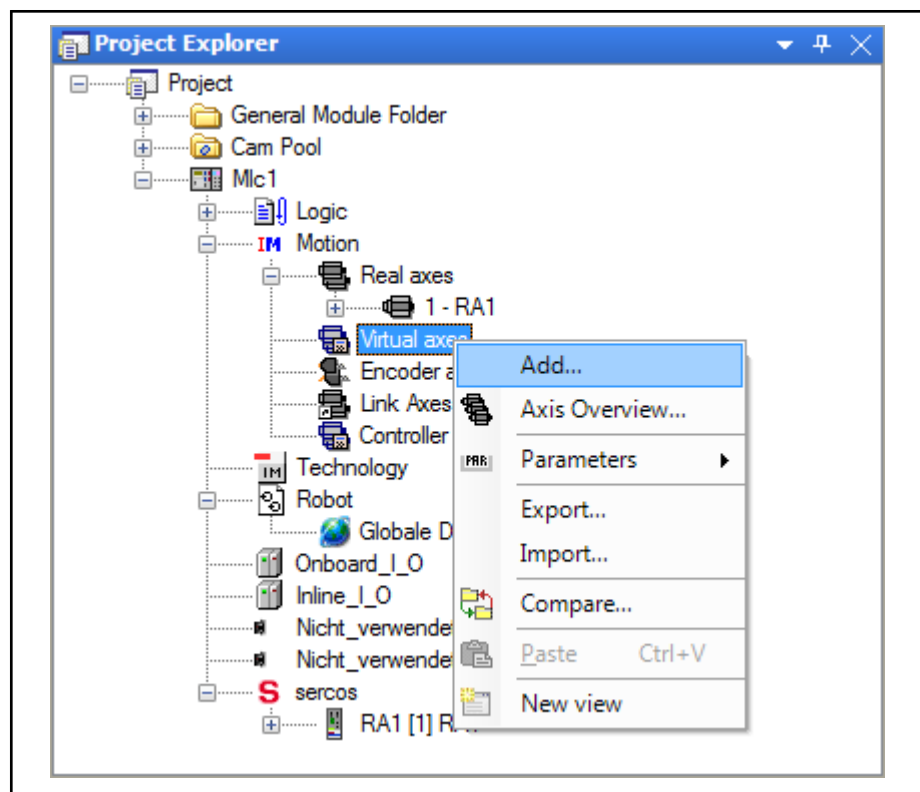


Fig. 6-22: Creating a virtual axis – Context menu

Dialogs to create a virtual axis

The creation of a virtual axis is supported by a wizard with two dialog boxes.

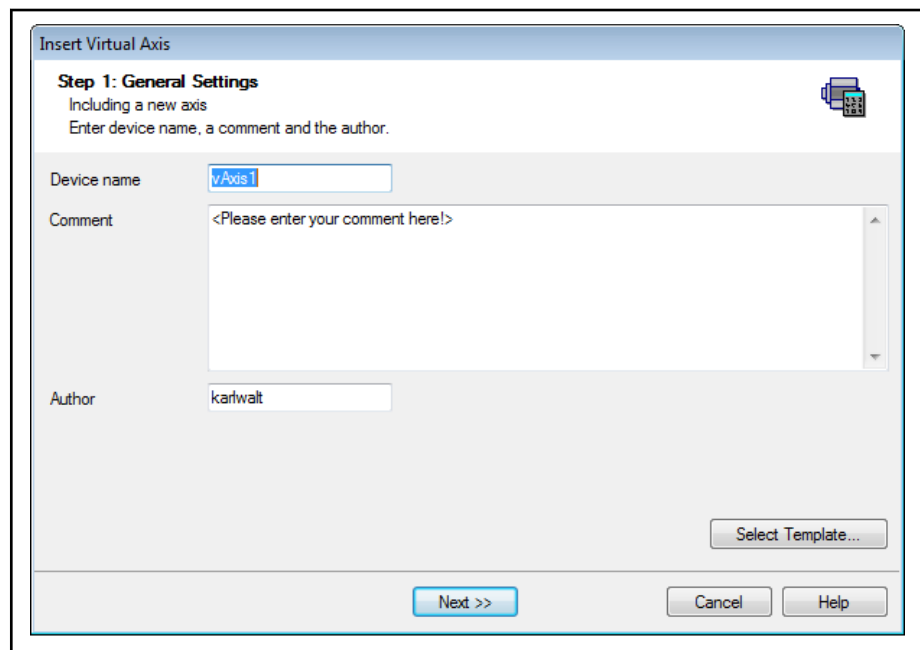


Fig. 6-23: Creating a virtual axis – General Settings

In the "General Settings" step, device name, comment on this device and author are entered.

Select a template for the following settings via **Select Template...** ([chapter 3.11 "Creation based on templates" on page 119](#)). Either an already existing virtual axis in the project or the parameter backup of a virtual axis can be selected as template.

Apply or change the preset values.

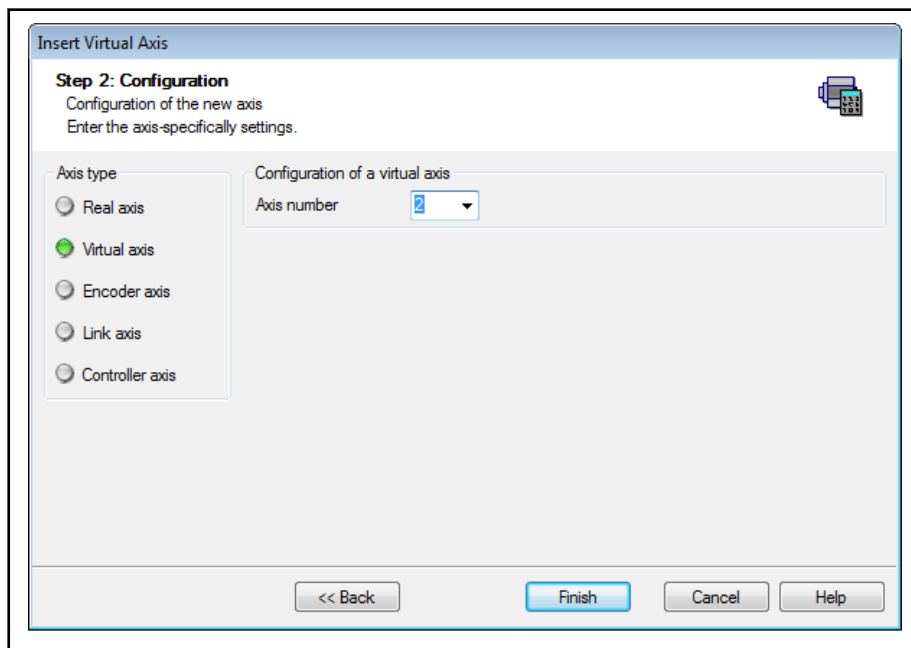


Fig. 6-24: Creating a virtual axis – Configuration

The axis number can be set in the "Configuration" step.

Axis assignment To address the axis, the PLC uses the axis number and axis name (here "2" or "vAxis1").

The virtual axis is shown only once in the Project Explorer:

Context menu If the context menu is opened on the folder **Motion -> Virtual Axes -> vAxis1** via right click, the following menu items are displayed:

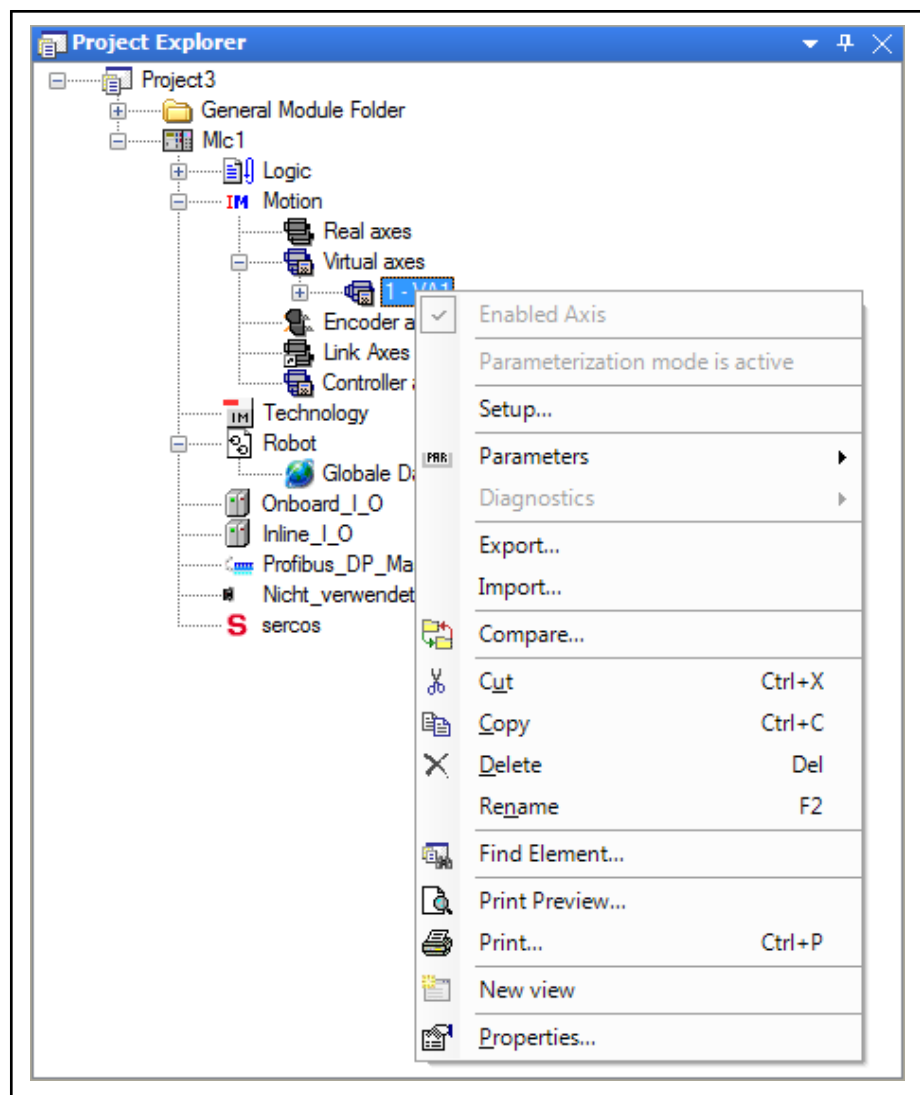


Fig. 6-25: Virtual axis - Context menu

As no connection is yet established (offline), some commands are disabled (for the complete description, see [chapter 6.4.4 "Virtual axis - Context menu" on page 395](#) or [chapter 6.4.3 "Virtual axis - Dialogs" on page 394](#)).

6.4.3 Virtual axis - Dialogs

Overview on dialogs

When opening the axis folder, the dialogs available for this axis are displayed.

First, it is assumed that the presets cover a wide range of applications and that a modification is only required in exceptional cases.

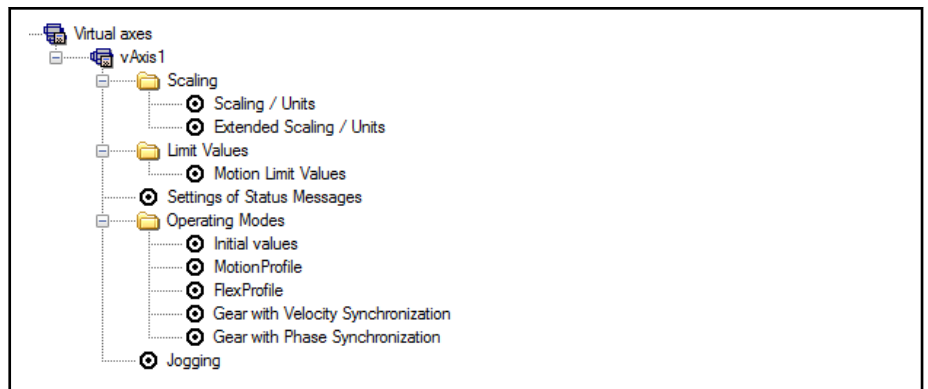


Fig. 6-26: Dialogs of a virtual axis

The values in the dialogs are partially calculated from multiple parameters. If a clear assignment exists, it is specified.

The following dialogs are available for virtual axes:

- Scaling
 - [chapter 6.8.7 "Scaling/units settings" on page 447](#)
 - [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- Limit values
 - [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)
- Operation modes
 - [chapter 6.8.17 "Initial values" on page 462](#)
 - [chapter 6.8.21 "MotionProfile" on page 471](#)
 - [chapter 6.8.22 "FlexProfile" on page 478](#)
 - [chapter 6.8.23 "Gear with velocity synchronization" on page 485](#)
 - [chapter 6.8.24 "Gear with phase synchronization" on page 489](#)

6.4.4 Virtual axis - Context menu

Overview on menu items

The context menu of a virtual axis in online mode contains the following menu items:

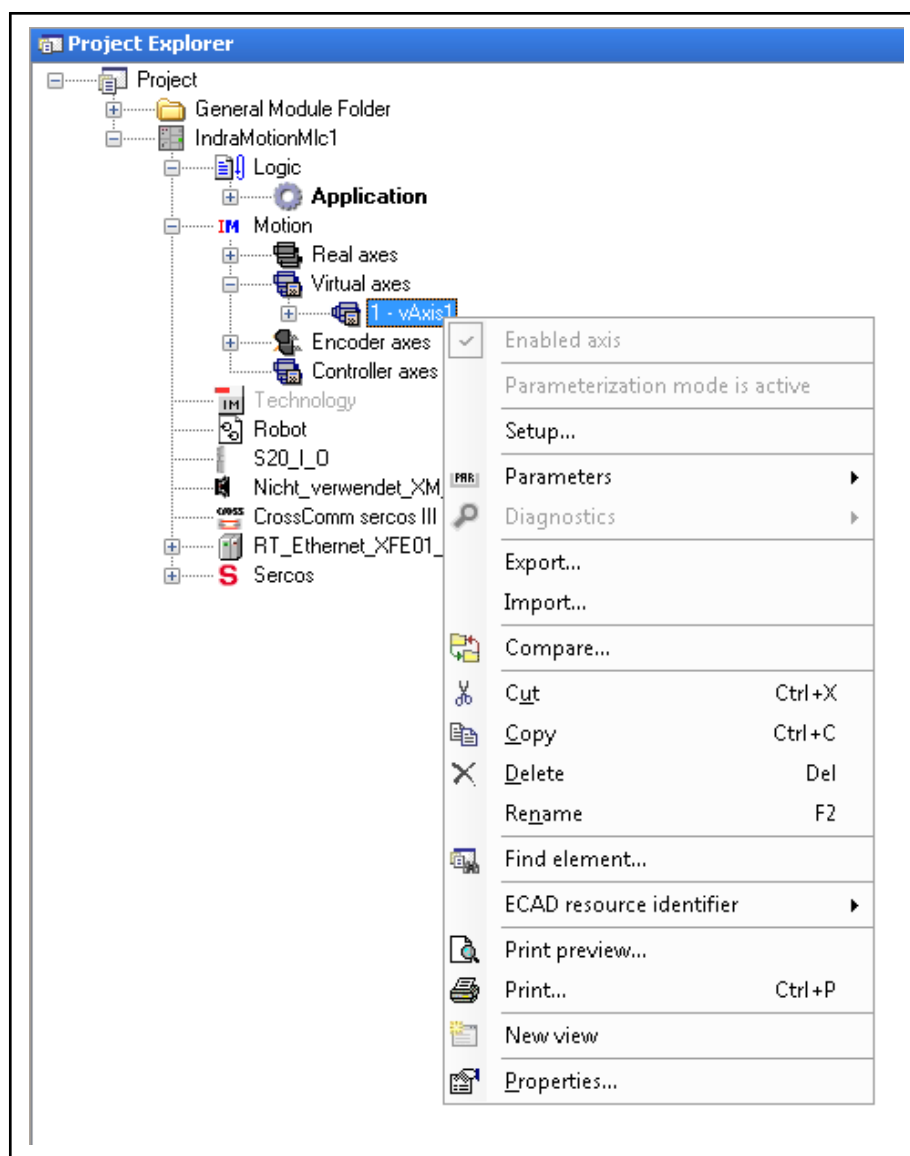


Fig. 6-27: Context menu of a virtual axis in online mode

- **Enabled axis**
Refer to the description of the parameter "A-0-0024, Axis state" in the documentation "IndraLogic XLC IndraMotion MLC 14VRS Parameters".
- **Parameterization Mode Active** - Switch on/off the parameterization mode of the axis. For more information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#)
- [chapter "Initial Commissioning" on page 377](#) - Setup cycle
- **Parameters**
 - [chapter "Parameter editor" on page 222](#)
 - [chapter "Parameter group" on page 224](#)
 - [chapter "Finding parameters" on page 226](#)
 - [chapter "Loading basic parameters, general" on page 397](#)
 - [chapter "Parameter adjustment" on page 226](#)
 - [chapter "Parameters - Export" on page 231](#)
 - [chapter "Parameters - Import" on page 232](#)

- [chapter "Status" on page 385](#)
- [chapter "IDN list of invalid operating data" on page 387](#)
- **Export...** - Saves axis elements in a file. This menu item is described in [chapter 4.4.14 "Exporting" on page 268](#)
- **Import...** - Imports axis elements from a file. This menu item is described in [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Compares and merges objects, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the complete axis from the project in **offline mode**
- **Rename** - Changes the axis name in **offline mode**



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- **Find Element...** - Allows scanning for elements in the project
- **Print Preview...** - Selects whether to print the projected properties, the parameters or both of the virtual axis. There is a print preview before printing
- **Print...** - Selects whether to print the projected properties, the parameters or both of the virtual axis
- **New View** - Displays the axis in an individual window
- **Properties...** - Refer to [chapter "Axis properties" on page 389](#)

Loading basic parameters, general

Restore the basic function of a drive with "Load basic parameters".

Practically, the axis is removed and newly created. All parameters directly located in the axes (stored in the S- and P-parameters of the drive) are assigned with default values like all other A-parameters in the control.

Creating a new axis:

When creating a new axis, note that the drive as well as the control have to have certain presettings.

1. Creating new axis (completely new)
 - Dragging drive to the Project Explorer
 - Going online
 - Load the basic parameters for the drive via the context menu items "Setup" or "Parameters" ⇒ "Load Basic Parameters..."
 - A-0-1000, Command: Load basic axis parameters: sets the required A-parameters for the drive to default values
Triggering: 0x11, parameter is reset automatically
 - P-0-4090, Configuration of default values, S-0-0262, C07_x Command "Initial Loading"
Triggering: P-0-4090 0x1, S-0-0262 0x11; P-0-4090 0x0, S-0-0262 0x00
2. Creating new axis (drive already optimized)
 - Dragging drive to the Project Explorer
 - Going online
 - Load the basic parameters for the drive via the context menu items "Setup" or "Parameters" ⇒ "Load Basic Parameters..."

- A-0-1000, Command: Load basic axis parameters: sets the required A-parameters for the drive to default values; not the S- and P-parameters.

Triggering: 0x11, parameter is reset automatically

3. Creating a new axis (axis was deleted before)



This procedure is not recommended!

- Dragging drive to the Project Explorer
 - Going online
 - "Load basic parameter" is not executed
- All old parameter assignments are applied

6.5 Controller axis

6.5.1 General information



Controller axes are only supported by the MLC system.

- Controller axes are used to implement the controller of an axis in the PLC and to command this axis as all other axes (PLCopen function blocks, AxisInterface). All Motion function blocks are available for this axis type.

Therefore, different predefined controller axes

- Third-party devices connected as PLC device (see [chapter 6.9 "Drive as PLC device" on page 500](#)) to the MLC control (e.g. third-party drives, encoder) can be coupled to the axis system of the MLC control using a controller axis. Such a controller axis can be used to identically command these devices and other axis types.

In this case, select "Freely programmable controller" as controller type.

A controller axis provides the following options:

- Direct traversing of PLC commands (e.g. MC_MoveAbsolute)
- Master and slave axis for a synchronized motion
- Kinematic axis (only for MLC)

User-defined controllers can be implemented in the PLC. Moreover, the control of a drive is not defined. For example, any number of inputs can be used as encoder inputs and one motor can be controlled with any number of outputs. The interface to the controller axis is generally the position command value or the actual position value (velocity as well as torque or force are also possible as command value).

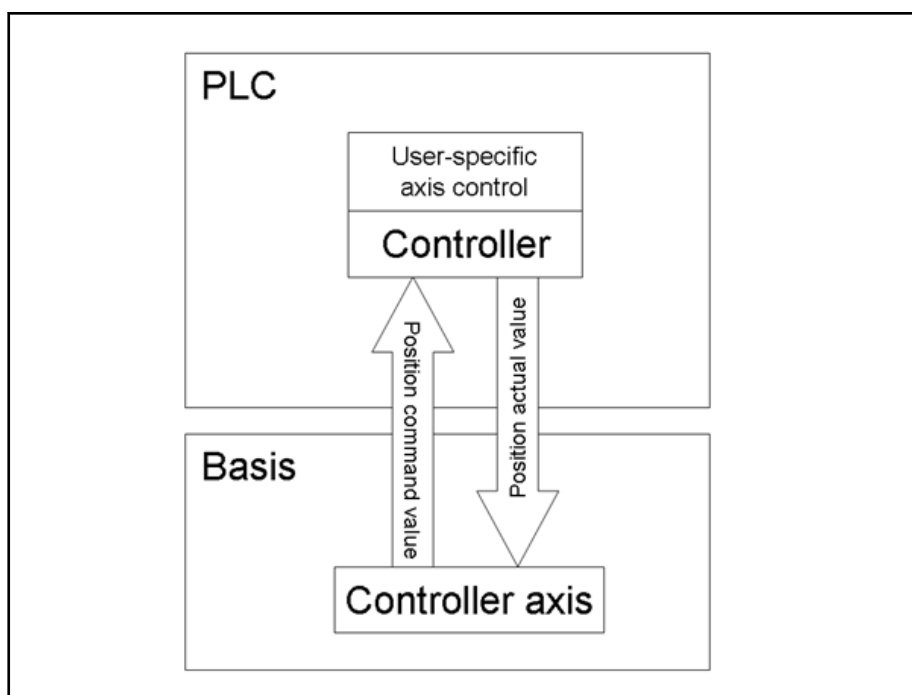


Fig. 6-28: Communication between controller axis and controller in the PLC

6.5.2 Creating a controller axis

Creating axis in the Project Explorer

Creating controller axis A controller axis is created in the Project Explorer, in the **Motion -> Control Axes** folder of the control. Thus, enable the context menu (right-click or press <Shift> + <F10>).

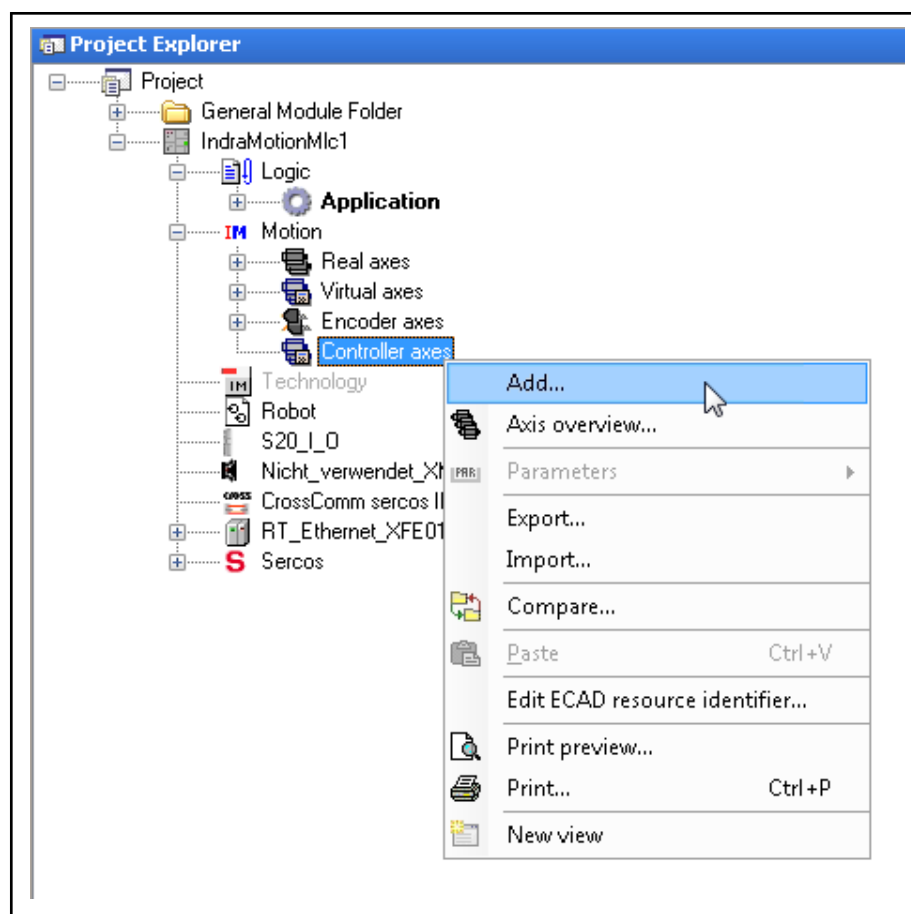


Fig. 6-29: Creating a controller axis - Context menu



An axis can only be created in offline mode!

Step 1: General settings

Dialogs to create a controller axis

The creation of a controller axis is supported by a wizard with multiple dialog boxes.

Insert controller axis

Step 1: General Properties
Including a new axis
Enter device name, a comment and the author.

Device name: CA

Comment: <Please enter your comment here!>

Author: user

Select Template...

Next >> Cancel Help

Fig. 6-30: Creating a controller axis – General settings

In the "General settings" step, device name, comment on this device and author are entered.

Select a template for the following settings via [chapter 3.11 "Creation based on templates" on page 119](#). Either an already existing controller axis in the project or the parameter backup of a controller axis can be selected as template.

Apply or change the preset values.

Step 2: Configuration

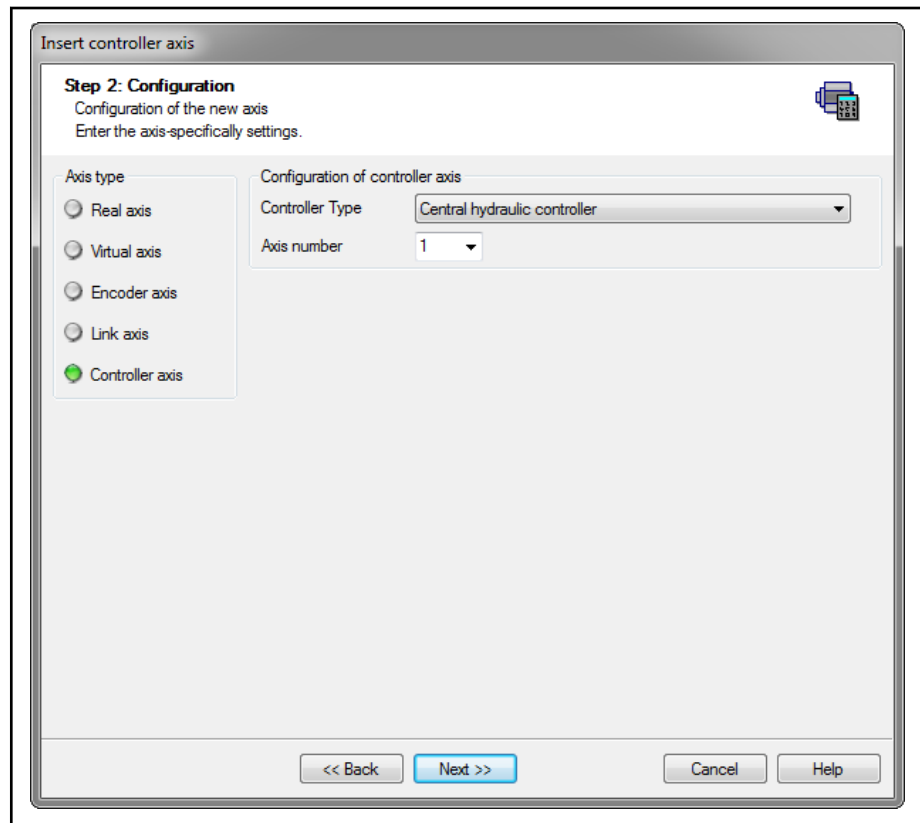


Fig. 6-31: Creating a controller axis – Configuration

The axis number can be set in the "Configuration" step.

Axis number The axis is provided with the next free axis number (here "1", as no axis is yet in the project).

To address the axis, the PLC uses the axis number .

Controller type The following controller types can be selected:

- Freely-programmable controller
- Hydraulic central controller
- Hydraulic synchronization controller
- Central Sytronix controller



No predefined PLC program code is created for the "freely programmable controller".

For the controller types "hydraulic central controller", "hydraulic synchronization controller" and "central Sytronix controller", PLC program code is created as predefined.



The axis number of the hydraulic central controller / central Sytronix controller has to be within the following ranges:

To 14V20:

- **L75:** Axis number 1 - 32
- **L65:** Axis number 1 - 32
- **L45:** Axis number 1 - 8
- **VPx:** Axis number 1 - 49
- **XM2x:** Axis number 1 - 20

From 14V22:

- **L75:** Axis number 1 - 64
- **L65:** Axis number 1 - 64
- **L45:** Axis number 1 - 16
- **VPx:** Axis number 1 - 99
- **XM2x:** Axis number 1 - 40
- **XM42:** Axis number 1 - 99

For the drive parameter description, refer to the IndraWorks online help "Rexroth IndraDrive help system".

The following chapter describes the creation of different controller types.

Step 3 (central controller/Sytronix controller): Signal handling

It is assumed that the steps from [chapter "Creating axis in the Project Explorer" on page 399](#) were already performed and that either "Central hydraulic controller" or "Sytronix controller" was selected as controller type.

Whether signal is assigned is specified in the "signal handling" step.

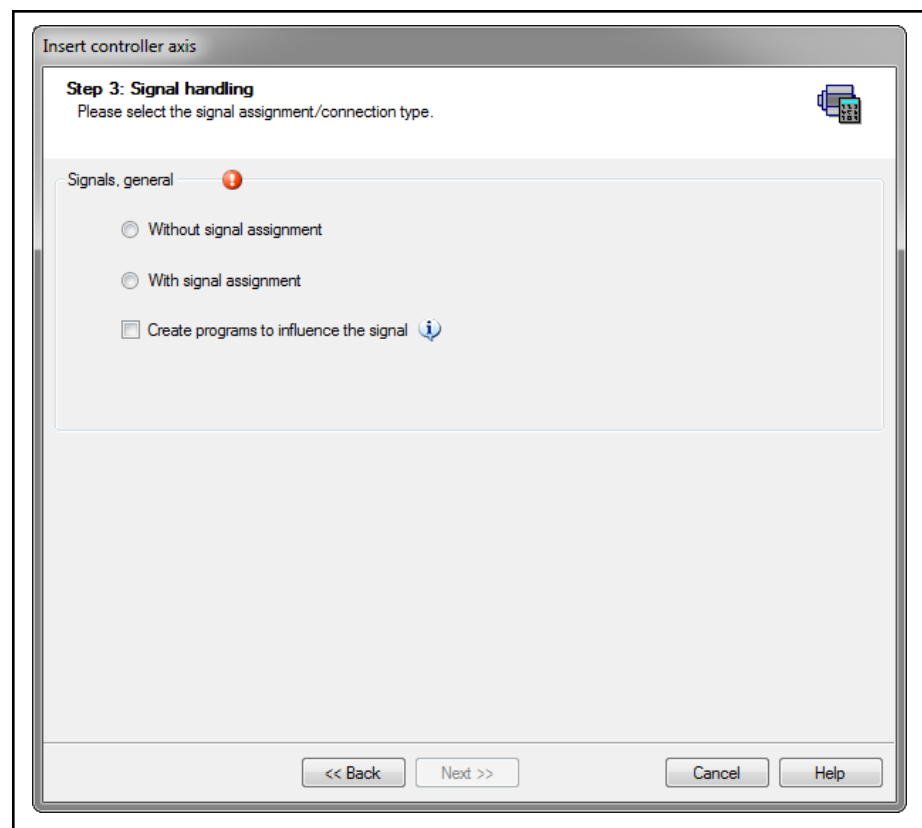


Fig. 6-32: Creating a central hydraulic controller axis – Signal handling



Select the checkbox **Create programs to influence the signal** to create additional programs which are cyclically processed in the "HCSercosSyncProg" program:

- **HCSercosSyncProgBefore** (is processed after the initialization of the adaptation module and before calling the actual value detection)
- **HCSercosSyncProgAfter** (is the latest processed in the "HCSercosSyncProg" program)

Typical use cases of signal influence is the use of user-specific adaptation modules (e.g. digital hydraulics) or the calculation of own actual values (e.g. calculation of the actual force value for cylinders with dynamic area changing).

The programs are created once for all axes. When the checkbox of any hydraulic controller axis is selected, the checkbox for all other axes is globally selected and write access is blocked.

To delete both programs, make the following steps:

1. Delete the programs "HCSercosSyncProgBefore" and "HCSercosSyncProgAfter" in the project tree.
2. Open the "Properties" dialog of any hydraulic controller axis and press **OK** (wizard deletes program calls in the "HCSercosSyncProg" program).



Additional information is displayed as tooltip.

Step 4 (central controller/Sytronix controller): Signal assignment

The signals for the IP20 4-axis module or for the selected S20 modules can be assigned here. It is either assigned via **Select Axis...** (quick selection for the required axis signals) or via the ... for an individual signal. If an individual signal is not required anymore, delete it via the **X** button.

Any PLC signals (or modules that cannot be selected in the default assignment) can be assigned via the "Free assignment" tab. In the latter case, it might be necessary that an error handling has to be programmed or that the hardware properties have to be considered in the application (refer to the notes).

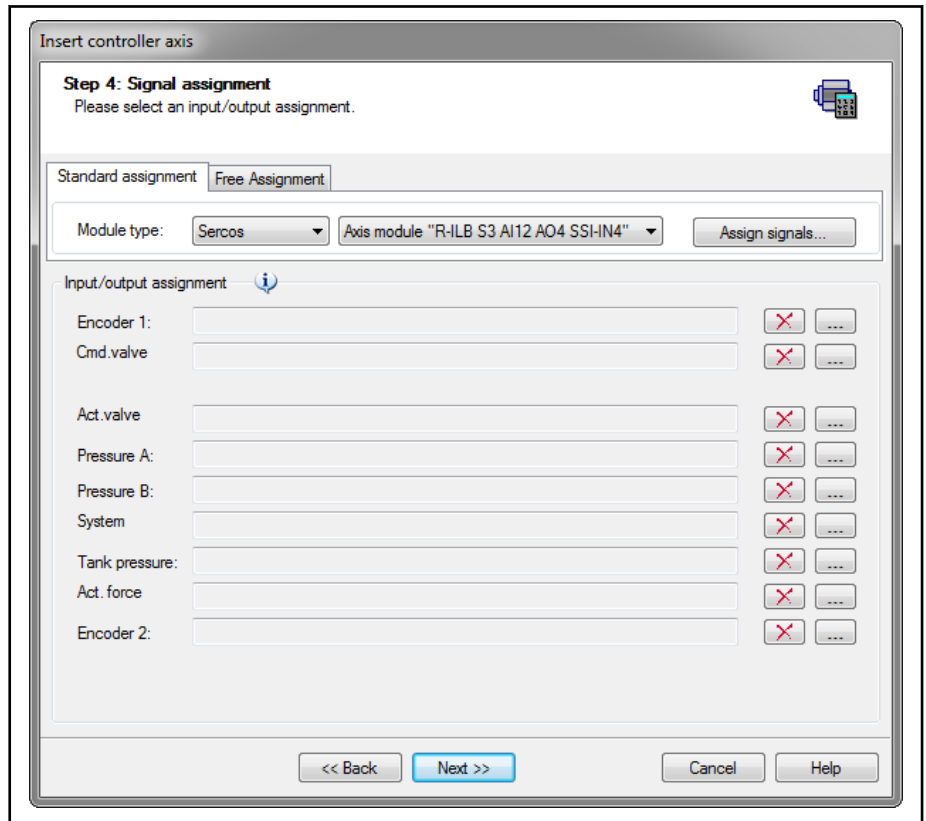


Fig. 6-33: Creating a central controller – Selection of the individual signals



Additional information is displayed as tooltip.

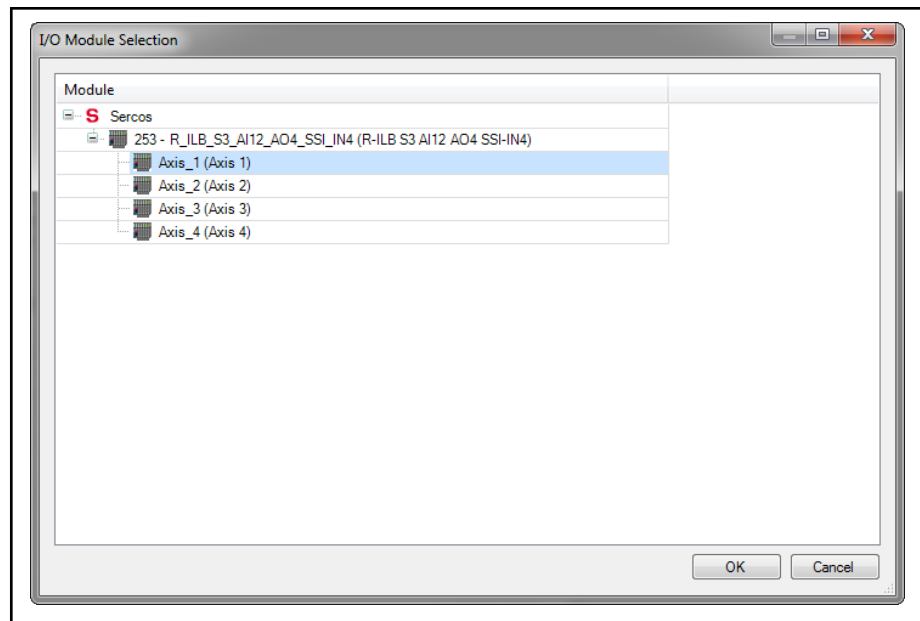


Fig. 6-34: Creating a central controller – Browser - Sercos III - Axis selection

The signals are assigned using the bus browser. Click to select the respective module. Depending on the selection, all connected modules of the respective bus are displayed in this mask.

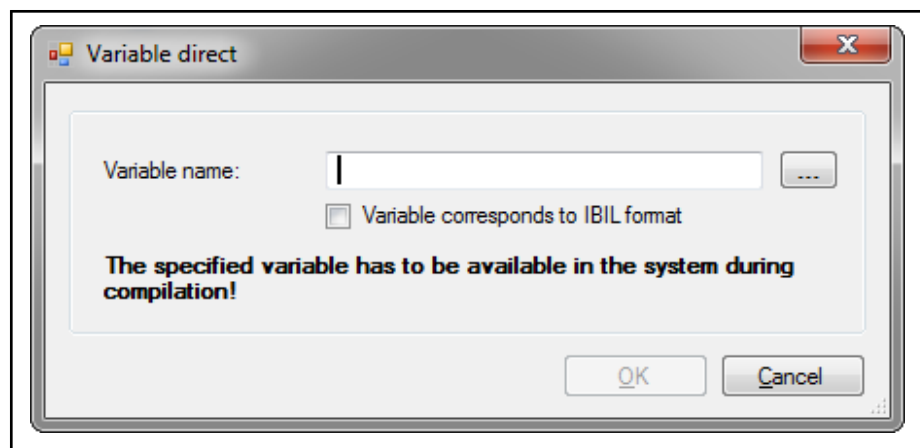


Fig. 6-35: Creating a central controller – Variable browser

The signals can alternatively be assigned on PLC variables. The variable name can be directly entered using the dialog. Press ... for selection with the variable browser.

The axis supports the scaled variable values (e.g. encoder signal in mm) and values in raw format (IBIL format / standard signal Inline modules). To switch between a scaled variable and a variable in raw format, select the checkbox **Variable corresponds to IBIL format**.

The signals can alternatively be assigned on PLC variables. The variable name can be directly entered using the dialog. Press ... to select the variable browser.



Signal/hardware selection

Observe the following when selecting the free assignment:

- General:** Observe the error substitute value.
 In case of hardware signals or variables in IBIL format, the error reactions occur in the axis if the error substitute values correspond to the standard modules (default settings).
 In all other cases, the variables/hardware signals have to be checked for validity in the application.
 When these signals become invalid, the application has to ensure that the axis is safely stopped.
 Use the ML_SetDiagEntry function for example.
- General:** If the actual value signals (mostly encoder signals) of an axis have to be applied to another hardware module/bus as command value (mostly analog output to valve) and if there is an error in the actual value signal, ensure that the command value signal is reset (mostly to zero).
 This requires a detailed analysis of the error source (bus failure, hardware module failure especially for the parameterized Sercos error reaction, only signal failure). If necessary, required supplements have to be implemented into the application.
- Hardware signal selection via the Sercos browser:** in particular, observe the behavior of the error substitute value of the selected mode for different error sources.
 The module S20-SSI-AO-1/1 outputs for example that latest pending value in case of a local bus error, irrespective of the behavior set. It is mostly not suitable for a closed-loop control.
- Hardware signal selection:** Observe that the quality of the signals is similar to that of the standard modules.
 In particular, observe the module velocity (a regular closed-loop control expects signals in a cycle of 2ms or less).
 Note the synchronism for encoder signals, as, otherwise, the actual velocity signals extremely fade away in the closed-loop control.

Required data types/units for scaled variables:

Input/output signal	Data type	Unit
Encoder 1	LREAL	Position scaling of the axis (default = mm)
Valve command value	LREAL	% (+-100)
Actual valve value	LREAL	% (+-100)
Pressure A	LREAL	Bar
Pressure B	LREAL	Bar
System pressure	LREAL	Bar
Tank pressure	LREAL	Bar

Actual force value	LREAL	Force scaling of the axis (e.g. kN)
Encoder 2	LREAL	Position scaling of the axis (default = mm)

Tab. 6-11: Creating a central controller – Data types/formats, variable direct

The signals for the IP20 4-axis module or for the selected S20 modules can be assigned here.

It is either assigned via **Select Axis...** (quick selection for the required axis signals) or via the ... for an individual signal.

If an individual signal is not required anymore, delete it via the **X** button.

Any PLC signals (or modules that cannot be selected in the default assignment) can be assigned via the "Free assignment" tab.

In the latter case, it might be necessary that an error handling has to be programmed or that the hardware properties have to be considered in the application (refer to the note above).

Step 5 (Sytronix controller): Axis assignment

It is assumed that the steps from [chapter "Creating axis in the Project Explorer" on page 399](#) were already performed and "central Sytronix controller" selected as controller type.

The real drive to be used for the Sytronix control is selected in the "Axis Assignment" step.

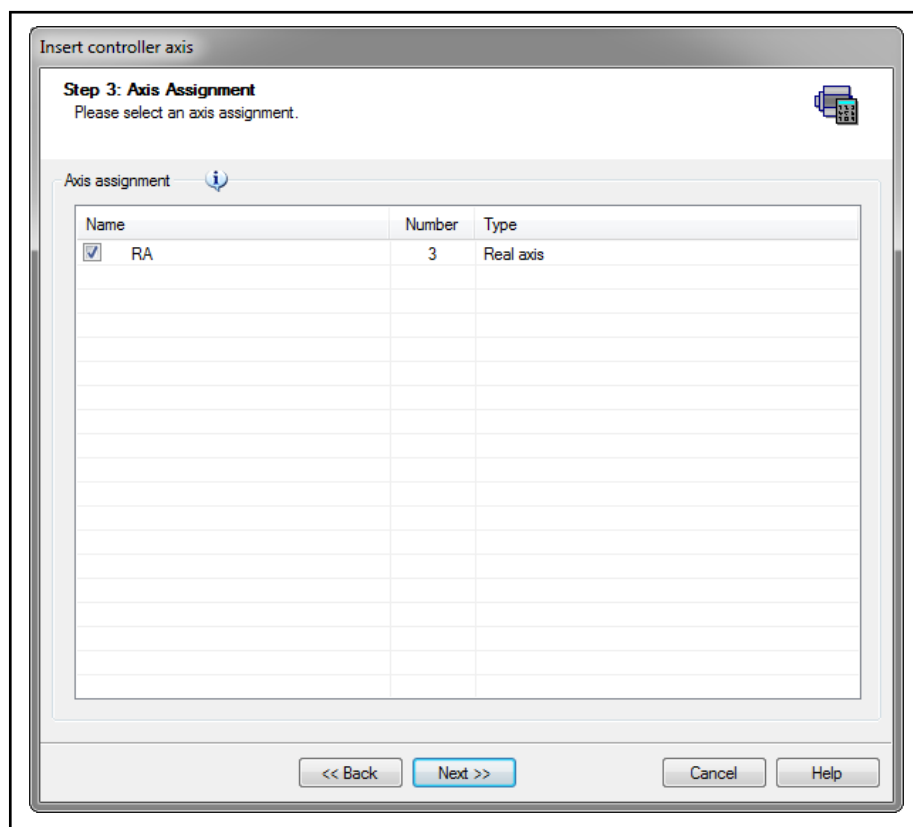


Fig. 6-36: Creating a Sytronix controller – Axis assignment

Step 3 (synchronization controller): Axis assignment

It is assumed that the steps from [chapter "Creating axis in the Project Explorer" on page 399](#) were already performed and "hydraulic synchronization controller" selected as controller type.

The slave axes of the synchronization axis are added in the step "Axis Assignment".

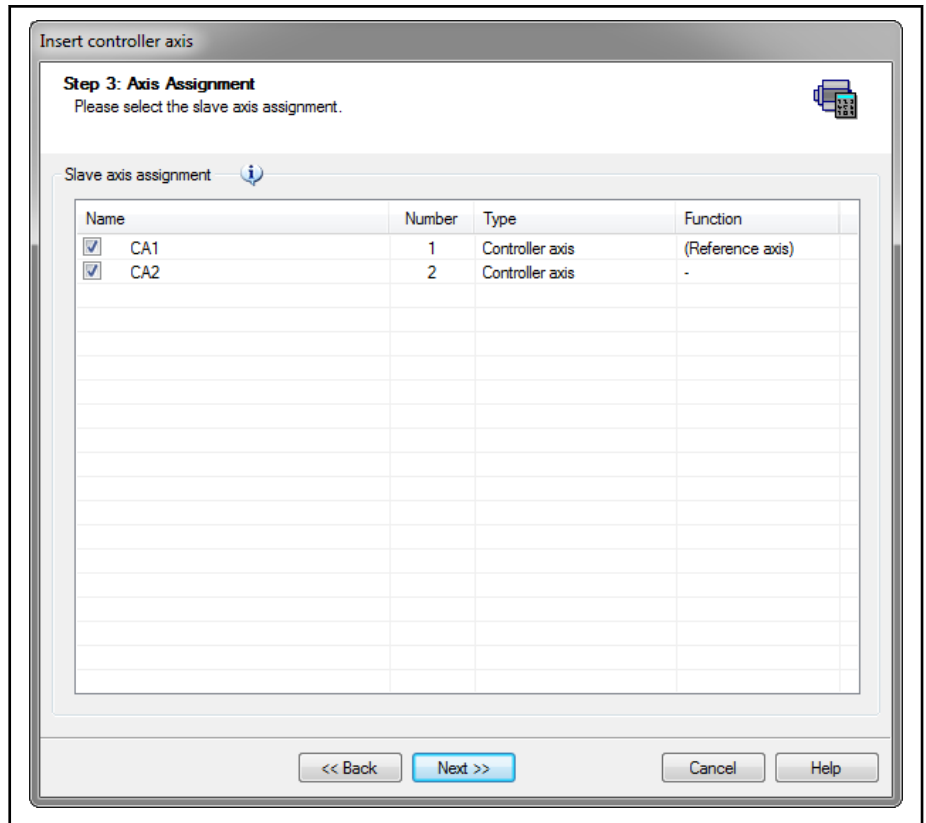


Fig. 6-37: Creating a synchronization controller – Axis assignment



The reference axis of the synchronization controller is labeled in the "Function" column. The axis listed first is set as reference axis by default. Change the assignment via the context menu (right-click).

Last step: Summary

The summary shows all parameters set. The axis in the "Motion" node is only created after the summary was confirmed. If it is the first inserted controller axis, multiple tasks and programs are additionally added to the PLC application to call the controller axis. The following figure exemplarily summarizes the hydraulic central controller.

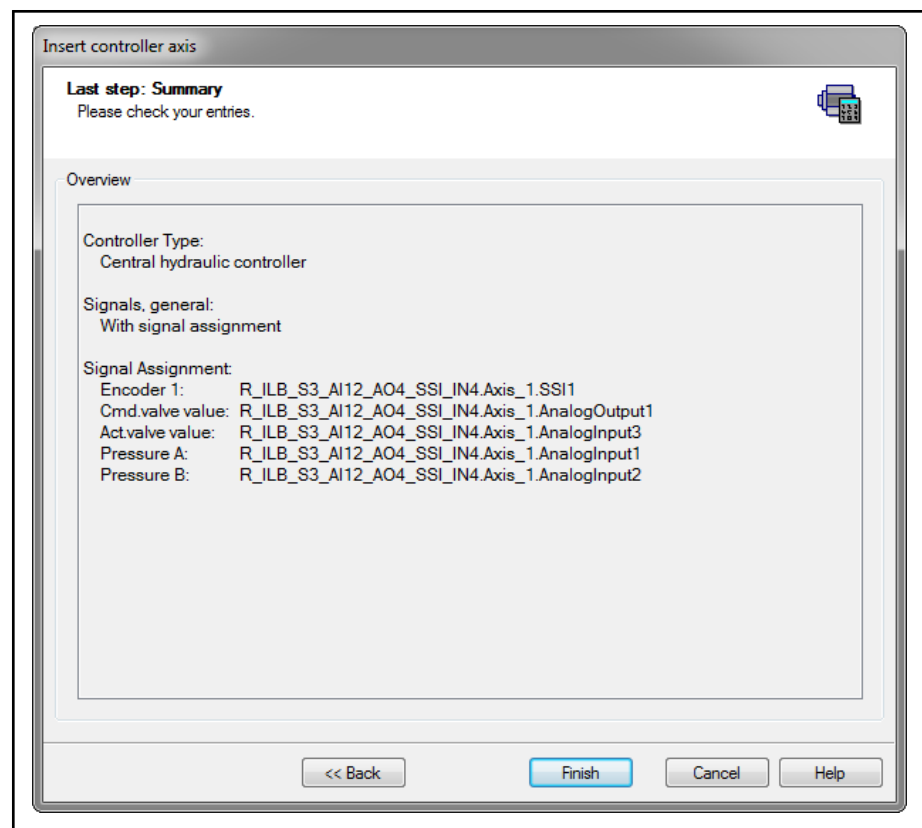


Fig. 6-38: Creating a hydraulic central controller – Summary

6.5.3 Controller axis - Dialogs

Controller axis (freely programmable) – Overview on dialogs

Open the folder of a freely programmable controller axis in online mode and the dialogs available for this axis are displayed.

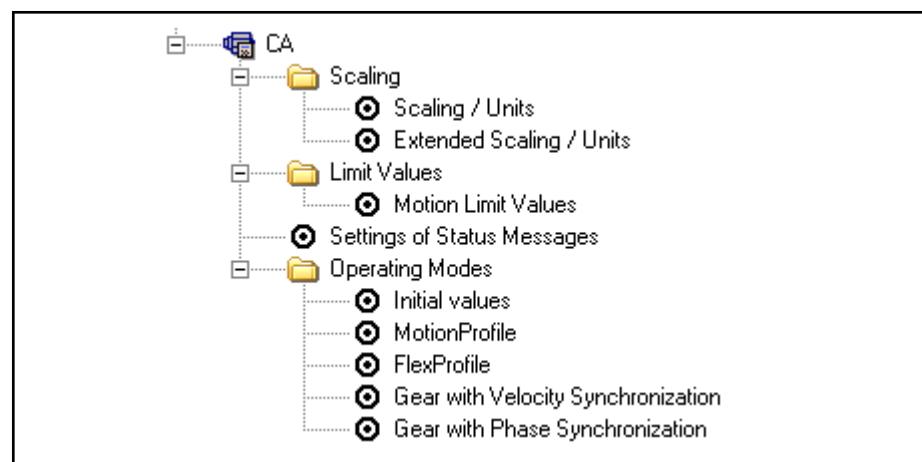


Fig. 6-39: Dialogs of a freely programmable controller axis

Some of the controller axis dialogs are only slightly different from the dialogs of a real axis. The descriptions of the corresponding dialogs of a real axis are located in

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)

- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)
- [chapter 6.8.21 "MotionProfile" on page 471](#)
- [chapter 6.8.22 "FlexProfile" on page 478](#)
- [chapter 6.8.23 "Gear with velocity synchronization" on page 485](#)
- [chapter 6.8.24 "Gear with phase synchronization" on page 489](#)

Controller axis (hydraulic central controller) – Overview on dialogs

Open the folder of a controller axis (hydraulic central controller) in online mode and the dialogs available for this axis are displayed.

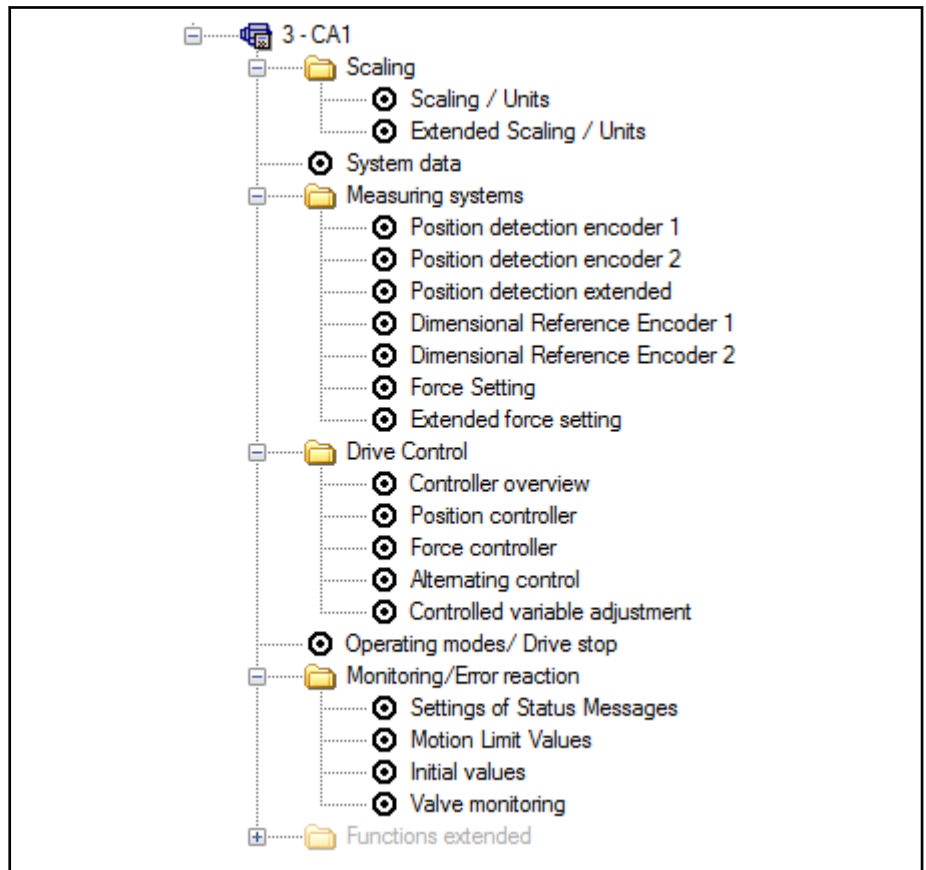


Fig. 6-40: Dialogs of a hydraulic central controller

The hydraulic central controller extends the dialogs of the freely programmable controller axis. For the descriptions of the corresponding dialogs, refer to

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)
- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)
- For measuring systems, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Measuring systems
- For the drive control systems, refer to the IndraWorks online help "HydraulicDrive, Central Controller, Functional Description" -> Drive control
- For operation modes, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Operation modes

- For the valve monitoring, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Valve monitoring
- For the error reaction, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Error reaction

Controller axis (hydraulic synchronization controller) – Overview on dialogs

Open the folder of a controller axis (hydraulic synchronization controller) in online mode and the dialogs available for this axis are displayed.

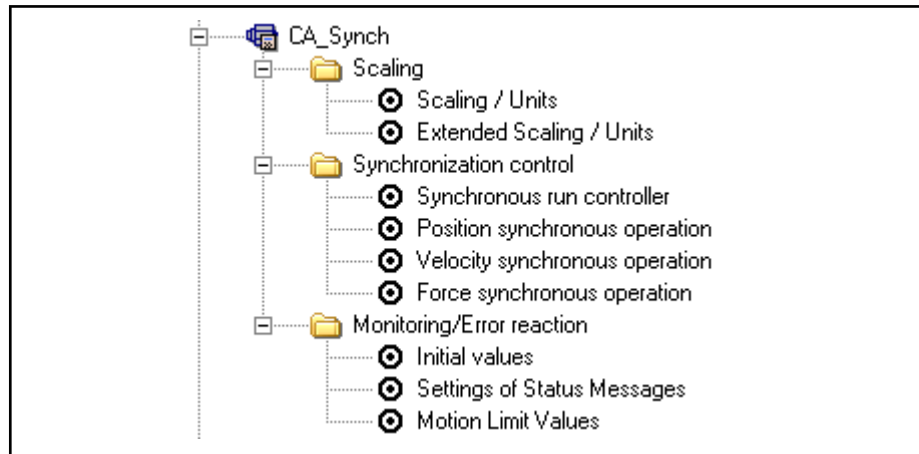


Fig. 6-41: Dialogs of a hydraulic synchronization controller

The hydraulic synchronization controller extends the dialogs of the freely programmable controller axis. For the descriptions of the corresponding dialogs, refer to

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)
- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)

Controller axis (central Sytronix controller) – Overview on dialogs

Open the folder of a controller axis (central Sytronix controller) in online mode and the dialogs available for this axis are displayed.

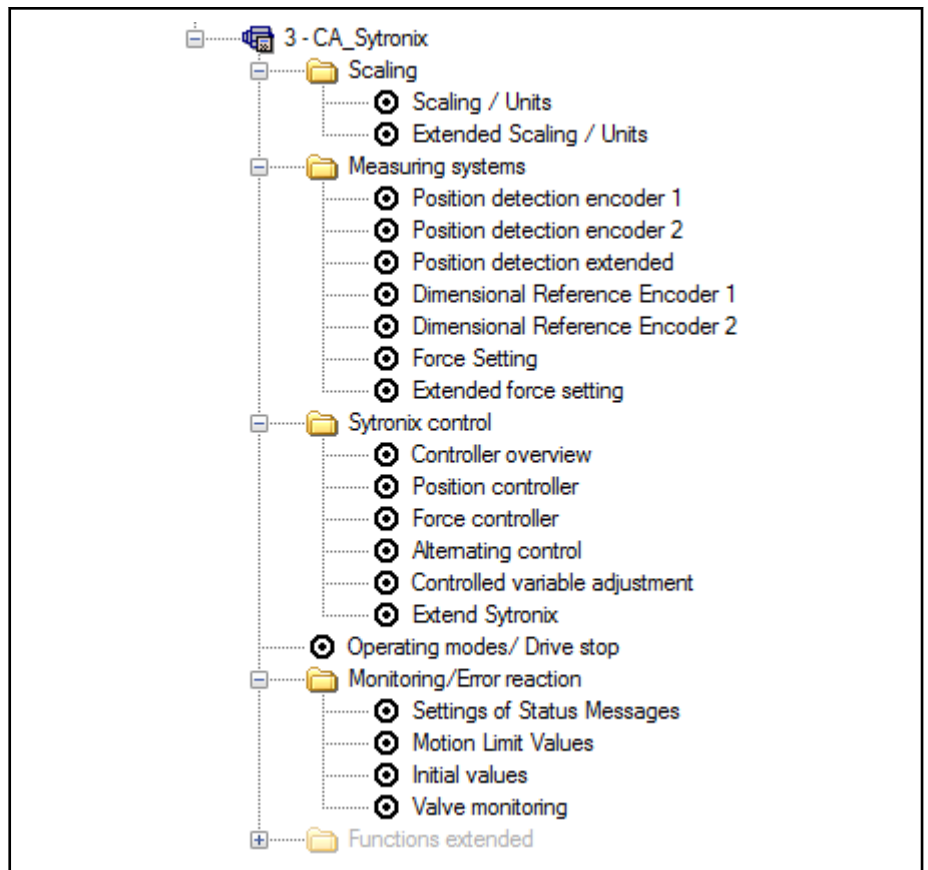


Fig. 6-42: Dialogs of a central Sytronix controller

The central Sytronix controller extends the dialogs of the freely programmable controller axis. For the descriptions of the corresponding dialogs, refer to

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)
- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)
- For measuring systems, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Measuring systems
- For the drive control systems, refer to the IndraWorks online help "HydraulicDrive, Central Controller, Functional Description" -> Drive control
- For operation modes, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Operation modes
- For the valve monitoring, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Valve monitoring
- For the error reaction, refer to the IndraWorks online help "Hydraulic-Drive, Central Controller, Functional Description" -> Error reactions

Controller axis (central Sytronix controller) – Dialog: Extend Sytronix

Extend Sytronix - CA_Sytronix

CA_Sytronix Offline

Sytronix leakage compensation

Pressure A: 0.0000 [bar]

Additive speed side A: 0.0000 [1/min]

Pressure B: 0.0000 [bar]

Additive speed side B: 0.0000 [1/min]

Sytronix vacuum compensation

Minimum pressure: 0.0000 [bar]

Minimum speed: 0.0000 [1/min]

Sytronix limit values

Nominal speed: 0.0000 [1/min]

Max. acceleration: 0.0000 [rad/s^2]

Critical system pressure: 0.0000 [bar]

Critical system pressure switch-off time: 0.0000 [s]

Process data

	Internal command	Actual value
Position		
Velocity		
Force		
Sytronix output		

Fig. 6-43: Dialog "Extend Sytronix"

- Leakage compensation** The function determines an additive speed with regard to the current pressure and direction of rotation. The additive speed is added to the command speed. The additive speed is calculated as follows:

$$\text{Additive torque} = \text{Actual pressure A|B} / \text{Pressure side A|B} * \text{Additive speed A|B}$$
- Vacuum compensation** The function is active if the speed is negative and impedes a vacuum of the pump. If the actual pressure falls at the pressure cell A under the set value of the parameter **Minimum pressure**, the **Minimum speed** is output instead. The compensation is disabled if the minimum pressure is 0.
- Nominal speed** The **nominal speed** outputs the maximum velocity of the Sytronix drive. The nominal speed is output for a maximum controller control value (100%).
- Acceleration monitoring** If the current acceleration exceeds the set parameter **Max. acceleration**, the current acceleration is limited to the maximum acceleration.
- Monitoring function** The maximum system pressure permitted is defined via the parameter **Critical system pressure**. If the system pressure exceeds the maximum value for the period **Critical system pressure switch-off time**, an error is generated and the drive is set to standstill.

6.5.4 Controller axis - Context menu

Overview on menu items

The context menu of a controller axis comprises the following menu items:

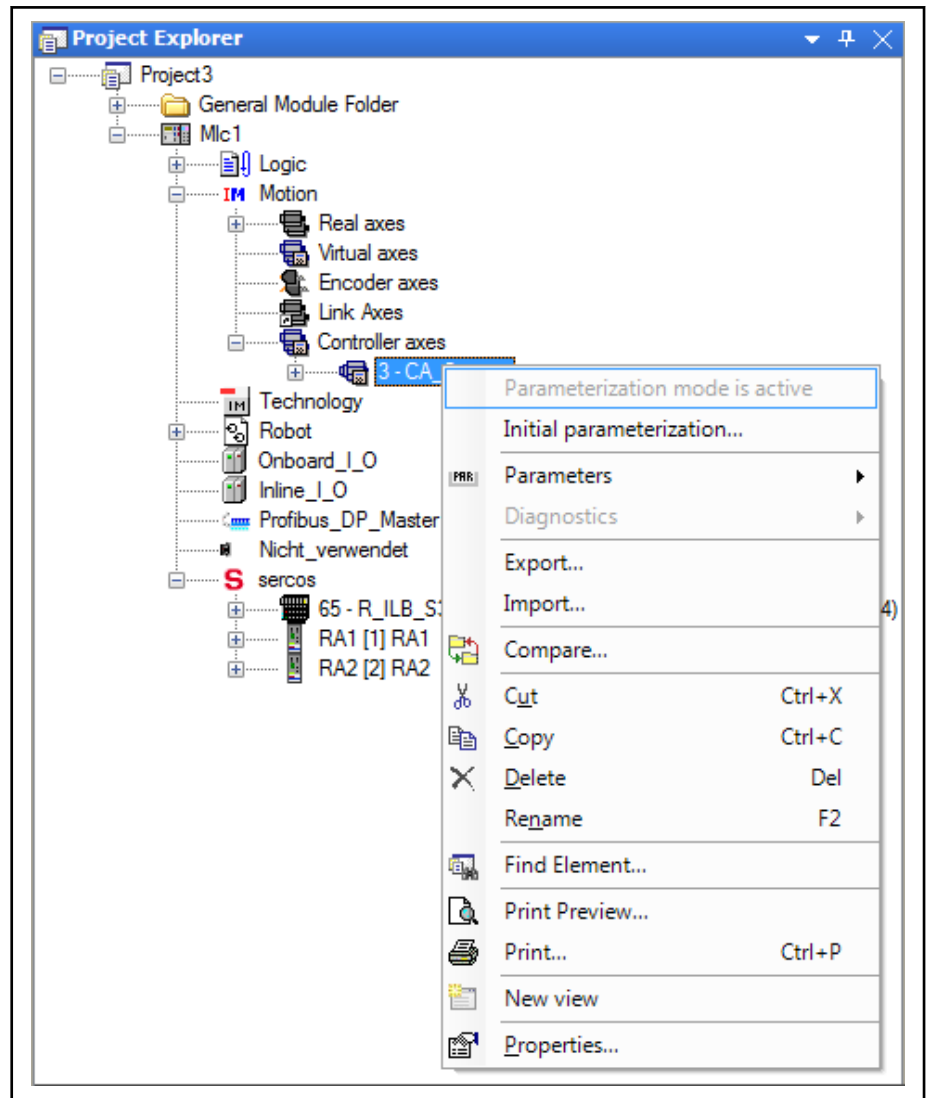


Fig. 6-44: Context menu of a controller axis in online mode

- **Parameterization Mode is Active** - Switch on/off the parameterization mode of the axis. For further information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#)
- **Initial Parameterization...** - See [chapter "Initial commissioning" on page 416](#)
- **Parameters**
 - [chapter "Parameter editor" on page 222](#)
 - [chapter "Parameter group" on page 224](#)
 - [chapter "Finding parameters" on page 226](#)
 - [chapter "Loading basic parameters, general" on page 397](#)
 - [chapter "Parameter adjustment" on page 226](#)
 - [chapter "Parameters - Export" on page 231](#)

- [chapter "Parameters - Import" on page 232](#)
- **Diagnostics** - See [chapter "Diagnostics" on page 416](#)
- **Export...** - Saves axis elements in a file. This menu item is described in [chapter 4.4.14 "Exporting" on page 268](#)
- **Import...** - Imports axis elements from a file. This menu item is described in [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Enables objects to be compared and merged, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the complete axis from the project in **Offline mode**.
- **Rename** - Changes the axis name in **offline mode**.



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- **Find Element...** - Finds an element in the project
- **Print Preview...** - Selects whether to print the configured properties, the parameters or both of the controller axis. There is a print preview before printing
- **Print...** - Selects whether to print the configured properties, the parameters or both of the controller axis
- **New View** - Displays the axis in an individual window
- **Properties...** - See [chapter "Axis properties" on page 389](#)

Initial commissioning

Since only some of the controller axis dialogs differ only slightly from the dialogs of a real axis, the following references to the dialogs of the real axes.

For the initial commissioning of a controller axis, the following dialogs are processed by a wizard:

- Load basic parameters. Upon delivery, the parameters are set to the preset default values. This procedure is described in [chapter "Loading basic parameters, general" on page 397](#)
- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.16 "Motion limit values" on page 460](#)
- [chapter 6.8.17 "Initial values" on page 462](#)
- [chapter 6.8.11 "Settings of status messages" on page 453](#)

Diagnostics

Status

With the dialog, the status information on the respective axis is graphically prepared and displayed. The window is split in two, the upper half contains general information, whereas the lower half contains detailed supplements.

To identify the axis:

- A-0-0001, Logic axis number
- A-0-0002, Axis name
- A-0-0005, Drive address
- A-0-0004, Axis type
 - Bit 3 - Real axis, IndraDrive or HydraulicDrive device
 - Bit 4 - Virtual axis

- Bit 5 - Encoder axis
- Bit 6 - Link axis (only IndraMotion MLC)
- Bit 7 - Controller axis
- A-0-0020, Axis diagnostic message
- A-0-1030, Command: Clear all axis errors, deletes the axis errors in the drive and in the control

Current axis values:

- A-0-0100, Actual position value
- A-0-0102, Actual velocity value
- A-0-0103, Actual acceleration value
- A-0-0110, Actual torque/force value

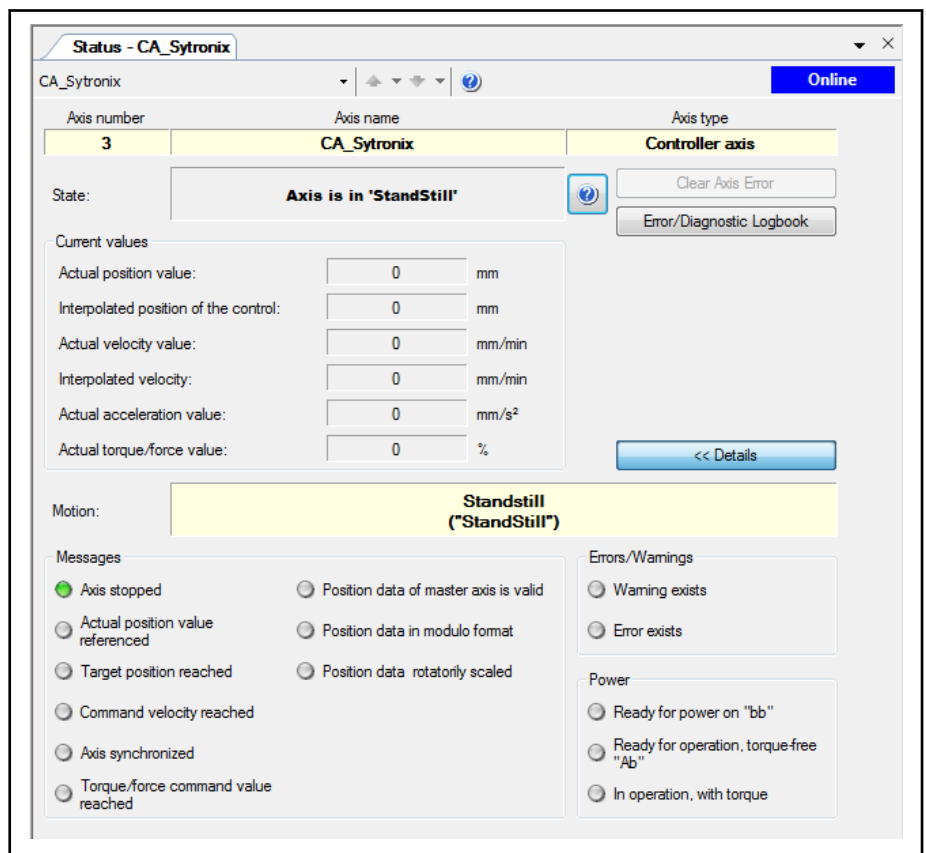


Fig. 6-45: Axis status of a controller axis

The detailed information is encrypted as bit arrays in the following parameters:

- A-0-0021, Axis status and
- A-0-0022, Extended axis status



Double-click on the axis in the "Device status" of the control to open the "Axis status" dialog.

Clearing errors

Enabling the context menu item, triggers "A-0-1030, Command: Clear all axis errors" and deletes the axis error in the drive and on the control.

6.5.5 Controller axis – Use cases

Controller axis to couple devices coupled as PLC device to the MLC

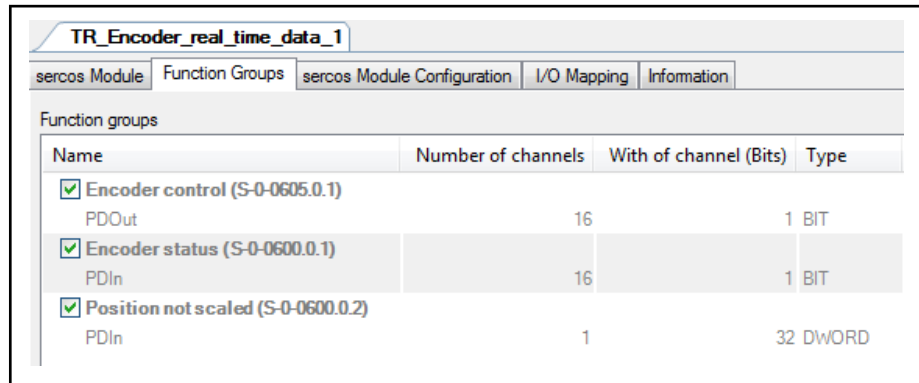
Connecting a Sercos encoder with a controller axis

Usage as master axis encoder

Using a controller axis, a Sercos encoder can be used as real master axis. The controller axis cannot be commanded in this application. It provides only position and velocity information. The controller axis cannot command any motion commands, but it can be used as "master" for synchronous operation modes.

Sercos encoder data

The Sercos encoder provides an incremental position and a status word. The absolute reference can for example be set via the control word.



TR_Encoder_real_time_data_1			
sercos Module		Function Groups	sercos Module Configuration
		I/O Mapping	Information
Function groups			
Name	Number of channels	Width of channel (Bits)	Type
☒ Encoder control (S-0-0605.0.1)			
PDOOut	16	1 BIT	
☒ Encoder status (S-0-0600.0.1)			
PDIn	16	1 BIT	
☒ Position not scaled (S-0-0600.0.2)			
PDIn	1	32 DWORD	

Fig. 6-46: Cyclic data of a Sercos encoder

From the incremental position S-0-0600.0.2, velocity and position have to be calculated each in the LREAL data type to apply velocity and position to a controller axis. Modulo calculations have to be additionally performed for modulo axes. Whether filtering and extrapolating the position is required depends on the application. Use the function block "MB_PositionFilterType01" from the library "ML_TechMotionBase" for calculations and filtering. The function block "ML_PositionFilter" from the GAT plug-in "SercosEncoderRealMaster" is also available as open program example.

Applying to the controller axis

To apply the position, velocity and status information, the "ML_ControlWriteActualData" function block is used. Diagnostic information is provided via the parameter A-0-0627 "Controller axis, diagnostic number".

GAT plug-in "SercosEncoderRealMaster"

The previously described conversion of the encoder position and the application to the controller axis is implemented in the GAT plug-in "SercosEncoderRealMaster".

The GAT plug-in also provides an FIR filter (floating average value) and an extrapolation that can be set. Diagnostics of the encoder are applied to the diagnostic system via the controller axis. Deleting errors at the AxisInterface of the controller axis is applied to the Sercos encoder.

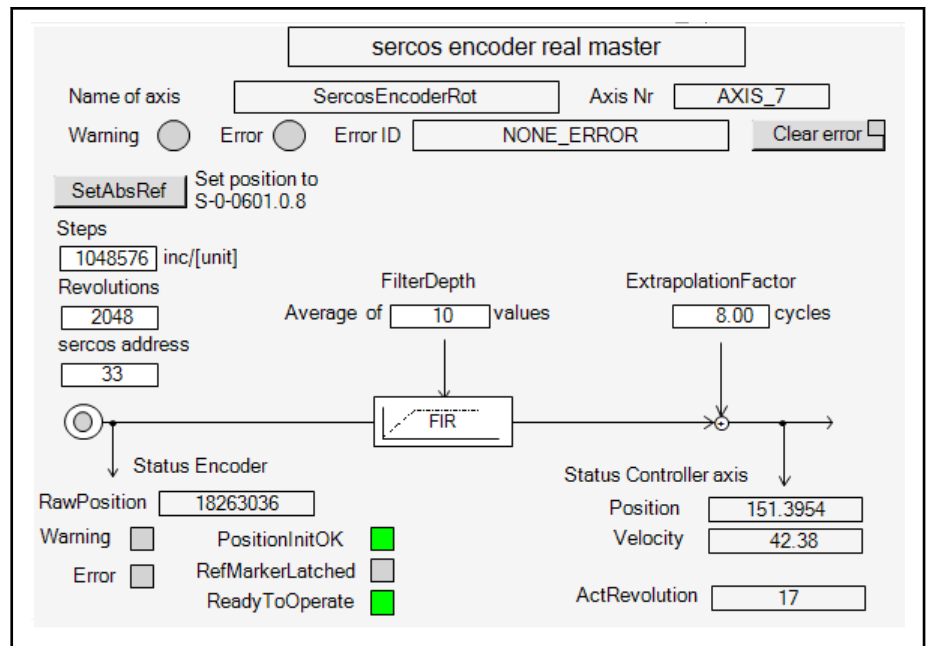


Fig. 6-47: VI-Logic visualization of the GAT plug-in "SercosEncoderRealMaster"

The plug-in assumes that the AxisInterface is used and applied to a controller axis. It is also possible to use the example program without AxisInterface or only the position calculation. The required steps are described in the plug-in documentation.

Procedure for an application without program template

- Install device description file and create a Sercos encoder (on the Sercos node, right-click, "Add...")
- Linking cyclic data with PLC program variables ("I/O Mapping" tab)
- Calculating position and velocity LREAL from the encoder position
- Modulo calculation, filtering and extrapolation if required
- Calling the function block "ML_ControlWriteActualData" in a cyclic program. Set control word of the controller axis
- Implementing diagnostic handling
- Creating a controller axis (controller type: Freely-programmable controller). (Node "Controller axes", right-click "Add...")
- Parameterizing the controller axis (scaling, position format...)
- Loading application, switching to phase 4, checking axis data of controller axis

Connecting a drive as PLC device via a controller axis

Coupling options of drives to the MLC control

Drives can be differently implemented by the MLC system:

- As "IndraDrive" or "HydraulicDrive" with interpolation in the control or in the drive
 - Support with the most comprehensive functional scope, adapted to the respective firmware version
 - Maximum axis parameters (A-parameters) are supported
 - Commissioning dialogs completely available (motor/measuring systems, scaling, limit values, drive control, operation modes, error response, optimization...)
 - PLCopen function blocks and AxisInterface available

- As "SercosDrive"
 - Especially for third-party devices with support acc. to the Sercos PackProfile
 - Reduced axis parameters (A-parameters) are supported
 - Reduced commissioning dialogs available (scaling, limit values, operation modes)
 - PLCOpen function blocks and AxisInterface are available with a limited functional scope (drive only in cyclic position control)
- As PLC device with device description file
 - Lowest dependency between the MLC control and the drive (especially for third-party devices, without PackProfile)
 - Flexible configuration of cyclic data in the PLC program
 - The interpolator depends on the set drive operation mode (for the cyclic position specification, the interpolator is calculated in the PLC. If command velocity values or target positions are specified, it is interpolated in the drive)
 - No axis parameters (A-parameters)
 - No specific dialogs in IndraWorks, engineering via direct connection using the respective engineering tool
 - No PLCOpen function blocks and AxisInterface

Controller axis for a drive as PLC device

Third-party devices not meeting the requirements for a SercosDrive (PackProfile) have to be connected as PLC device.

To use the PLCOpen functions blocks or the AxisInterface for commanding purposes in this case, a controller axis can be used.

The controller axis (type: freely-programmable controller) is thus used as coupling axis. This controller axis is then commanded.

The interpolator for the controller axis is calculated in the MLC control firmware as for an axis with interpolation in the control.

For the controller axis, axis parameters are available for the most significant axis characteristics. (Command and actual values for position, velocity, scaling parameter...).

The controller axis is coupled to the drive as PLC device as follows:

- via the "ML_ControlWriteActualData" function block (described in "IndraLogic XLC/IndraMotion MLC14VRS PLCOpen libraries", see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)). The function block is provided with the actual values (position, velocity and torque) as well as the status word of the drive as PLC device
- via the control word of the drive
- via command and actual values (e.g. control word, position command value, status word, actual position value)

Procedure when using a drive as PLC device with corresponding controller axis

For such as case, the plug-in "**ControllerAxis_PlcDrive**" is available for the Framework GAT. This plug-in provides a program example including a description for an "**IndraDrive**" implemented as PLC device.

This can also be used as starting point for any third-party drive and has then to be adapted to the boundary conditions of the third-party device is necessary.

Proceed as follows for an application without program template:

- Parameterizing the drive with a direct connection and the corresponding engineering tool (for an IndraDrive, it is IndraDrive Ds)
 - Determining the operation modes of the drive as it is suitable for the parameter A-0-0018 "Process controller control word" for a Sercos drive:
 - Primary operation mode: Position control
 - Secondary mode 1: Torque control
 - Secondary mode 2: Velocity control
 - Scaling, controller parameters...
- Create a drive as PLC device using a device description file (for a Sercos device, go to the "Sercos" node, right-click, "Add...")
- Configuring the cyclic data between drive and control (double-click on the drive below the "Sercos" node, tab "Drive Inputs and Outputs")
 - "Status word" and "Actual position" as inputs for example.
 - "Control word" and "command position" as outputs for example
- Linking specified cyclic data with PLC program variables ("I/O Mapping" tab)
- Calling the function block "ML_ControlWriteActualData" (as described in "IndraLogic XLC/IndraMotion MLC14VRSPLCopen Libraries", see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)) in a cyclic program. Set control word and controller axis
- Creating a controller axis. Controller type: Freely programmable controller (node "Controller axes", right-click "Add...")
- Parameterizing the controller axis (scaling, position format...)
- Loading application, switching to phase 4, commanding controller axis

6.6 Link axis

6.6.1 General information



Link axes are only supported by the IndraMotion MLC.

The link axis represents a Sercos II axis provided on another control in the cross communication. Link axes can only be used as masters for other axes and cannot be directly commanded.

Example:

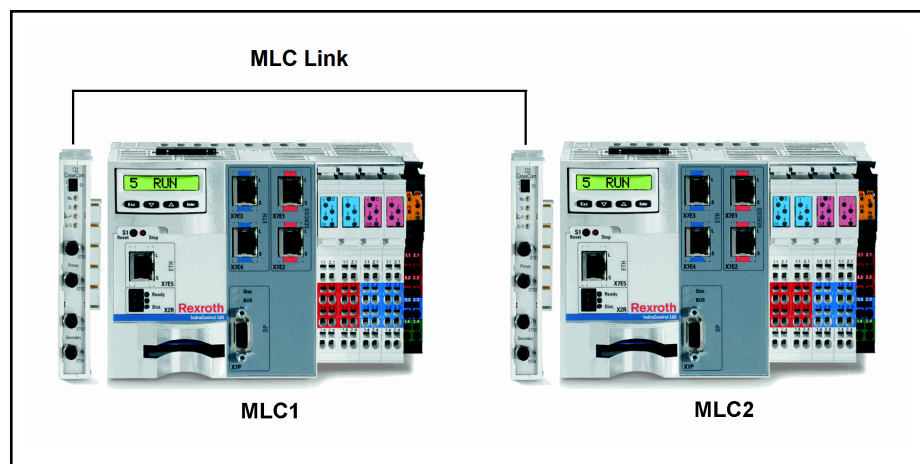


Fig. 6-48: Example: Sercos II cross link with two IndraControl MLC Lxx controls

MLC 1 has a virtual axis provided via the cross link. To use this axis in the MLC 2, create a link axis on the MLC 2. This link axis can be used as master axis to synchronize other MLC 2 axes.

6.6.2 Creating a link axis

Settings at the consumer

Local link axes



An axis can only be created in offline mode!

To "consume" an axis provided as "link axis A" or "link axis B" as master for own local axes at the producer, a representative has to be locally defined making this axis visible for the own control.

Thus, a link axis is created locally in the IndraWorks node Motion ► "Link Axis".

This axis obtains axis number and axis name to become addressable and the assignment to a master axis in the control link.

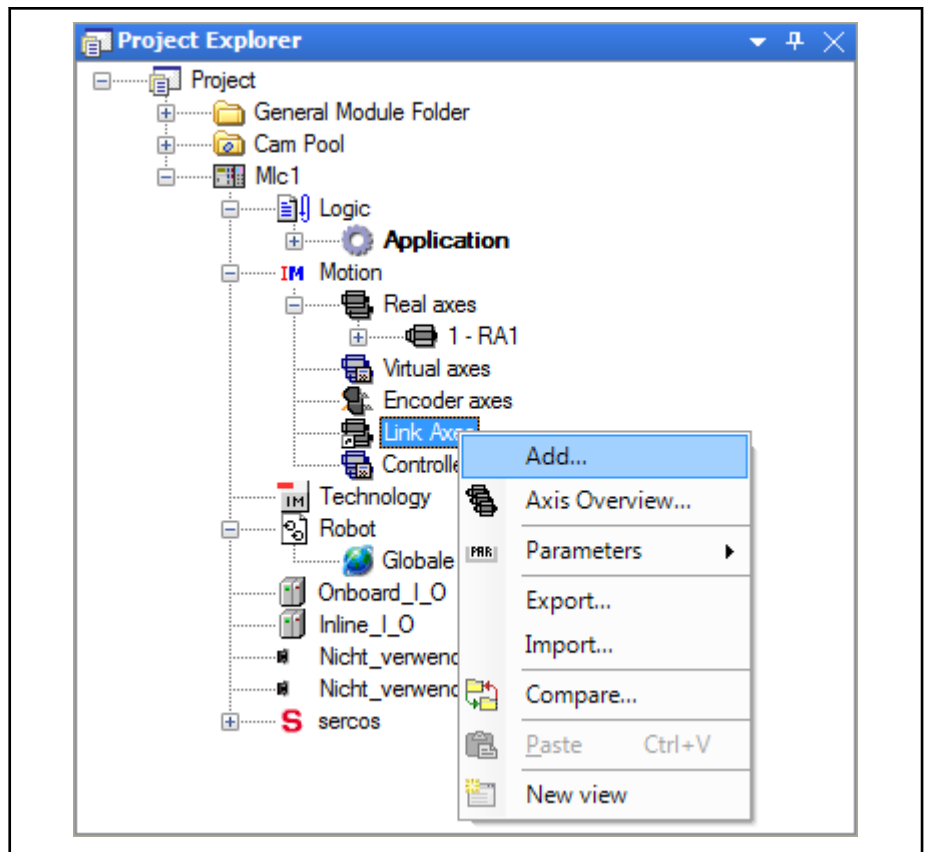


Fig. 6-49: Adding a link axis to the project

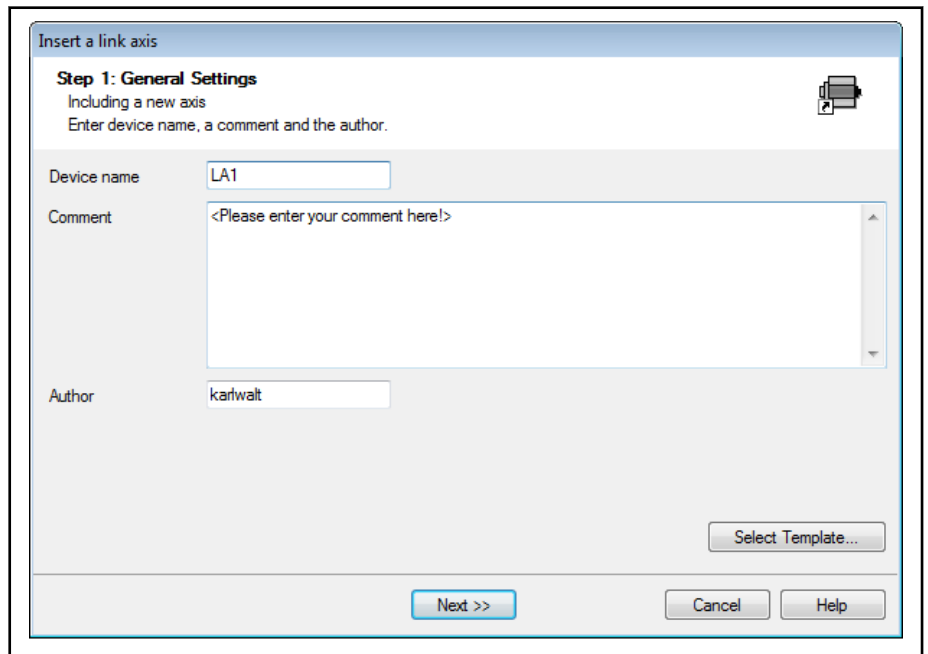


Fig. 6-50: Selecting the axis of an external control as link axis ①

In the "General Settings" step, device name, comment on this device and author are entered.

Select a template for the following settings via **Select Template...** (see [chapter 3.11 "Creation based on templates" on page 119](#)). Either an already ex-

isting link axis in the project or the parameter backup of a link axis can be selected as template.

Apply or change the preset values.

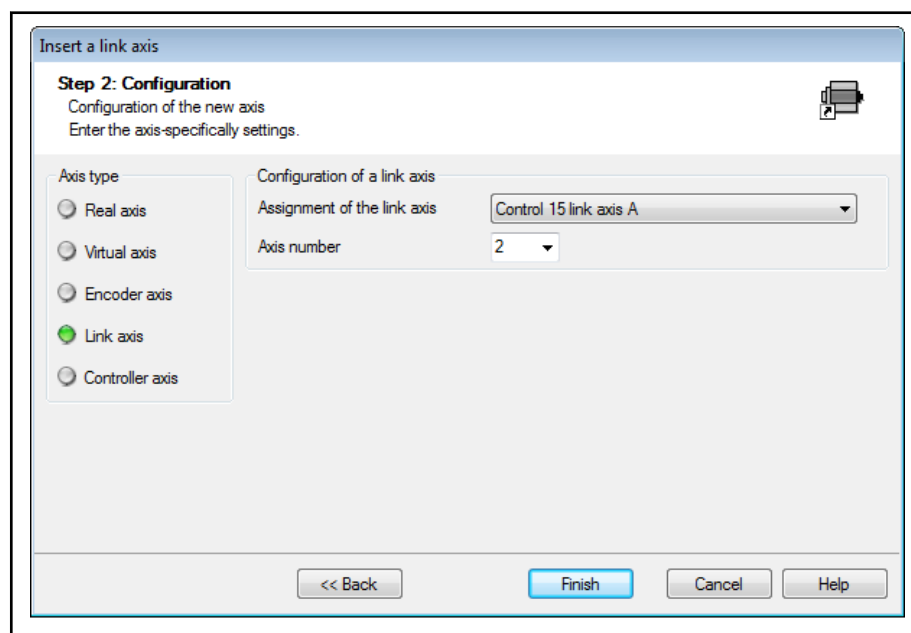


Fig. 6-51: Selecting the axis of an external control as link axis ②

The link axis and axis number can be assigned in the "Configuration" step.



All available link axes produced are always listed, since during configuration (offline), the link devices or link axes available cannot be determined.



Ensure that the selected axis is also actually provided by the respective control in the link.

A local link axis is assigned to an (external) master axis in the link via the list parameter "A-0-0008, Link axis, master axis selection".

The control address and the number of the desired master axis of this control are entered into this parameter.

The following applies:

Entry in A-0-0008	Effective master axis position
List element 1: xxxx (control selection)	Master axis position A/B of the control with control address xxxx
List element 2: yyyy (link axis selection)	yyyy = 1: Master axis position A yyyy = 2: Master axis position B
Example: A-0-0008 = 15 1	MLC 15 master axis position A (MLC 15 link axis A)

Tab. 6-12: Master axis assignment



A change in the assignment on the consumer side, e.g. by the PLC can be executed via the parameter "A-0-0008".

Like other local axes, local link axes have their own parameters and related dialogs.

The number of supported parameters is limited but corresponds approximately to that of an encoder axis (see parameter "A-0-0010, List of all A-parameters").

Creating a link axis using a CrossComm module is described in "Rexroth IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Settings at the producer

The settings to be made by the producer for the Sercos link are described in "Rexroth IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.6.3 Link axis - Dialogs

Overview on dialogs

When opening the link axis folder, the dialogs available for this axis are displayed.

First, it is assumed that the presettings cover a wide range of applications and that a modification is only required in exceptional cases.

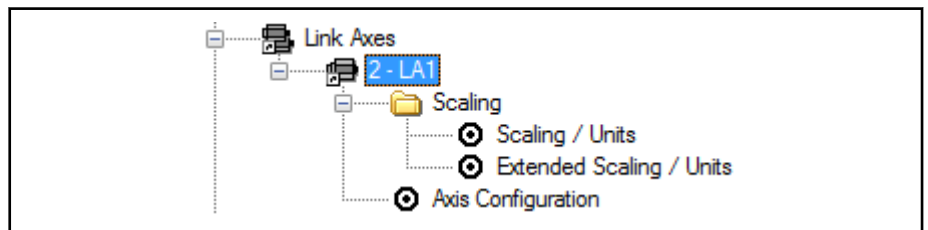


Fig. 6-52: Dialogs of a link axis

The values in the dialogs are partially calculated from multiple parameters. If a clear assignment exists, it is specified.

The following dialogs are available for link axes:

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.25 "Axis configuration" on page 493](#)

6.6.4 Link axis – Context menu

Overview on menu items

The context menu of a link axis in online mode contains the following menu items:

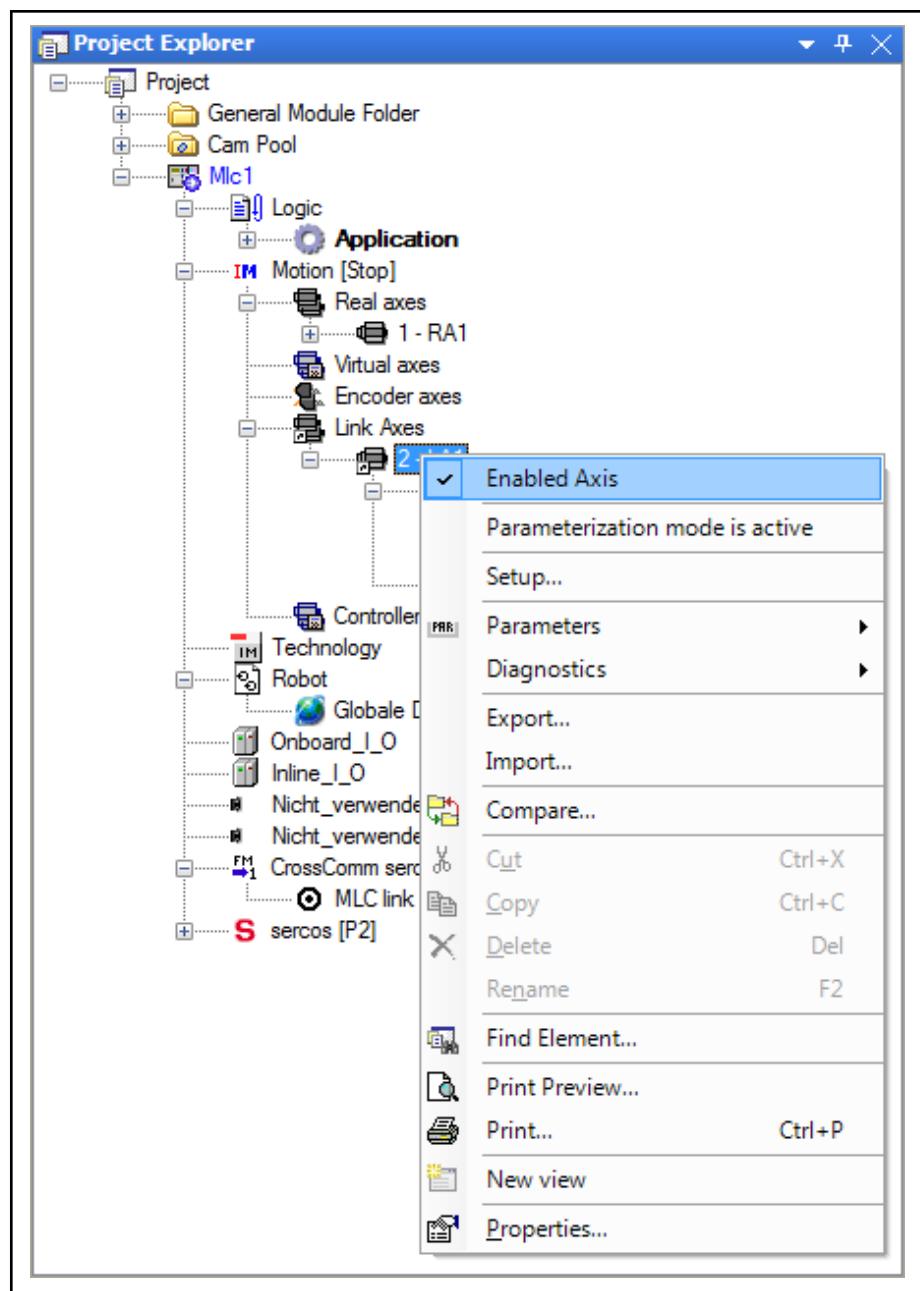


Fig. 6-53: Context menu of a link axis in online mode

- **Parameterization mode is active** - Switch on/off the parameterization mode of the axis. For further information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#)
- [chapter "Initial Commissioning" on page 377](#) - Commissioning cycle of the link axis
- **Parameters**
 - [chapter "Parameter editor" on page 222](#)
 - [chapter "Parameter group" on page 224](#)
 - [chapter "Finding parameters" on page 226](#)
 - [chapter "Loading basic parameters, general" on page 397](#)
 - [chapter "Parameter adjustment" on page 226](#)

- [chapter "Parameters - Export" on page 231](#)
- [chapter "Parameters - Import" on page 232](#)
- [chapter "Status" on page 385](#)
- [chapter "IDN list of invalid operating data" on page 387](#)
- **Export...** - Saves axis elements in a file. This menu item is described in [chapter 4.4.14 "Exporting" on page 268](#)
- **Import...** - Imports axis elements from a file. This menu item is described in [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Enables objects to be compared and merged, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the complete axis from the project in **Offline mode**.
- **Rename** - Changes the axis name in **offline mode**.



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- **Find Element...** - Finds an element in the project
- **Print Preview...** - Selects whether to print the configured properties, the parameters or both of the link axis. There is a print preview before printing
- **Print...** - Selects whether to print the configured properties, the parameters or both of the link axis
- **New View** - Displays the axis in an individual window
- **Properties...** - See [chapter "Axis properties" on page 389](#)

6.7 Encoder axis

6.7.1 General information

Encoder axes are used to evaluate an additional encoder of a real, existing drive and to provide the position information as axis in the system. An encoder axis can be used as master axis for synchronized motions and cannot be commanded.

6.7.2 Creating an encoder axis (real master axis)

Creating an axis in the Project Explorer

Creating the real axis to connect the encoder of the encoder axis

For a real master axis, the master axis position is derived from the signals of a master axis encoder. The encoder uses the drive control electronics of a predefined real axis, e.g. RA1, to supply the data required, i.e. before defining an encoder axis, the real axis RA1 has to be created first (see also [chapter 6.3.3 "Creating a real axis" on page 370](#)). Subsequently, the procedure described below is to be followed.

In the example, the axis RA1 has the drive address 1 and the axis number 1.



Without previous measuring encoder configuration (see [chapter "Configuring the measuring encoder" on page 431](#)) on the corresponding real axis, operating the encoder axis is not possible.



An axis can only be created in offline mode!

An encoder axis is created in the Project Explorer, in the **Motion -> Encoder Axes** folder of the control. Thus, enable the context menu (right-click or press <Shift> + <F10>).

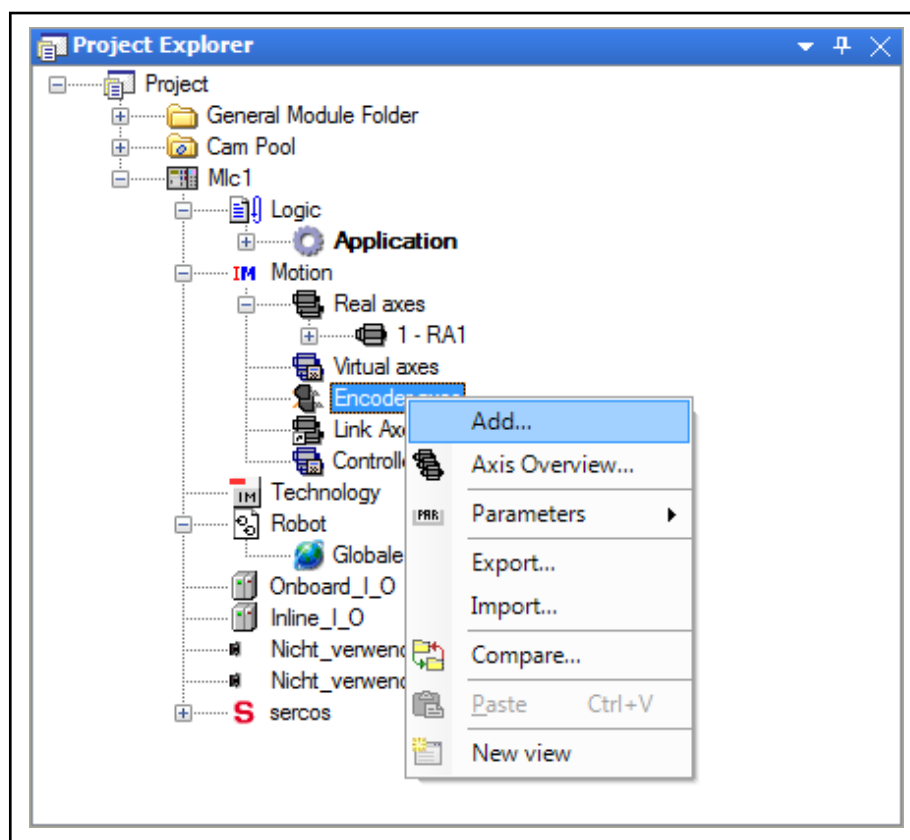


Fig. 6-54: Creating an encoder axis - Context menu

Dialogs to create an encoder axis

The creation of an encoder axis is supported by a wizard with two dialog boxes.

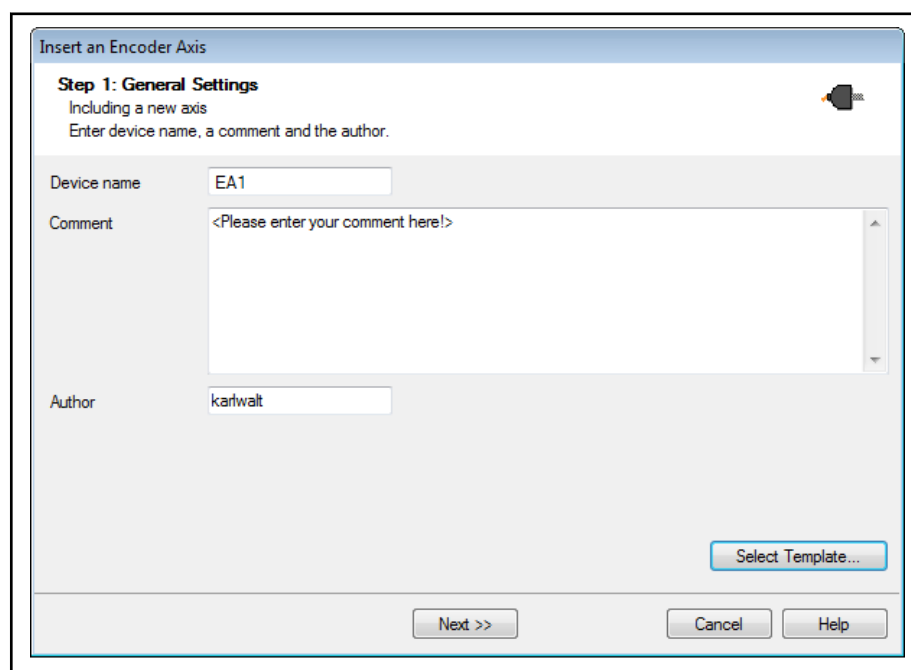


Fig. 6-55: Creating an encoder axis – General Settings

In the "General settings" step, device name, comment on this device and author are entered.

Select a template for the following settings via **Select Template...** (see [chapter 3.11 "Creation based on templates" on page 119](#)). Either an already existing encoder axis in the project or the parameter backup of an encoder axis can be selected as template.

Apply or change the preset values.

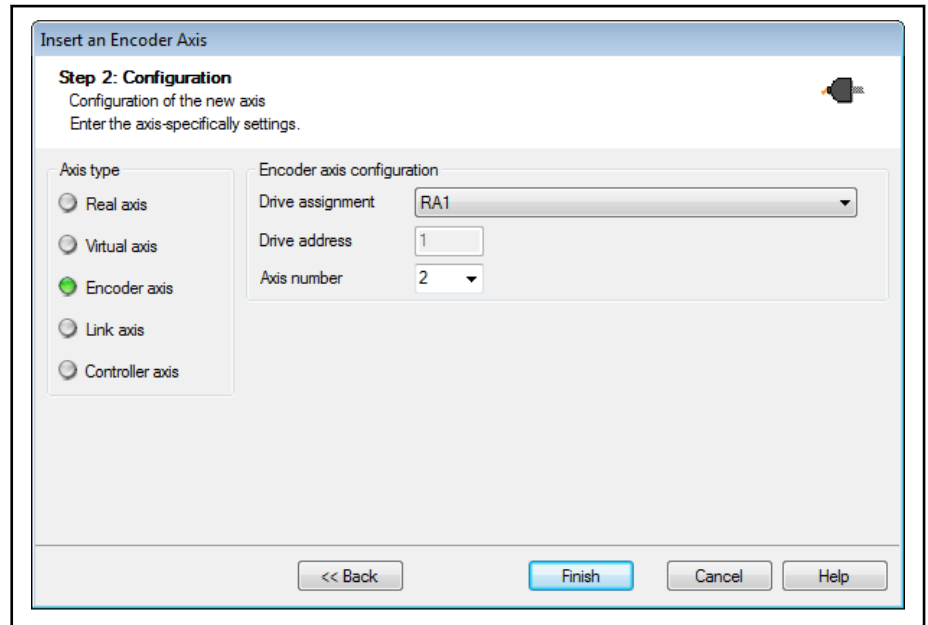


Fig. 6-56: Creating an encoder axis – Configuration

In the "configuration" step, select the drive (scroll window drive assignment: In the example RA1).

RA1 and thus its drive address 1 is selected.



Deactivating the real axis RA1, its drive, its electronics, results in the deactivation of the real encoder axis EA1, whose encoder is connected to this electronics (see also [chapter 7.7 "Axis modes" on page 535](#)).

Axis assignment To address the axis, the PLC uses axis number and axis name (here "2" or "EA1").

The encoder axis is shown only once in the Project Explorer:

Context menu Right-click to open the context menu on the folder **Motion -> Encoder Axes -> EA1** to display the following menu items:

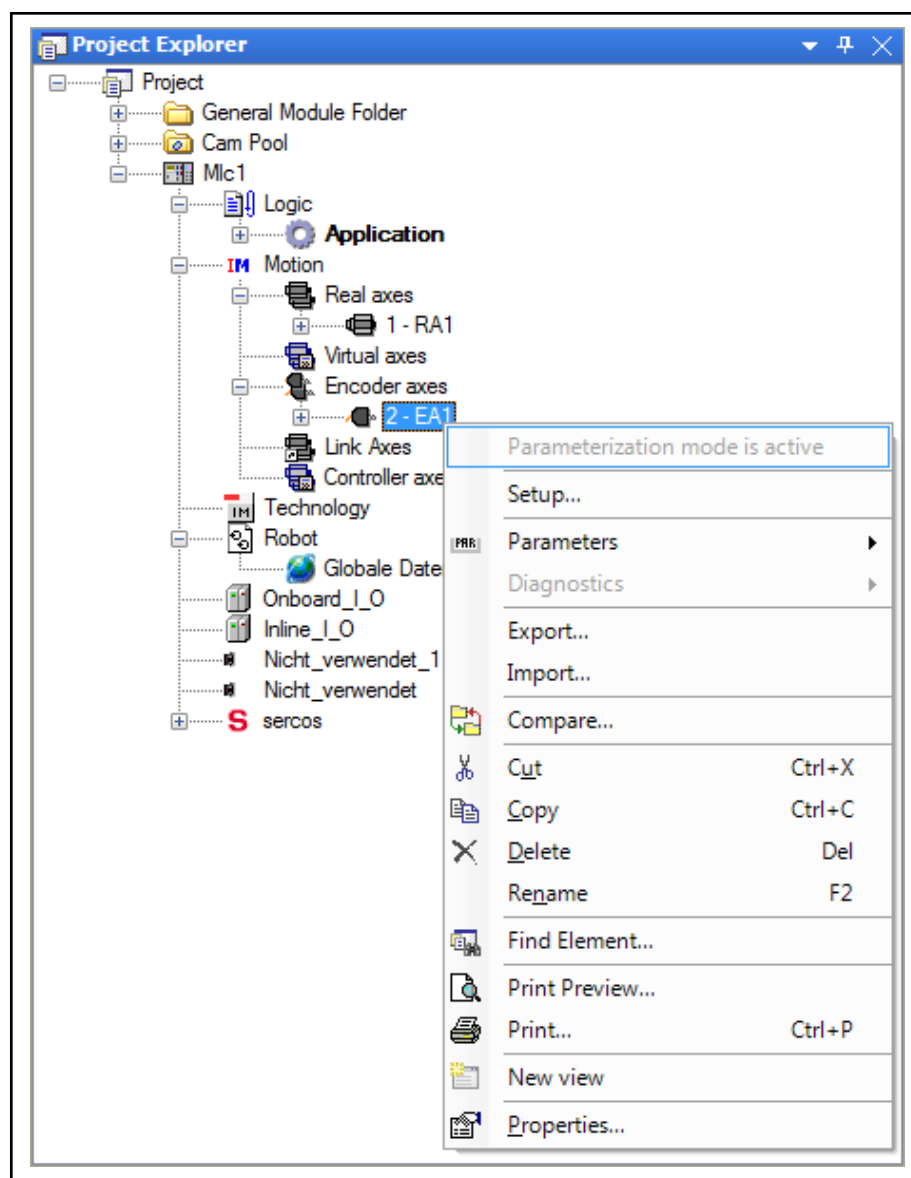


Fig. 6-57: Encoder axis - Context menu

The following can be selected:

- **Setup...**
- **Parameters**
- **Export...**
- **Import...**
- **Compare...**
- **Delete**
- **Rename**
- **Find Element...**
- **Print Preview...**
- **Print...**
- **New View**
- **Properties...**

As no connection is established (offline), many commands are disabled (for the complete description, see [chapter 6.7.4 "Encoder axis - Context menu" on page 432](#) or [chapter 6.7.3 "Encoder axis - Dialogs" on page 431](#)).

Configuring the measuring encoder

The measuring encoder has to be configured below the Sercos node in the real axis whose control electronics is used by the encoder. Select the encoder and right-click to open the "Configuration" dialog.

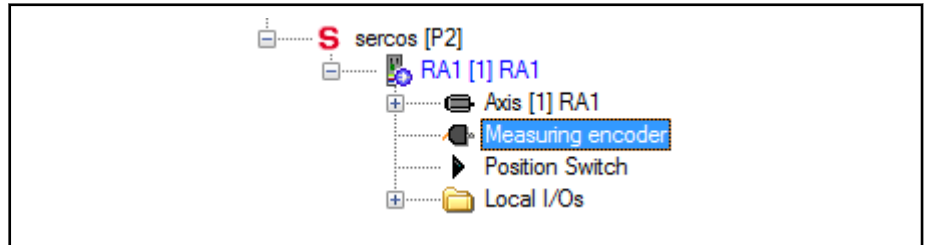


Fig. 6-58: Measuring encoder connected to the real axis RA1

The configuration of an encoder axis requires a referenced measuring encoder.

The dialog distinguishes with regard to the measuring encoder type.

The left side of the dialog presets the encoder data.

On the right, the data for referencing is preset.

The **Set absolute position for measuring encoder** button triggers the processing of the complete referencing.



"Measuring encoder referenced" is the prerequisite for any further operation with the encoder axis.

The measurement encoder dialog is explained in [chapter 6.8.6 "Measuring systems" on page 445](#).



For details, refer to "Rexroth IndraDrive Firmware for Drive Controllers", chapter "Measuring encoder" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.7.3 Encoder axis - Dialogs

Overview on dialogs

When opening the encoder axis folder, the dialogs available for this axis are displayed.

First, it is assumed that the presettings cover a wide range of applications and that a modification is only required in exceptional cases.

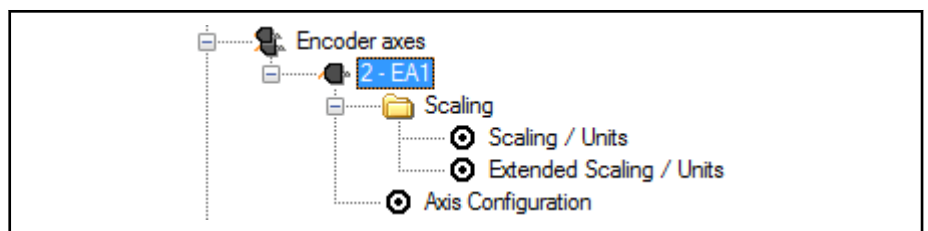


Fig. 6-59: Dialogs of an encoder axis

The values in the dialogs are partially calculated from multiple parameters. If a clear assignment exists, it is specified.

The following dialogs are provided for the encoder axis:

- [chapter 6.8.7 "Scaling/units settings" on page 447](#)
- [chapter 6.8.8 "Scaling/units extended" on page 449](#)
- [chapter 6.8.25 "Axis configuration" on page 493](#)

6.7.4 Encoder axis - Context menu

Overview on menu items

The context menu of an encoder axis in online mode - in this example: EA1 - contains the following menu items:

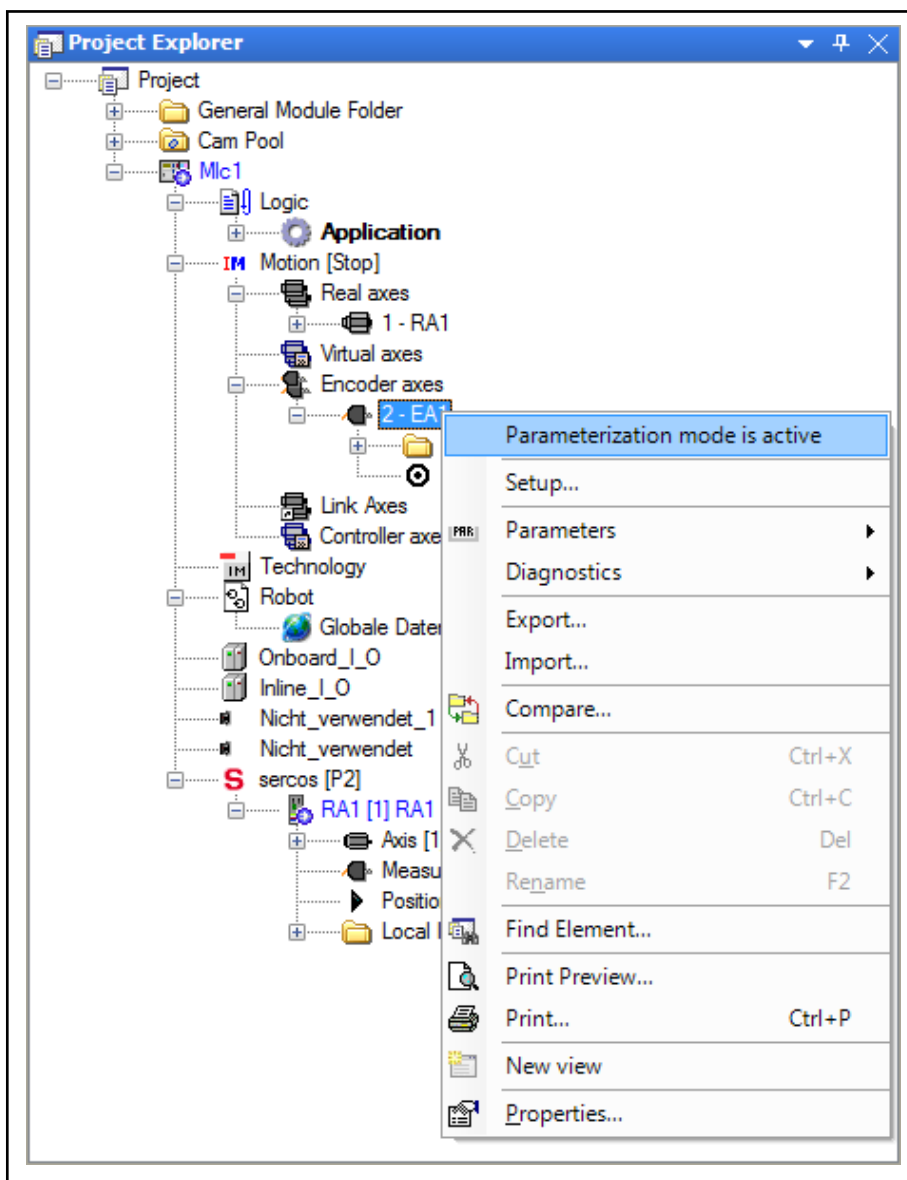


Fig. 6-60: Context menu of an encoder axis in online mode

- **Parameterization mode is active** - Switch on/off the parameterization mode of the axis. For further information on the parameterization mode, refer to [chapter 7.7.5 "Axis in parameterization mode" on page 539](#)
- [chapter "Initial Commissioning" on page 377](#) - Commissioning cycle of the encoder axis
- **Parameters**
 - [chapter "Parameter editor" on page 222](#)

- [chapter "Parameter group" on page 224](#)
- [chapter "Finding parameters" on page 226](#)
- [chapter "Loading basic parameters, general" on page 397](#)
- [chapter "Parameter adjustment" on page 226](#)
- [chapter "Parameters - Export" on page 231](#)
- [chapter "Parameters - Import" on page 232](#)
- [chapter "Status" on page 385](#)
- [chapter "IDN list of invalid operating data" on page 387](#)
- **Export...** - Saves axis elements in a file. This menu item is described in [chapter 4.4.14 "Exporting" on page 268](#)
- **Import...** - Imports axis elements from a file. This menu item is described in [chapter 4.4.15 "Importing" on page 270](#)
- **Compare...** - Enables objects to be compared and merged, see [chapter 4.4.16 "Comparing/merging" on page 272](#)
- **Delete** - Deletes the complete axis from the project in **Offline mode**.
- **Rename** - Changes the axis name in **offline mode**.



The axis reference to the PLC also changes with the axis name. This can cause the application being compiled with errors.

- **Find Element...** - To find an element in the project
- **Print Preview...** - Selects whether to print the configured properties, the parameters or both for the encoder axis. There is a print preview before printing
- **Print...** - Selects whether to print the configured properties, the parameters or both for the encoder axis
- **New View** - Displays the axis in an individual window
- **Properties...** - See [chapter "Axis properties" on page 389](#)

Disabling an axis - Encoder axis



Disabling the real axis results in disabling a real encoder axis connecting its encoder to this electronics.



The parameter assignments of the axes to be disabled are provided for export.

6.8 Dialogs

6.8.1 Overview on dialogs

When opening an axis folder, the dialogs for that axis are displayed below the axis node. These dialogs allow accessing status displays and axis settings. Most of the dialogs are only available in online mode or during offline parameterization.



A part of the dialogs is only used for Robot Control V1.

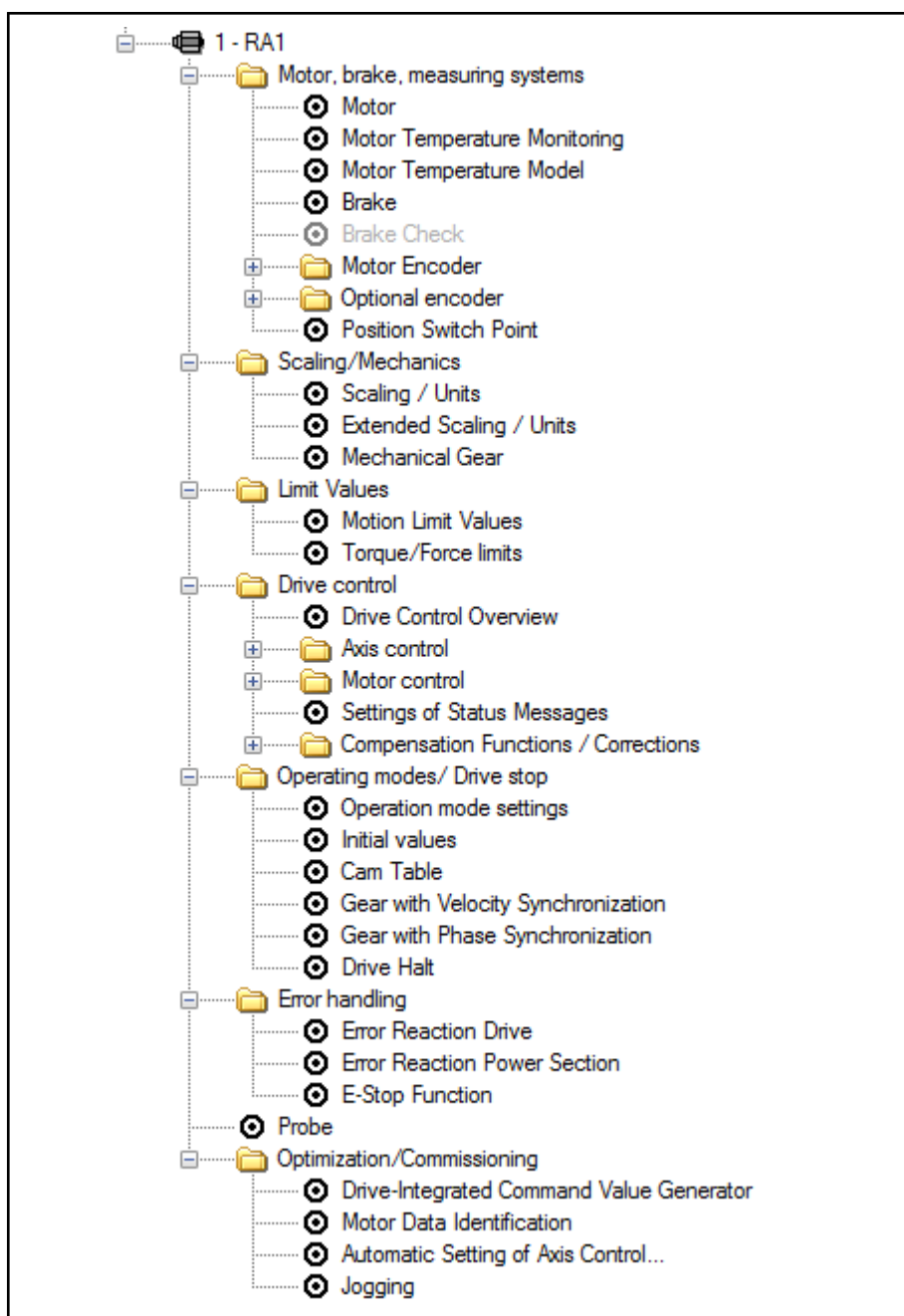


Fig. 6-61: Dialogs of a real axis (IndraDrive)

The presettings already cover many use cases. A modification is only required in exceptional cases.



If IndraDrive drive units are disabled at "Interpolation in the Drive", EcoDrive CS and SercosDrive, the drive is controlled via PackProfile (refer to the following figure).

As the IndraDrive and EcoDrive CS devices are drive devices specified in detail - in contrast to the SercosDrive - device-specific dialogs are provided for commissioning.

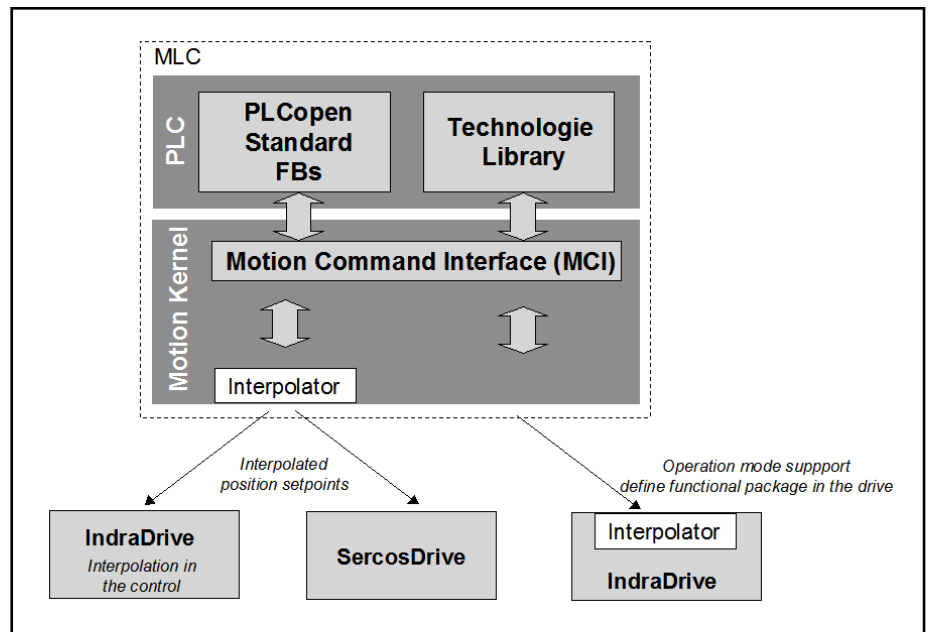


Fig. 6-62: Control principle for different drives

The values in the dialogs are partially calculated from multiple parameters. If a clear assignment exists, it is specified.



Dialogs exclusively referring to internal drive data are only described by a reference to the original product manuals.

Depending on the axis type, different dialog scopes are available:

Dialog	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
chapter 6.8.2 "Operation mode settings" on page 437	x	x	x				
chapter 6.8.3 "Motor" on page 443	x	x					
chapter 6.8.4 "Motor temperature monitoring" on page 444	x	x					
chapter 6.8.5 "Brake" on page 445	x	x					
chapter 6.8.6 "Measuring systems" on page 445	x	x					
chapter 6.8.7 "Scaling/units settings" on page 447	x	x	x	x	x	x	x
chapter 6.8.8 "Scaling/units extended" on page 449	x	x	x	x	x	x	x
chapter 6.8.9 "Mechanical gear" on page 451	x	x					
chapter 6.8.10 "Closed-loop control" on page 452	x	x					
chapter 6.8.11 "Settings of status messages" on page 453	x	x	x	x	x		

Dialog	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
chapter 6.8.12 "Drive halt" on page 454	x	x					
chapter 6.8.13 "Establishing dimensional reference" on page 455	x	x					
chapter 6.8.14 "Error response" on page 456	x	x					
chapter 6.8.15 "E-Stop function" on page 459	x	x					
chapter 6.8.16 "Motion limit values" on page 460	x	x	x	x	x		
chapter 6.8.17 "Initial values" on page 462	x	x	x	x	x		
chapter 6.8.18 "Compensation functions/ corrections" on page 463	x	x					
chapter 6.8.19 "Drive-integrated command value generator" on page 465	x	x					
chapter 6.8.20 "Cam table" on page 465	x						
chapter 6.8.21 "MotionProfile" on page 471		x	x	x	x		
chapter 6.8.22 "FlexProfile" on page 478		x	x	x	x		
chapter 6.8.23 "Gear with velocity synchro- nization" on page 485	x	x	x	x	x		
chapter 6.8.24 "Gear with phase synchroni- zation" on page 489	x	x	x	x	x		
chapter 6.8.26 "Drive-integrated safety en- gineering" on page 495	x	x					
chapter 6.8.27 "Position switching point" on page 496	x	x					
chapter 6.8.28 "Touch probe" on page 496	x	x					
chapter 6.8.29 "Jogging (Robot Control V1)" on page 499	x	x		x			

*
VA
RA
EncA
LnkA
IPO

only for MLC
Virtual axis
Controller axis
Encoder axis
Link axis
Interpolation

Tab. 6-13: Dialogs of different axis types

Open the following dialogs via the context menu of the drive:

Dialog	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
chapter "Initial Commissioning" on page 377	x	x	x	x	x	x	x
chapter "Parameters" on page 378	x	x	x	x	x	x	x
chapter "Communication" on page 380	x	x	x				
chapter "Diagnostics" on page 385	x	x	x	x	x	x	x

*
VA Virtual axis
RA Controller axis
EncA Encoder axis
LnkA Link axis
IPO Interpolation

Tab. 6-14: Dialogs of different axis types to be opened via the context menu

6.8.2 Operation mode settings



This dialog box is available for the interpolation in the drive and in the control.

Call AxisOperation modes / Drive haltOperation mode settings
Target Use this dialog for different operation mode settings.

Fig. 6-63: "Operation mode settings" dialog

General information	The settings are applied on all operation mode selected via PLCOpen function blocks: • Type of position control: In a position-controlled mode, it can be differentiated between an operation with and without lag. The lag error is the difference between the position command value and the actual position value
	 Only for the drive types "IndraDrive" and "HydraulicDrive".
	• Selection of the position encoder: This setting determines which encoder provides the actual position values
	 Only for the drive types "IndraDrive" and "SercosDrive".
	• Extension of the position command value interface: For operation modes to transfer position command values to the drive ("S-0-0047, Position command value"), the accuracy of the values in the drive can be increased. The accuracy of the parameter S-0-0047 is used to increase the parameter "P-0-0100, Position command value extension". The parameter P-0-0100 is additionally configured in the master data telegram (MDT). This is possible for all operation modes with "interpolation in the control" as well as for operation modes with "interpolation in the drive" using the parameter S-0-0047 as command value specification (positioning).
	 Only for the drive types "IndraDrive" and "HydraulicDrive".
	• Actual hybrid position value (encoder 2 selected): The actual position value is generated from the motor encoder and the optional encoder. This value can be smoothed using the parameter P-0-0241 "Actual position smoothing time constant for hybrid position control". It is used for hybrid position control or measuring wheel mode (refer to the IndraDrive Functional Description)
	 Only for the drive type IndraDrive.
Torque/force control	This setting removes the torque/force command value from the cyclic Sercos telegram configuration (MDT). This is for example required for the HydraulicDrive to operate the axis with the so-called "alternating control". That means that the axis is in position control due to a PLCOpen function block and that the torque command value is additionally specified or controlled (not with a PLCOpen function block, but separately via UserCmdData).
	 Only for the drive types "IndraDrive" and "HydraulicDrive".
Settings of the operation mode selection of the drive	This setting can be used for the PLCOpen function block MC_Stop in which operating type the deceleration motion has to take place.

Select between the following variants:

- Deceleration motion in velocity control
- Deceleration motion in position control
- Deceleration motion in the current operation mode. This is implemented according to position or velocity control. (see "A-0-0007, Axis configuration")



The selection is only available for controller axis as well as IndraDrive and HydraulicDrive with interpolation in the control.

Synchronization at position control transition

With this setting, user-specific values can be set for velocity and acceleration to allow a user-specific transition from velocity control to position control.

The respective limit values for velocity and acceleration are set to allow a fast transition when changing from velocity control to position control.



Only for IndraDrive with interpolation in the control.

Calculating the axis status

This setting can be used to calculate the status bits either based on the command values or based on the command values and actual values of an axis. Thus, e.g. InPosition (bit 6) of the parameter "A-0-0021, Axis status" as well as the respective outputs of the PLCopen function blocks are determined based on the respective configuration.

Also refer to:

- [Status information based on the command values or on the command and actual values, page 439](#)



Only for real axes with interpolation in the control and controller axes.

Involved parameter

- A-0-0007, Axis configuration

Status information based on the command values or on the command and actual values

List of supported axes/drives:

- IndraDrive with interpolation in the control
- HydraulicDrive with interpolation in the control
- SercosDrive
- Controller axis

This functionality allows to calculate status information based on the command values or on the command values and actual values.

For unsupported axes, the configuration is aborted with the error "F02D7008 sercos: Invalid operation data".

For axes with interpolation in the drive, the status is generated as before based on the actual values. A selection is not provided.

The setting affects the following data structures of the IndraLogic XLC/ IndraMotion MLC control system:

- Status bits "A-0-0021 Axis status(32 - bit) and A-0-2121 Axis status (64 - bit)" incl. **SharedMemory ▶ AxisData structures**
- Outputs of the PLCopen function blocks (e.g. "Done" MC_MoveAbsolute; "InVelocity" MC_MoveVelocity)

To generate the status based on the actual values, the command value has to be considered as well to ensure a correct sampling. That means that there

is an **& operation** between the actual values and the command values (from now on, only the generation of actual values is considered).

It is taken into account that the respective command value reached the target and that the respective actual value moves within the window limits set. This is required to avoid the "noise" of the respective status bits.

Example:

If an axis moves with the velocity x and an MC_MoveAbsolute is started with a target position close to the current actual position, the target position is passed due to the deceleration path.

Thus, the "InPosition" bit (A-0-0021 - bit 6) is **high** for a short period (one cycle) and becomes **low** again.

After a successful reversal of motion (absolutely scaled axis), the target position is approached and the bit is permanently **high**.

The problem is more serious for a modulo-scaled axis.

If multiple modulo revolutions are required for the deceleration path, the bit becomes **high** for one cycle per revolution until the target position is reached with standstill.

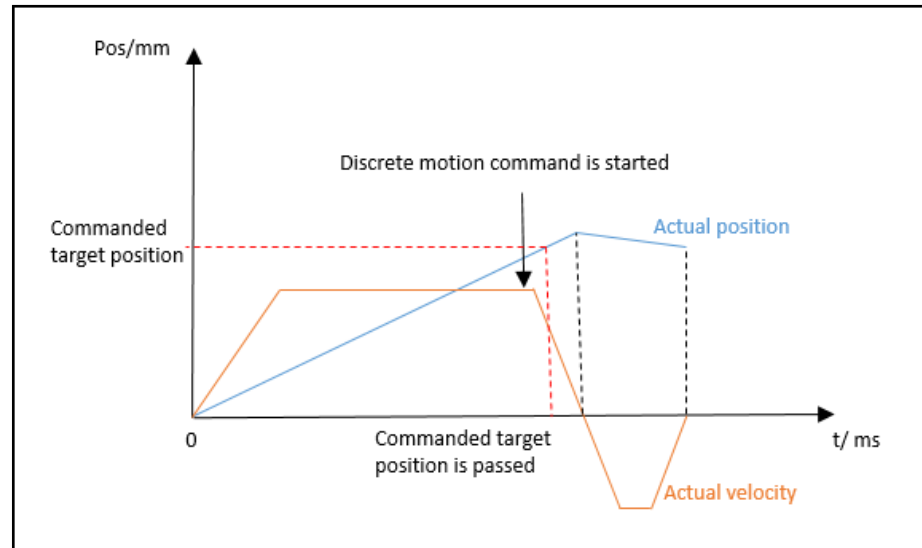


Fig. 6-64: Translatory motion with passing the target position

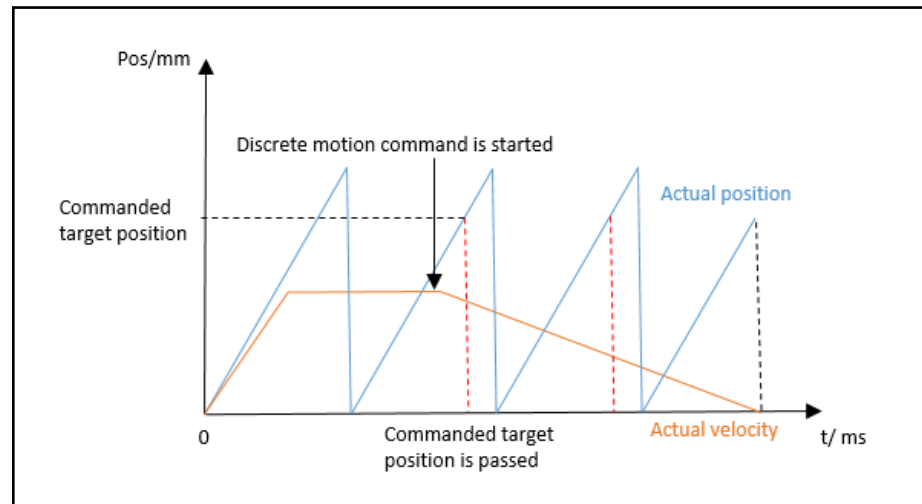


Fig. 6-65: Rotary motion with passing the target position

When generating via actual values, the existing windows are used as for the interpolation in the drive. Thus, a motion close by the window limits can cause a "noise" of the status bits. This "noise" is caused by the noise of the actual values. It can for example occur if the window limits are too tight.

If the user requests the generation via actual values, either configuring in IndraWorks (see **Screenshot ► Calculation of the axis status**) or writing on the parameters "A-0-0007, Axis configuration, bit 15" is required.

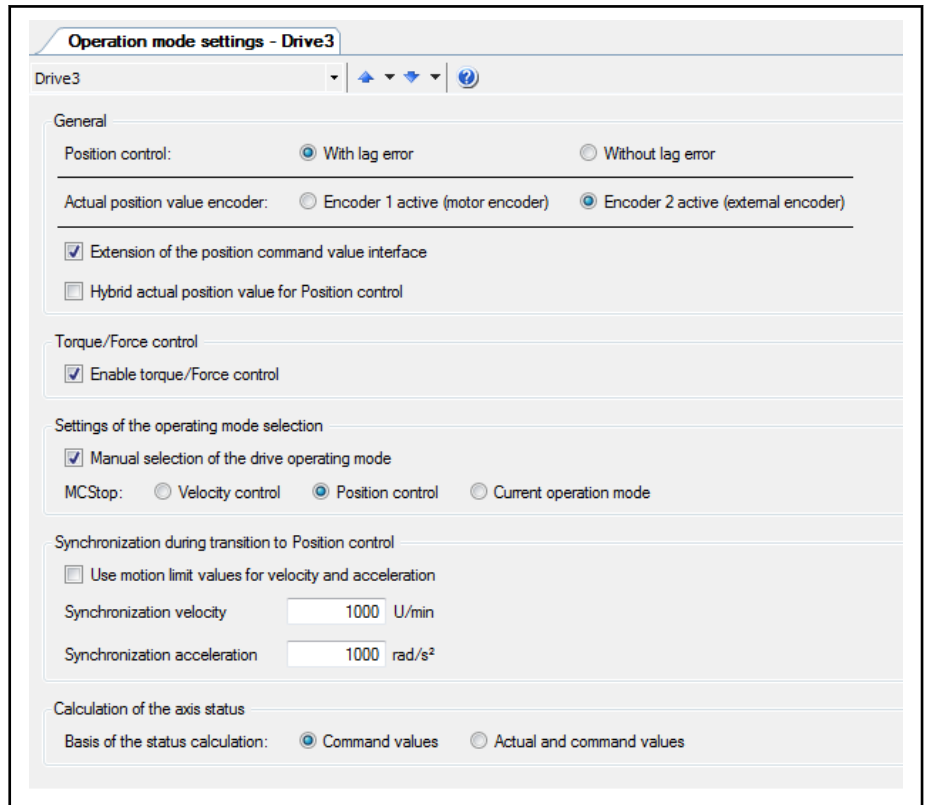


Fig. 6-66: Dialog for status message extended by the "selection" as basis for the status calculation

The requested response can only be enabled in the control phase 2 (P2) or via the parameterization level (PM). In another control phase (P0, P3, BB) operational readiness (OM), an activation try is acknowledged with the error "F02D7005 sercos: Operation data is write-protected at this time".

Due to the applications, it is sometimes required to parallelly consider both the information, i.e. the status based on the command values and the status based on the command values and actual values. This is the only option to make a statement or decision in the application program regarding further processing.

As this information cannot be provided in the same parameter, another parameter is available.

Use the parameter "A-0-2120, Axis status based on the controlled values" or the parameter "A-0-0021, Axis status" to retrieve information.

List of affected status bits

- A-0-0021 bit 4:** Axis command velocity = actual velocity
 Bit becomes "high" if "A-0-0152, Interpolated velocity" is equal to the commanded command velocity and if "A-0-0102 Actual velocity value" is within "A-0-0223, Velocity window". The bit becomes "low" again as soon as one of the two conditions is not met anymore.

- **A-0-0021 bit 5:** Axis velocity lower than/equal to A-0-0222 (Standstill window)

Bit becomes "high" if "A-0-0152, Interpolated velocity" is equal to 0 and if "A-0-0102, Actual velocity value" is within "A-0-0222, Standstill window". The bit becomes "low" again as soon as one of the two conditions is not met anymore.

- **A-0-0021 Bit 6:** Axis command position = actual position

Bit becomes "high" if "A-0-0150, Interpolated position" is equal to the commanded target position and if "A-0-0100, Actual position value" is moving within "A-0-2795, Positioning window". The bit becomes "low" again as soon as one of the two conditions is not met.

- **A-0-0021 bit 7:** Axis is synchronized

Position-synchronous motion:

- Bit becomes "high" if "A-0-2653, ELS, synchronous position command value" of the slave axis is equal to "A-0-0150, Interpolated position" and if "A-0-0100, Actual position value" moves within "A-0-0622, Synchronization run window, position".

In case of a position-synchronous motion, the actual velocity value has to be considered besides the synchronous position to impede the "noise" of the status bit for modulo axes. If only "A-0-2653, ELS, synchronous position command value" and "A-0-0622, Synchronization run window, position" are used to generate the status bits, noise of the status bits can result for the modulo axes if the slave axis remains in standstill (due to a mechanical blockage) and if the master axis passes the actual position value of the slave axis with very modulo revolution.

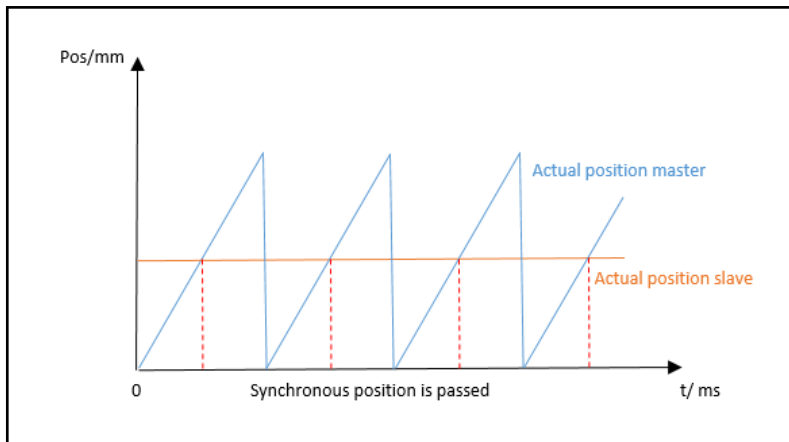


Fig. 6-67: Position-synchronous motion with mechanical blockage at the slave axis

Velocity-synchronous motion:

- Bit becomes "high" if "A-0-2654, ELS, synchronous velocity" of the slave axis is equal to "A-0-0152, Interpolated velocity" and if "A-0-0102, Actual velocity value" is within "A-0-0623, Synchronization run window, velocity".

- **A-0-0021 bit 11:** Axis torque/force command value = actual value

Bit becomes "high" if "A-0-0156, Interpolated force" is equal to the commanded target force and if "A-0-0110, Actual torque/force value" is within "A-0-0221, Torque/force window". The bit becomes "low" as soon as one of the two conditions is not met.

List of affected function block outputs:*DiscreteMotion:*

- MC_MoveAbsolute, MC_MoveRelative, MC_MoveAdditive:

The function block output "Done" is analog to the status bit A-0-0021, bit 6.

ContinuousMotion:

- MC_MoveVelocity:

The function block output "DoneInVelocity" is analog to the status bit A-0-0021, bit 4.

MC_TorqueControl:

The function block output "InTorque" is analog to the status bit A-0-0021, bit 11

SynchronizedMotion:

- MB_GearInPos, MC_CamIn, MB_MotionProfile, ML_FlexProfile:

The function block output "InSync" is analog to A-0-0021, bit 7 for position-synchronous motions.

MC_GearIn:

The function block output "InSync" is analog to A-0-0021, bit 7 for velocity-synchronous motions.

List of affected data in the SharedMemory:

- **Axis_Standstill:** The element of the AxisData structure is analog to the status bit A-0-0021, bit 5.
- **Axis_InPosition:** The element of the AxisData structure is analog to the status bit A-0-0021, bit 6.
- **Axis_InSync:** The element of the AxisData structure is analog to the status bit A-0-0021, bit 7.
- **Axis_InTorque:** The element of the AxisData structure is analog to the status bit A-0-0021, bit 11.

6.8.3 Motor



This dialog is available for IndraDrive for interpolation in the drive and in the control.

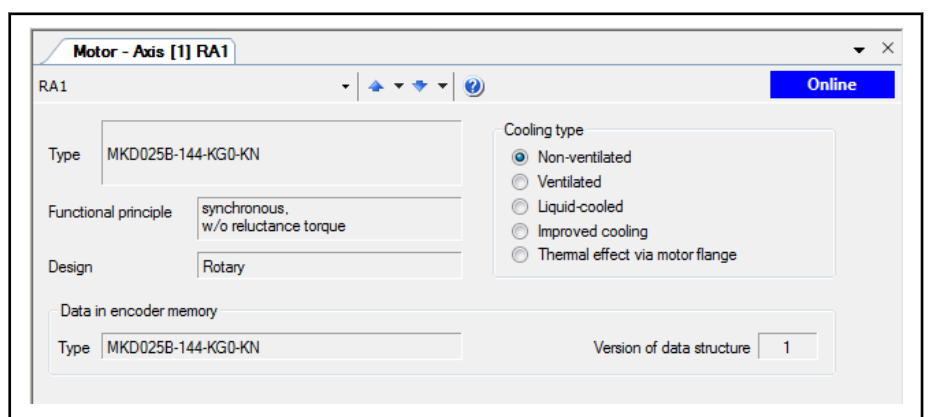


Fig. 6-68: "Motor" dialog

The dialog shows the essential data of the motor and allows the setting of the cooling method used.

The data of this window is stored in the following S- and P-parameters:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)
Motor type	S-0-0141	
Motor type	P-0-4014	
Cooling type	P-0-0640	

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Motor, axis mechanics, measuring systems" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.4 Motor temperature monitoring



This dialog is available for IndraDrive for interpolation in the drive and in the control.

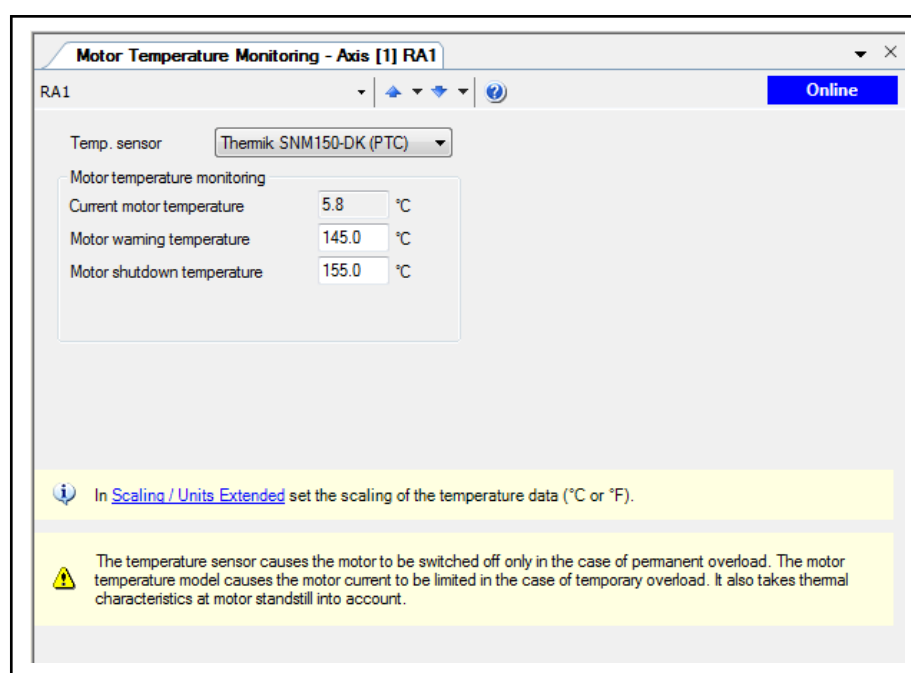


Fig. 6-69: "Motor Temperature Monitoring" dialog

The dialog sets the sensor type for the motor temperature monitoring. Furthermore, the dialog informs on the thermal motor data.

The data is stored in the following S- and P-parameters:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)
Motor temperature	S-0-0383	
Motor warning temperature	S-0-0201	
Motor shutdown temperature	S-0-0204	
Thermal time constant of motor	P-0-4035	
Thermal time constant of winding	P-0-4034	
Thermal short-time overload of winding	P-0-4037	

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Motor temperature monitoring" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.5 Brake



This dialog is available for IndraDrive for interpolation in the drive and in the control.

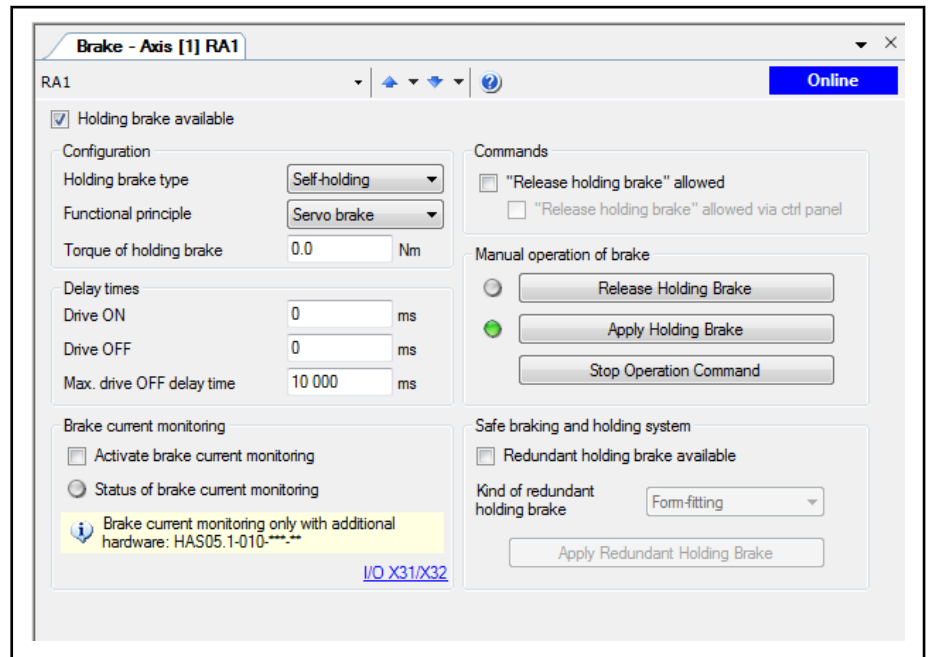


Fig. 6-70: "Brake" dialog

Type and design of the brake set in this dialog is transferred as information to the controller.

The data is stored in the following S- and P-parameters:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)
Holding brake, control word		P-0-0525
Nominal load of holding system		P-0-0547
Waiting time of the drive ON		S-0-0206
Waiting time of the drive OFF		S-0-0207
Maximum drive off delay time		S-0-0273

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "General operation of motors with IndraDrive" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.6 Measuring systems

Motor encoder



This dialog is available for IndraDrive for interpolation in the drive and in the control.

IndraDrive supports three types of encoder:

- Motor encoder, the encoder is located on the motor shaft itself
- [chapter "Optional encoder" on page 446](#), the encoder is located at the load to compensate, e.g. for disturbance variables of the gear
- [chapter "Configuring the measuring encoder" on page 431](#), the encoder has the highest degree of tolerance with regard to its application; it only uses the drive electronics for the data communication and can e.g. realize a measuring wheel or be used as real master axis.

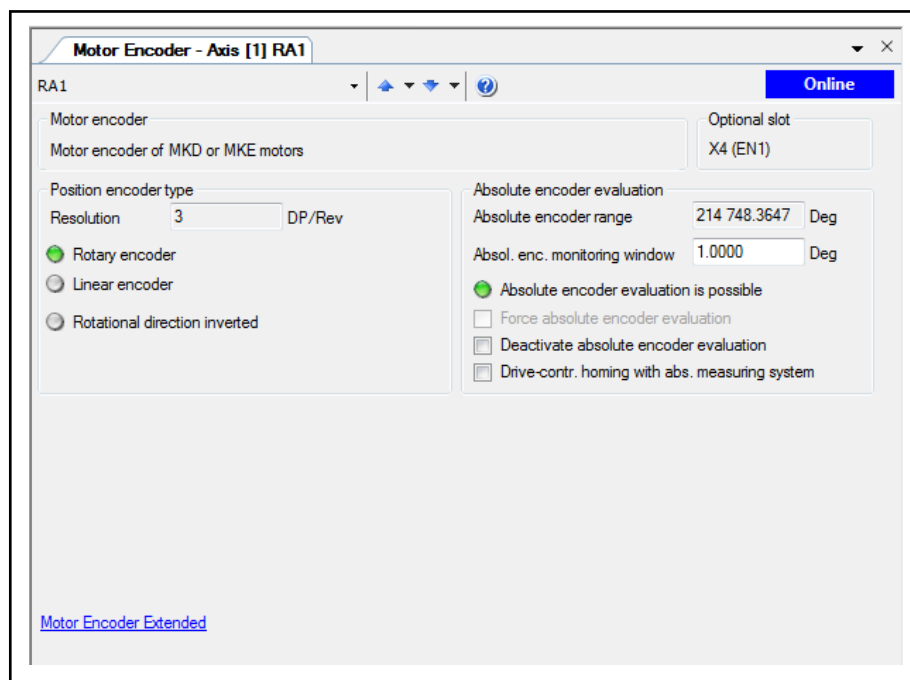


Fig. 6-71: "Motor Encoder" dialog

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Measuring systems" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Optional encoder



This dialog is available for IndraDrive for interpolation in the drive and in the control.

IndraDrive supports three types of encoder:

- [chapter "Motor encoder" on page 445](#) the encoder is located on the motor shaft itself
- Optional encoder. This encoder is located on the load side to compensate, e.g. for disturbance variables of the gear
- [chapter "Configuring the measuring encoder" on page 431](#), the encoder has the highest degree of tolerance with regard to its application; it only uses the drive electronics for the data communication and can e.g. realize a measuring wheel or be used as real master axis.

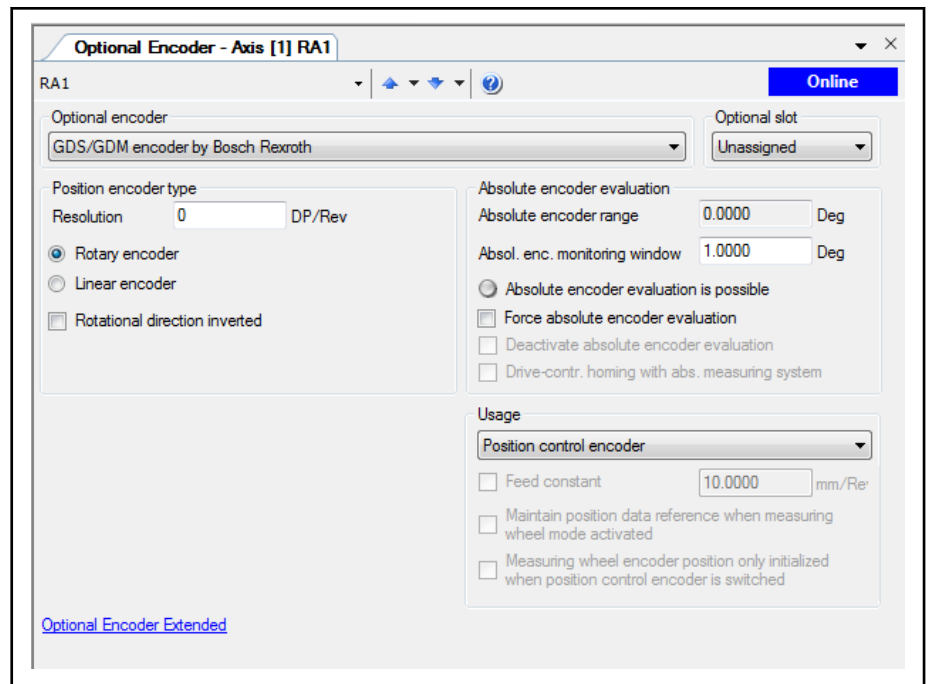


Fig. 6-72: "Optional Encoder" dialog

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Measuring systems" (see chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6).

6.8.7 Scaling/units settings



This dialog is available for all axis types.

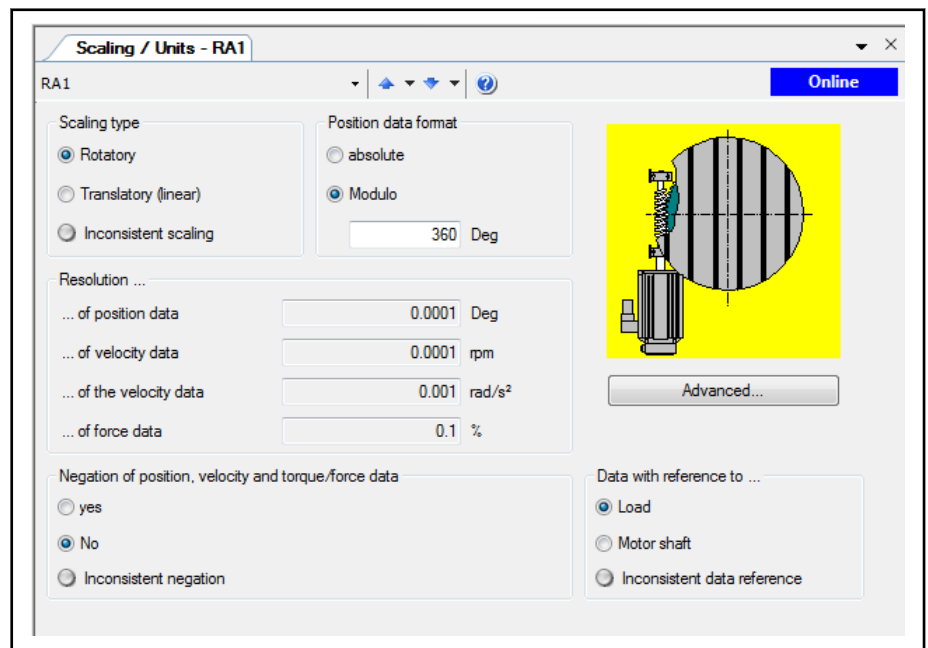


Fig. 6-73: "Scaling/units" dialog (example of real axis)

The "Scaling/Units" dialog of settings derives the presets for position, velocity and torque/force data from the same scheme.

Scaling type, scaling factor, scaling exponents

The scaling type of the data determines the format and the relation in which the data is exchanged between the drive and the control or the interface.

With the scaling factor and the scaling exponent, the scaling factor and the decimal places are specified in case of parameterized scaling. In case of a preference scaling, these two units are automatically set.

	Scaling type	Scaling factor	Scaling exponent
Position	A-0-0059	A-0-0060	A-0-0061
Velocity	A-0-0056	A-0-0057	A-0-0058
Torque/force	A-0-0050	A-0-0051	A-0-0052

Tab. 6-15: Overview on scaling parameters

Traversing velocity

If the axis is modulo scaled, the maximum traversing velocity during the interpolation in the control depends on how the Motion cycle time and the modulo value are set. This is limited by the "Nyquist-Shannon sampling theorem" (for a description, refer to <http://wikipedia.org>).

Max. traversing velocity = (0.5 x modulo [degree or mm]) / cycle time [s].

Theoretical maximum traversing velocity assuming a modulo of 360°

Motion cycle time in ms	Velocity in rpm
1	30000
2	15000
4	7500
8	3750
16	1875

Tab. 6-16: Maximum traversing velocity with a modulo of 360°

Scaling type, format of the position data

Either the scaling type rotary or translatory scaling (A-0-0053, A-0-0056, A-0-0059 bit 1...0 each) can be selected. The position data format allow the settings "absolute" and "modulo" (A-0-0059, Bit 7) .

If the format is set to "modulo", the modulo value has to be entered in degrees or feed distance in mm into the "Modulo value" field.

The following parameters are used by the dialog:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Hydrau- licDrive * (IPO in the drive)	Hydrau- licDrive * (IPO in the drive)	Sercos- Drive	Virtual axis	Encoder axis	Link axis *	Control- ler axis *
Scaling type for position data "A-0-0059"	x	x	x	x	x	x	x	x	x
Scaling type for velocity data "A-0-0056"	x	x	x	x	x	x	x	x	x
Scaling type for acceleration data "A-0-0053"	x	x	x	x	x	x	x	x	x
Scaling type for torque/ force data "A-0-0050"	x	x	x	x					x

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Hydrau- licDrive * (IPO in the drive)	Hydrau- licDrive * (IPO in the drive)	Sercos- Drive	Virtual axis	Encoder axis	Link axis *	Control- ler axis *
Modulo value "A-0-0045"	x	x			x	x			x
Feed distance of the slave drive "A-0-0046"	x	x	x		x	x	x	x	x

* only for MLC

Tab. 6-17: Parameters for the different scaling types

Detailed data can be entered into [chapter 6.8.8 "Scaling/units extended"](#) on [page 449](#).

6.8.8 Scaling/units extended



This dialog is available for all axis types.

The dialog box supplements data to [chapter 6.8.7 "Scaling/units settings"](#) on [page 447](#) in detail.

If the axis is an IndraDrive, the following dialog is displayed:

Extended scaling/units - RA1

RA1 Online

Scaling type of position data

- ☒ Rotatory
- ☐ Translatory
- ☐ Absolute
- ☒ Modulo

☒ Load reference

☐ Motor reference

☐ Preferred scaling

☐ User-defined

☐ Negation

Position resolution, rotatory: 3 600 000

Unit: Deg

Resolution: 0.0001

Velocity data scaling type

- ☒ Rotatory
- ☐ Translatory

☒ Load reference

☐ Motor reference

☐ Preferred scaling

☐ User-defined

☐ Negation

Resolution: 0.0001

Factor: 1

Exponent: -4

Unit: rpm

Acceleration data scaling type

- ☒ Rotatory
- ☐ Translatory

☒ Load reference

☐ Motor reference

☐ Preferred scaling

☐ User-defined

Resolution: 0.001

Factor: 1

Exponent: -3

Unit: rad/s²

Torque/Force data scaling type

- ☐ Torque
- ☐ Force
- ☒ In percent

☒ Load reference

☐ Motor reference

☐ Preferred scaling

☐ User-defined

☐ Negation

Resolution: 0.1

Factor: 1

Exponent: -1

Unit: %

Torque/force reference value

Torque/force reference value: 1000 Nm

Scaling type for temperature data

- ☒ Degree Celsius (°C)
- ☐ Degree Fahrenheit (°F)

Fig. 6-74: "Scaling/units extended" dialog for IndraDrive axes

The dialog of the other axis types provides respectively less setting options.

The following parameters are analyzed:

Axes

Setting	IndraDrive (IPO drive)	IndraDrive (IPO con- trol)	Hydraulic Drive * (IPO drive)	Hydraulic Drive * (IPO control)	Sercos Drive	Virtual axis	Encoder axis	Link axis *	Control- ler axis *
Position									
Scaling type for position data "A-0-0059"	x	x	x	x	x	x	x	x	x
Scaling factor for translatory position data "A-0-0060"	x	x	x	x	x				
Scaling exponent for translatory position data "A-0-0061"	x	x	x	x	x				
Position resolution, rotatory "A-0-0062"	x	x	x	x	x				
Position polarities "A-0-0029"	x	x	x	x	x	x			x
Modulo value "A-0-0045"	x	x			x	x			x
Feed distance of the slave drive "A-0-0046"	x	x	x		x	x	x	x	x
Velocity									
Scaling type for velocity data "A-0-0056"	x	x	x	x	x	x	x	x	x
Scaling factor for velocity data "A-0-0057"	x	x	x	x	x				
Scaling exponent for velocity data "A-0-0058"	x	x	x	x	x				
Velocity polarities "A-0-0048"	x	x	x	x					
Acceleration									
Scaling type for acceleration data "A-0-0053"	x	x	x	x	x	x	x	x	x
Scaling factor for acceleration data "A-0-0054"	x	x	x	x					
Scaling exponent for acceleration data "A-0-0055"	x	x	x	x					
Force/torque									

Setting	IndraDrive (IPO drive)	IndraDrive (IPO control)	Hydraulic Drive * (IPO drive)	Hydraulic Drive * (IPO control)	Sercos Drive	Virtual axis	Encoder axis	Link axis *	Control- ler axis *
Scaling type for torque/ force data "A-0-0050"	x	x	x	x					x
Scaling factor for torque/force data "A-0-0051"	x	x	x	x					x
Scaling exponent for torque/force data "A-0-0052"	x	x	x	x					x
Temperature									
Scaling type for temperature data "A-0-0063"	x	x	x	x					x

* only for MLC

User-defined scaling

A user-defined scaling (selection with scaling factor and exponent) can be set via the scaling parameters (bit 3) for force, acceleration, velocity and position.

1. A-0-0050 " Scaling type for torque/force data"
2. A-0-0053 " Scaling type for acceleration data"
3. A-0-0056 " Scaling type for velocity data"
4. A-0-0059 " Scaling type for position data"

Depending on the axis type, a user-defined scaling is not always supported for all sizes.

User-defined scaling	IndraDrive (IPO drive)	IndraDrive (IPO control)	Hydraulic Drive * (IPO drive)	Hydraulic Drive * (IPO control)	Sercos Drive	Virtual axis	Encoder axis	Link axis *	Control- ler axis *
Position	x	x	x	x	x				x
Velocity	x	x	x	x	x				x
Acceleration	x	x	x	x	x				x
Force ¹⁾	x	x	x	x	x				x

* only for MLC

1) For drive firmware MPX08 or MPX17 and higher

6.8.9 Mechanical gear



This dialog is available for IndraDrive for interpolation in the drive and in the control.

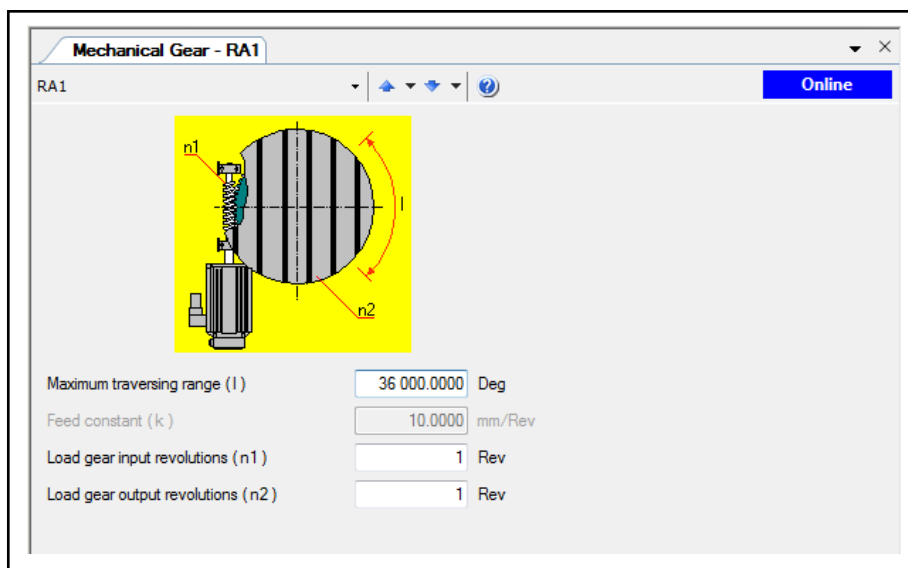


Fig. 6-75: "Mechanical Gear" dialog

The data of this window is stored in the following S- and P-parameters:

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
Maximum traversing range		S-0-0278
Load gear input revolutions		S-0-0121
Load gear output revolutions		S-0-0122
Transmission ratio		$(S-0-0122)/(S-0-0121)$
Feed constant		S-0-0123

The parameter S-0-0123 is only relevant for linear axes driven by a rotary motor. The feed constant is the distance covered by the axis, when the gear output shaft or motor shaft performs one rotation.

Determination of the feed constant with different mechanical transmission elements. For ball screw spindle, the default value is:

Feed constant = spindle lead typ. value 10.00 mm/rev.)

For details, see "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Motor, axis mechanics, measuring systems" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.10 Closed-loop control



This dialog box is available for the interpolation in the drive and in the control.

The basics of the control dialogs are described with the corresponding products "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Overview on drive control" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.11 Settings of status messages



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis (only for MLC).

The dialog box evaluates the status of the axis (A-0-0021, Axis status).

The following messages depend on whether the respective value is in its window:

- "AA-0-0021, Standstill (bit 5)"
- "AA-0-0021, Actual velocity = velocity command value (bit 4)"
- "AA-0-0021, In position (bit 6)"
- "A-0-0021, Synchronous position (bit 7)" and
- "A-0-0021, Synchronous velocity" likewise (bit 7)

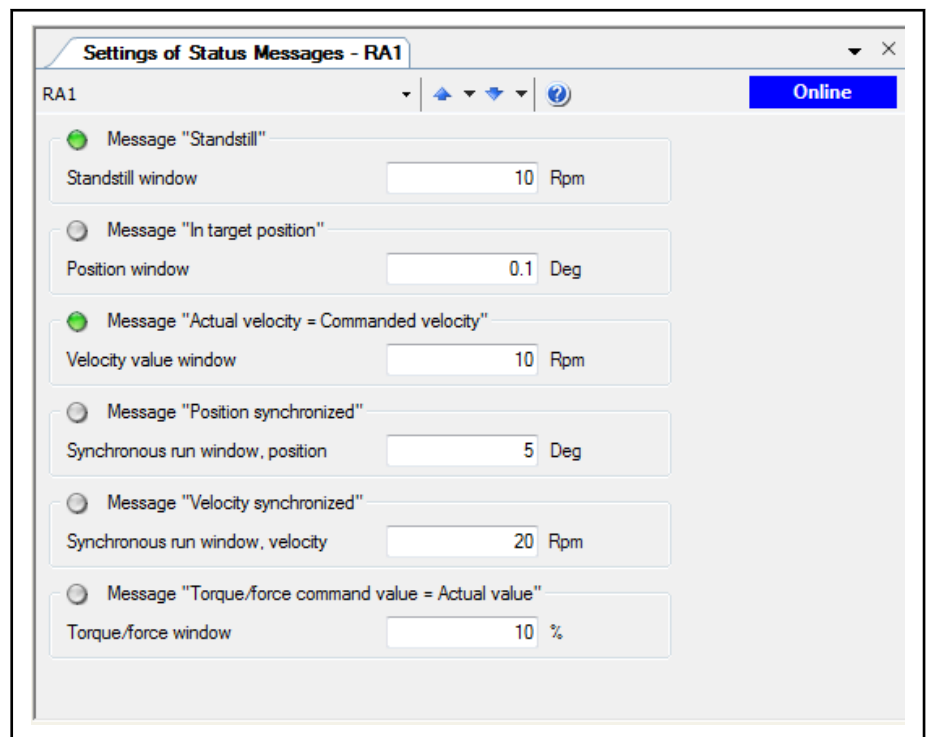


Fig. 6-76: "Settings of status messages" dialog

The values are filed in the following parameters:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Axis status	A-0-0021						
Velocity	x						
Actual velocity value	A-0-0102						
Standstill window	A-0-0222						
Velocity window	A-0-0223						
Synchronization run window, velocity	A-0-0623						

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Position							
Actual position value	A-0-0100						
Positioning window	A-0-2795						
Synchronization run window, position	A-0-0622						

* only for MLC

- A-0-0222, Standstill window** The "Standstill" status bit is set if "A-0-0102, Actual velocity value" is in "A-0-0222, Standstill window" (-> A-0-0021, Bit 5).
- A-0-0223, Velocity window** For any velocity command value, the "A-0-0102, Actual velocity value" is in the window defined by "A-0-0223, Velocity window" (-> A-0-0021, Bit 4).
- A-0-2795, Position window** For any command position value, the "A-0-0100, Actual position value" is in the window defined by "A-0-2795, Positioning window" (-> A-0-0021, Bit 6).
- A-0-0622, Synchronization window, position** With the "Synchronized Motion" function blocks with subordinate position control (MC_GearInPos, MC_CamIn, MB_MotionProfile, ML_FlexProfile), if the difference between the position command value and the actual position value is smaller than the "A-0-0622, Synchronization run window, position", bit 7 in parameter "A-0-0021, Axis status" is set.
- A-0-0623, Synchronization window, velocity** With the "Synchronized Motion" function blocks (MC_GearIn), if the difference between the velocity command value and velocity actual value is smaller than the "A-0-0623, Synchronization run window, velocity", bit 7 in parameter "A-0-0021, Axis status" is set.

6.8.12 Drive halt



This dialog box is available for the interpolation in the drive and in the control.

The dialog summarizes the most important preset values of the drive (rapid) stop.

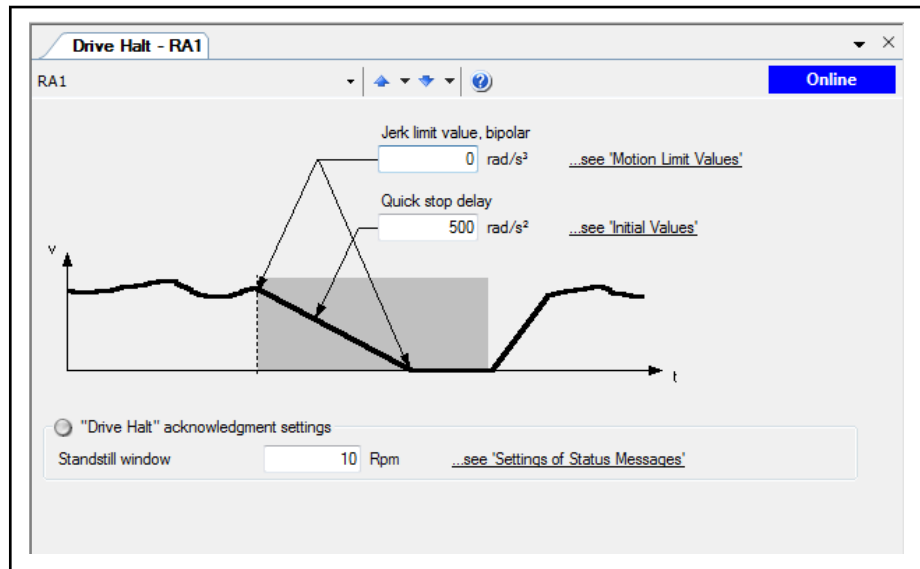


Fig. 6-77: "Drive halt" dialog

The individual parameters are pre-adjusted in different dialogs:

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
Jerk limit value, bipolar chapter 6.8.16 "Motion limit values" on page 460	A-0-0036	
Rapid stop deceleration chapter 6.8.17 "Initial values" on page 462	A-0-0224	
Standstill window chapter 6.8.11 "Settings of status messages" on page 453	A-0-0222	
Axis status fig. 6-18 "Status dialog – Axis status of a real axis" on page 386	A-0-0021 (Bit 15)	

6.8.13 Establishing dimensional reference

Motor encoder



This dialog box is available for the interpolation in the drive and in the control.

This dialog is used to set the dimensional reference of the motor encoder.

Fig. 6-78: "Data Reference Motor Encoder" dialog

P-0-0095, Absolute encoder monitoring window for motor encoder

When switching-on a drive with absolute motor encoder, it is checked whether the actual position value deviates from the actual position value at the last switch-off.

If the deviation exceeds the value specified in this parameter, the error message "F2074 Actual position value 1 outside the absolute encoder window" is output. When switching-off the drive, the current encoder data of the absolute

S-0-0052, Reference value

motor encoder is stored in "P-0-0177, Absolute encoder buffer motor encoder").

In this parameter, the desired actual position value is inserted with regard to a certain axis position (reference position). With the command "P-0-0012, C0300 command: Set absolute position", the value entered into parameter S-0-0052 is applied at the reference position as actual position value.

Thus, a certain position reference system can be established for an axis or an existing reference system can be replaced by a new one (switching).

S-0-0051, Actual position value encoder 1

The actual position value encoder 1 displays the current position of the motor encoder. After the drive was switched on, the communication phases are run through and the actual position value is initialized with the command "S-0-0128, C0200 Preparation of switching to phase 4", i.e. the actual position value is set to its initial value.

Furthermore, the following parameters are involved:

- S-0-0403, Actual position value status
- S-0-0147, Homing parameter

Optional encoder

This dialog box is available for the interpolation in the drive and in the control.

The dialog is intended for setting the dimensional reference of an optional encoder.

For more information, refer to the documentation "Rexroth IndraDrive MPx-20 Functions", chapter "Measuring systems" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.14 Error response**Drive**

This dialog is available for IndraDrive for interpolation in the drive and in the control.

This dialog configures the reaction in case of error in the drive.

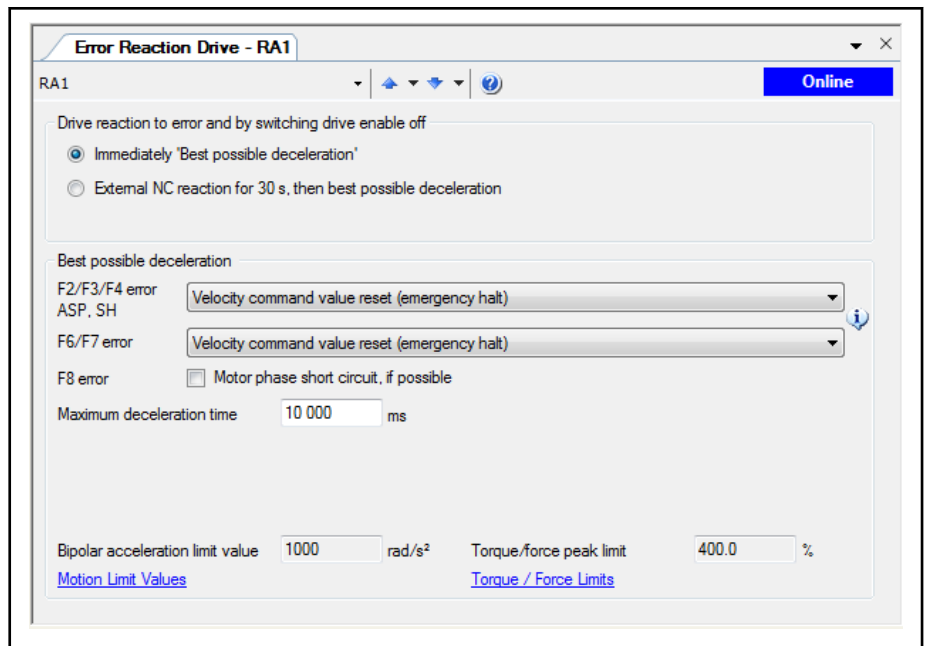


Fig. 6-79: "Error reaction drive" dialog

For each error, the type of the "Optimum deceleration procedure" as well as the maximum braking time can be indicated.

Error reaction can be switched off

For drive errors, the automatic error reaction set by default can be switched off individually for each drive. Thus, even a drive with errors can be synchronized and delayed with a master axis. If the error reaction is switched off, there is a period of 30 seconds starting from the error detection to decelerate the drive. After this period, the best possible deceleration is automatically executed by the drive.

For the **interpolation in the drive** the switch-off becomes effective for all **F2/F3** drive errors. F2/F3 drive errors are evaluated as F0 errors on the control and thus there is no error reaction from the control. Irrespective of that fact, the drive executes an autarkic error reaction starting from error class 4 (e.g. Sercos ring interruption) according to the drive documentation.

For the **interpolation on the control** the switch-off becomes effective for **all** drive error classes. All drive errors are evaluated as F0 errors on the control and thus there is no error reaction from the control. Irrespective of that fact, the drive executes an autarkic error reaction starting from error class 4 (e.g. Sercos ring interruption) according to the drive documentation.



In case of a switched off error reaction, the drive does not automatically delay if a non-fatal error occurs. This behavior can damage the machine. The drive has to be set to standstill in the PLC user program.

An automatic error reaction for drive errors set by default can be switched off as follows:

- In the IndraWorks drive dialog "Error reaction --> Error reaction drive", enable the option "30 s NC external NC reaction, then best possible deceleration to standstill" (P-0-0117 Bit 0 = TRUE)
- Set the additional axis parameter "A-0-0651, Diagnostics, control word" Bit 0 = TRUE. Thus, no automatic error reaction is executed for drive errors by the control

- The PLC user program is responsible for the deceleration of the axis containing errors. It is recommended to always query the error bit of the drive (e.g. AxisData[].Axis_Error) cyclically and to start an error reaction in case of a set bit

Example:

For non-fatal drive errors of a real slave axis, only the master axis is delayed in the PLC user program via the MC_Stop function block. The slaves axis remains synchronized even in case of an error and delays with the master axis. After these 30 s, the best possible deceleration starts on the slave axis (the synchronous link is canceled in standstill). After eliminating the error cause, the error is deleted by the MB_Command (C-0-1030, Command: Clear all control errors) function blocks and the PLCopen Motion function block of the slave axis (e.g. MB_GearIn-Pos) has to be restarted via a positive edge at the "Execute" input.



If the error reaction is switched off, the drive error of the PLCopen state remains (the "Errorstop" state remains inactive). Furthermore, the "Error" output is not set at the Motion function blocks (e.g. MC_MoveVelocity). Irrespective of that fact, the "Error" bit AxisData[].Axis_Error and "A-0-0021, Axis status" are set.

Since the PLCopen state "Errorstop" does not become effective in case of error, the drive errors cannot be deleted via the PLCopen function block MC_Reset. An alternative is the command "A-0-1030, Command: Clear all axis errors" or "C-0-1030, Command: Clear all control errors" via the MB_Command function block.

Power section



This dialog is available for IndraDrive for interpolation in the drive and in the control.

This dialog configures the reaction in case of error in the power section.

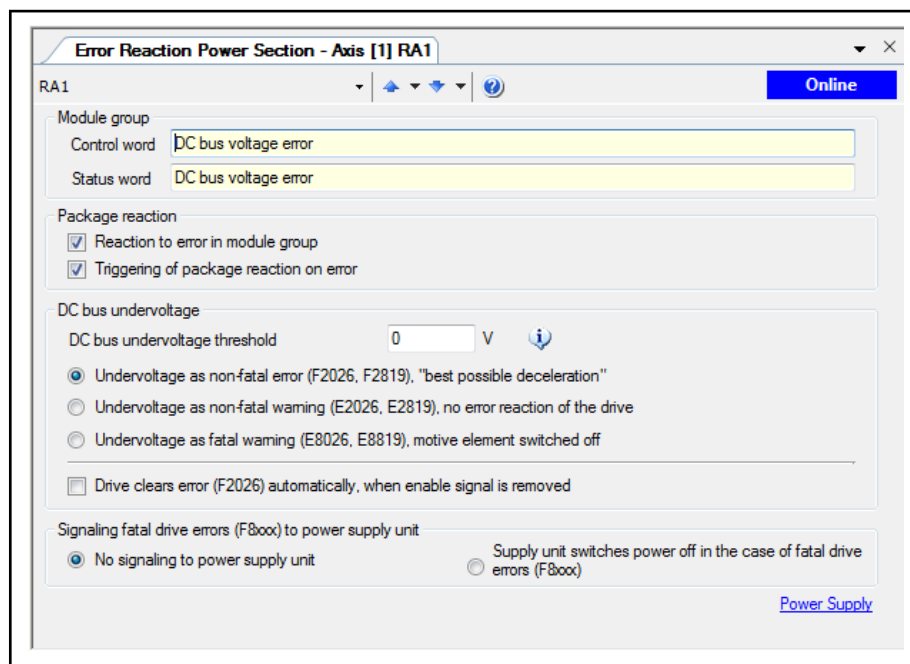


Fig. 6-80: "Error reaction power section" dialog

P-0-0460, Module link, control word	The following parameters are displayed: In this parameter, the information sent from a device (inverter or converter) to the module bus is displayed. Due to the hierarchical structure of the module bus, only the information with the highest priority becomes effective (read only)!
P-0-0461, Module network, status word	In this parameter, the currently active information of the module bus is displayed.
P-0-0118, Power supply, configuration	In this parameter, the settings regarding error messages and error reactions for drives are made, which are connected with each other via the DC intermediate circuit and the module bus (drive package). Furthermore, the handling of the DC intermediate circuit undervoltage is determined.



The DC intermediate circuit voltage (power bus) is not switched off in case of non-fatal errors when the "Drive package" is in operation!

6.8.15 E-Stop function



This dialog box is available for the interpolation in the drive and in the control.

The activation of the E-Stop function and the determination of the drive response is carried out via the parameter "P-0-0008, Activation of E-Stop function".

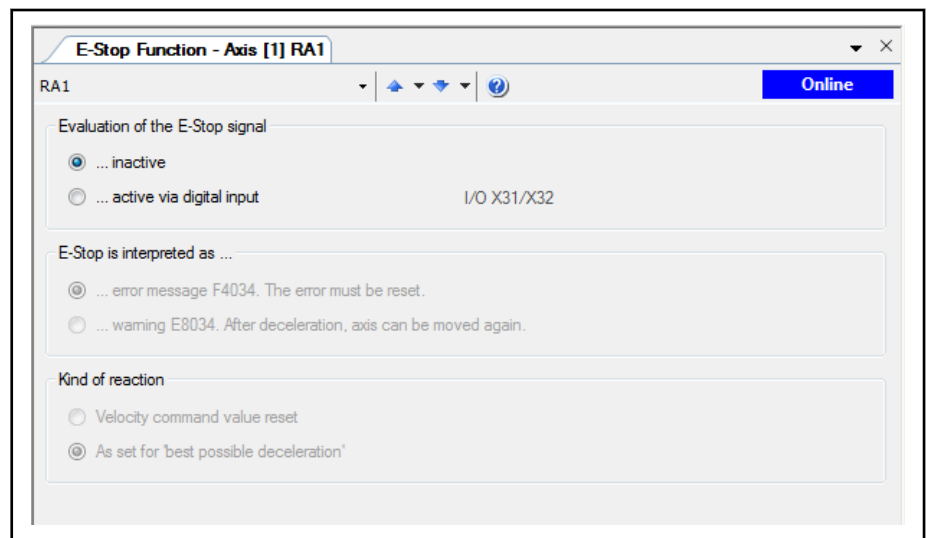


Fig. 6-81: "E-Stop function" dialog

By activating "P-0-0008, E-Stop input (Bit 0 = 1)" and allocating the bit 0 state of "P-0-0223, E-Stop input" to a digital input, the drive is initiated to execute the response defined to stop the drive defined via P-0-0008 if there is 0 V at the E-Stop.

"P-0-0223, E-Stop input" has to be assigned via parameters "P-0-0300, Digital I/Os, allocation list" and "P-0-0301, Digital I/Os, bit numbers" to a digital input. The definition of the input can be changed via the dialog box located behind the "I/O X31/X32" link.

The data of this window is stored in the following S- and P-parameters:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)
E-Stop input		P-0-0008
E-Stop input		P-0-0223
Digital I/O assignment list		P-0-0223
Digital I/O bit numbers		P-0-0301

The basics of the "E-Stop function" and "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "E-Stop function" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).



The input is always "0" active!

6.8.16 Motion limit values



This dialog box is available for the interpolation in the drive and in the control.

The dialog provides an overview on the preset motion limit values of the real axis.

Fig. 6-82: "Motion limit values" dialog

The dialog provides the respective parameters for the control (A-parameters) as well as for the drive (S- and P-parameters) as table.

The parameters for the drive are not displayed if the drive is disabled or off-line and not configured.

The following parameters are evaluated:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Position	x						
Position limit value monitoring, Position polarities, Bit 4	A-0-0029/S-0-0055		A-0-0029				
Actual position value	A-0-0100/S-0-0051		A-0-0100				
Position limit value, positive	A-0-0030/S-0-0049		A-0-0030				
Position limit value, negative	A-0-0031/S-0-0050		A-0-0031				
Travel range limit switch	A-0-0028/P-0-0090		A-0-0028				
Velocity	x						
Velocity limit value, positive	A-0-0032/S-0-0038		A-0-0032				
Velocity limit value, negative	A-0-0033/P-0-0090		A-0-0033				
Velocity limit value, bipolar	A-0-0035/S-0-0091		A-0-0035				
Acceleration	x						
Acceleration limit value, bipolar	A-0-0034/S-0-0138		A-0-0034				
Jerk	x						
Jerk limit value, bipolar	A-0-0036/S-0-0349		A-0-0036				
Torque/force	x						
Torque/force limit value, positive	A-0-0039 / S-0-0082		A-0-0039				
Torque/force limit value, negative	A-0-0040 / S-0-0083		A-0-0040				
Torque/force limit value, bipolar	A-0-0038/S-0-0092		A-0-0038				

* only for MLC

Monitoring the travel range exceedance

The value of "A-0-0029, Bit 4 or S-0-0055 Bit 4 position polarities" decides whether the position limit monitoring of the axis is active (Bit 4 = TRUE).

If the position limit monitoring is active, the "A-0-0100, Actual position value" indicates the status of the axis and the adjustable "A-0-0030, Position limit value, positive", "A-0-0031, Position limit value, negative" show the admissible motion limits.

The user can now decide, whether a "Fatal Warning" is output with subsequent shutdown of the drive or whether an "Error" is triggered according to the error reaction preset in "P-0-0119, Optimum standstill procedure".

Actual position value	Smaller than negative position limit value	Higher than positive position limit value
Warning	E0110030, Negative travel limit exceeded	E0110029, Positive travel limit exceeded
Errors	F2116030, Negative travel limit exceeded	F2116029, Positive travel limit exceeded

Tab. 6-18: Diagnostics as a response to the exceeding of the position limit values

Monitoring limit values

Irrespective of the activation of the position limit value monitoring, the other limit values can either be accepted with their default setting or changed user-specifically. Bipolar limit value means that the same value is effective in positive as well as in negative direction.

If said limits are exceeded in either direction, a warning is output (see following table).

Actual value	Smaller than negative limit value	Higher than positive limit value
Velocity	E0112063, Commanded velocity greater than Limit (A-0-0032/ 33)	
	E0112064, Slave axis, velocity limit exceeded (A-0-0032/33)	
	E0112065, Slave Axis, velocity limit exceeded positive limit	
	E0112066, Slave Axis, velocity falls short of negative limit	
Acceleration	E0112039, Maximum acceleration exceeded	

Tab. 6-19: Warnings as a response to the exceeding/falling below of the limits

The jerk and torque/force limit values do neither trigger a warning nor an error message, but they limit the respective command values [for detailed information, see parameter description "A-0-0036, Jerk limit value, bipolar" and "A-0-0038, Torque/force limit value, bipolar").



The jerk limit value is only effective in the operating states "Discrete" and "Continuous" Motion.

6.8.17 Initial values



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis (only for MLC).

The dialog box displays the initial values used for the PLCopen function blocks. Starting point is the state after reboot:

Initial values - RA1

RA1

Status: No motion is executed. The displayed values are currently NOT used.

Parameters:

	Initial values	Effective command values
Position	These values are predetermined by the protective circuit in the Motion-FBs in the PL-Program.	0 Deg
Target position		0 Deg
Velocity		0 Rpm
Acceleration		0 rad/s²
Deceleration		0 rad/s²
Jerk		0 rad/s³

Quick stop parameter:

Quick stop delay: 500 rad/s²

Direction (only effective when using the MC_MoveAbsolute function block):

☐ Positive
☐ Negative
☒ Shortest distance

Positioning window for shortest: 1 Grad

Online

Fig. 6-83: Initial values after a reboot

The following parameters are evaluated:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Position	x						
Command position	A-0-2200						
Target position	A-0-2201						
Velocity	x						
Command velocity	A-0-2202						
Direction of motion	A-0-0203						
Acceleration	x						
Command acceleration	A-0-2203						
Rapid stop deceleration	A-0-0224						
Jerk	x						
Jerk	A-0-0216						
Jerk limit value, bipolar	A-0-0036						
Rapid stop jerk	A-0-0225						

* only for MLC

The values of the parameters given in the parameter monitor result from the initialization at startup. The values are of no relevance, since no motion has yet been made.

The values displayed are overwritten with the values of the respectively active PLCopen (e.g. MC_MoveVelocity) function block.

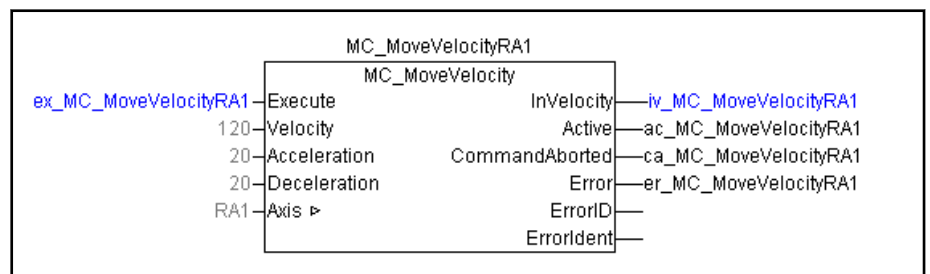


Fig. 6-84: Active PLCopen function block: MC_MoveVelocity



If the following prerequisites are met, a dimensional reference can be set via the parameter A-0-2807 "Command: Set absolute position" and A-0-2806 "Reference position":

- Axis in operating mode (phase 4)
- Axis is standstill

The status message "Actual position value is homed" is always set for a virtual axis in the parameter A-0-0021 "Axis status".

6.8.18 Compensation functions/corrections

Encoder correction



This dialog is available for IndraDrive for interpolation in the drive and in the control.

The quality of processing and accuracy the axis follows a preset path is affected by several factors.

One factor is the accuracy used by a measuring system to identify the position of an axis or a shaft. IndraDrive controller devices provide the option to improve system-dependent inaccuracies of position-measuring systems with sinusoidal signals. Thus, the following behavior of a drive or an axis regarding the position command values and velocity command values is improved. Frequently, the bandwidth of the control loops can also be improved with a higher adjustable control loop amplification.

The basics of the "compensation functions, encoder corrections" are described for the respective products in "Rexroth IndraDrive Firmware for Drive Controllers MPH-05, MPB-05, MPD-05", chapter "Encoder error correction".

Backlash on reversal correction



This dialog is available for IndraDrive for interpolation in the drive and in the control.

By means of the backlash on reversal correction, a clearance can be easily corrected in the axis mechanics.

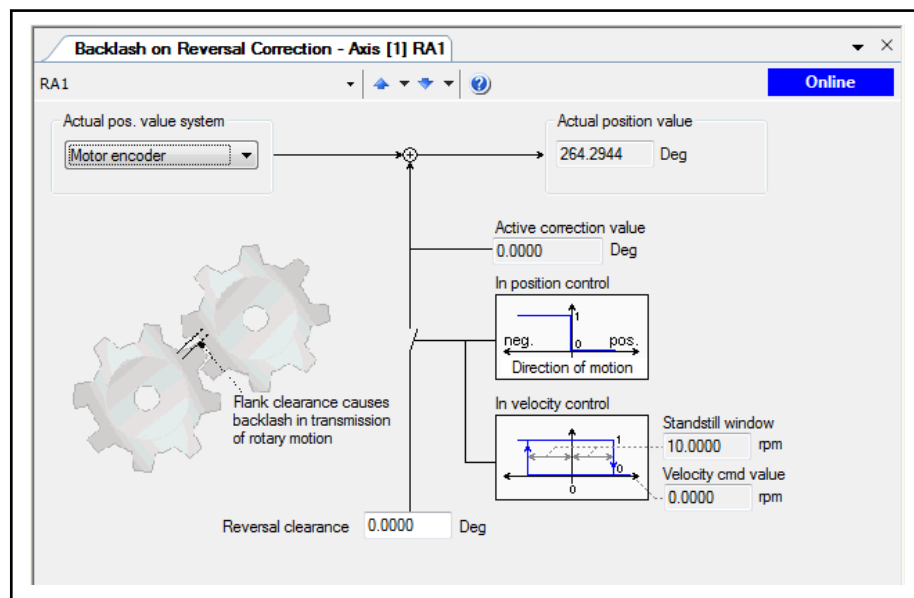


Fig. 6-85: "Backlash on reversal correction" dialog

Parameters used:

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
AxisCorr. Control word	P-0-0413	
AxisCorr. active correction value	P-0-0401	
Actual position value encoder 1	S-0-0051	
Backlash	S-0-0058	
Standstill window	S-0-0124	
Velocity command value	S-0-0036	

Further information on the parameters to be used are provided in the IndraDrive firmware description.

6.8.19 Drive-integrated command value generator



This dialog is available for IndraDrive for interpolation in the drive and in the control.

The basics of the "drive-integrated command value generator" are described product-specifically in "Rexroth IndraDrive Firmware for Drive Controllers" and "Rexroth IndraDrive MPx-20 Functions", chapter "Drive-integrated command value generator" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.20 Cam table

General information



This dialog box is only available if the checkmark before the option "Interpolation in Drive" was **not** removed during the creation of the real axis.

If a real axis operates as slave axis in the MC_CamIn Motion function block, the drive runs in the operating state "cam table with real/virtual master axis". In this operating state, there is a fixed relation between a given master axis position and a slave axis. Master axes (masters) can either be virtual axes or encoder axes.

Based on the virtual master axis position (actual position value, master), the effective master axis position (actual position value in the actual value cycle) is generated with "Master Axis Position Offset", "Gear" and "Dynamic Synchronization".

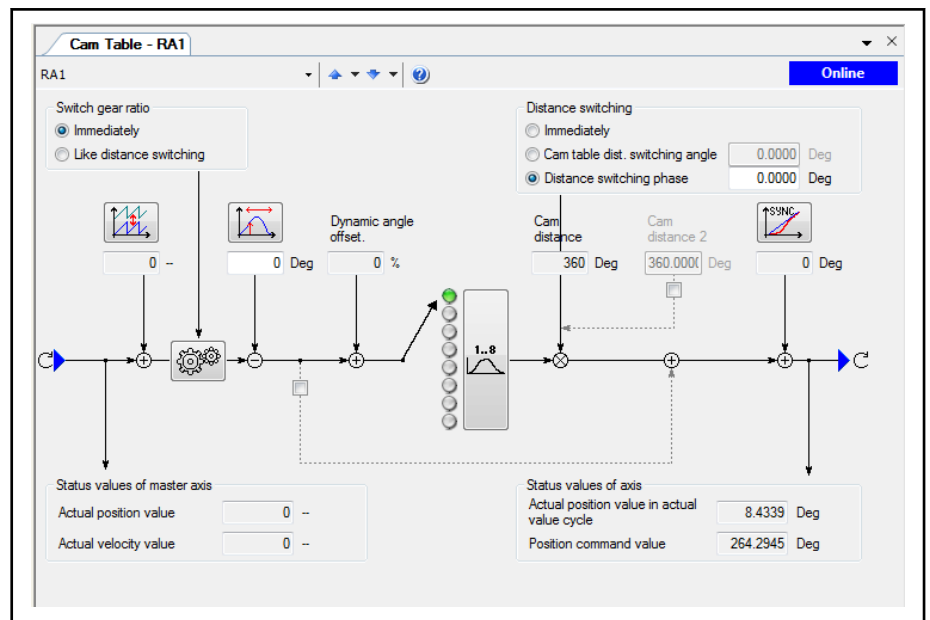


Fig. 6-86: "Cam table" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Control word, synchronization operating states	P-0-0088						
ELS, phasing, additive position command value	A-0-2710						
ELS, PhasingTableAngle, cam table beginning	A-0-2730						
Dynamic phase offset	P-0-0085						
Switching phase, cam, distance	P-0-0144						
Switching phase, cam	P-0-0094						
ELS, CamIn, cam distance	A-0-2741						
ELS, PhasingSlave, additive position command value	A-0-2750						
ELS, CamIn, cam table preselection	A-0-2740						
Master axis, actual position value	A-0-0300						
Master axis, actual velocity value	A-0-0302						
Actual position value in the actual value cycle	P-0-0753						
ELS, position command value	A-0-2655						
ELS, gear reduction	A-0-2745						
Scaling type for position data	A-0-0059						

* only for MLC

The cam table dialog displays the master axis parameters when the drive is in the operating state "Cam table with real/virtual master axis". The parameters are modified from the PLC program by the MC_CamIn Motion function block.

Gear switching	Definition of the gear switching either "immediately" or "like distance switching" (P-0-0088).
Distance switching	Definition of the distance switching either "immediately" or definition of the cam table switching phase or the distance switching phase (P-0-0088).
Master axis position offset	Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".
Gear settings	Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".
Cam table - Phase offset	Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity" as well as "A-0-2620, ELS, phase offset of table beginning, process controller".
Dynamic phase offset	This functionality is currently not supported by the IndraLogic XLC/ IndraMotion MLC system.

Cam table selection

Selection and download of a cam table created with the CamBuilder to a cam table of the drive.

Dynamic synchronization - Phase synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2761, ELS, PhasingSlaveVel, additive command velocity" and "A-0-2615, ELS, additive velocity command value, process controller".

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller". With the "P-0-0750, Master axis revolutions per master axis cycle", the modulo range of the master axis position is specified.

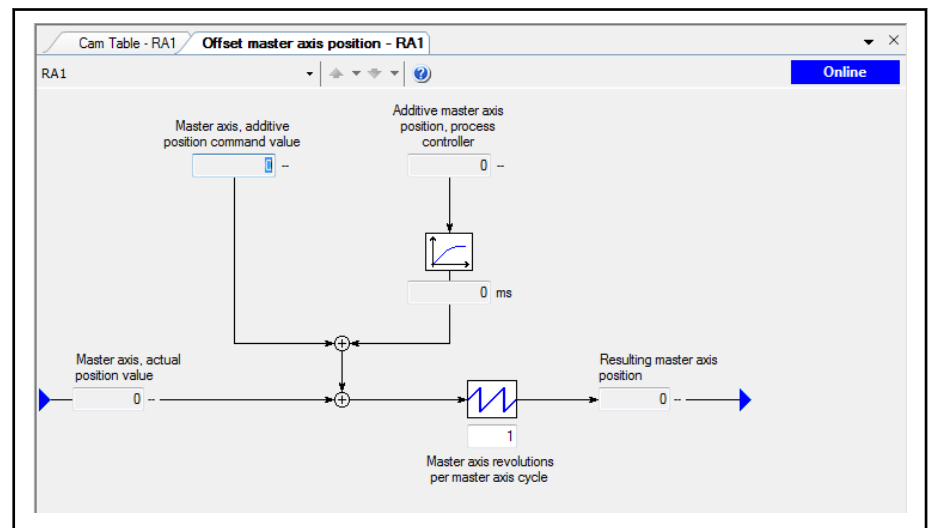


Fig. 6-87: "Offset master axis position" dialog in the "Cam table" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value	A-0-2710						
Master axis, actual position value	A-0-0300						
Additive master axis position, process controller	A-0-2600						
ELS, filter constant, additive master axis position	A-0-2601						
ELS, resulting master axis position	A-0-2650						
Master axis revolutions per master axis cycle	P-0-0750						

* only for MLC

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS,

master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".

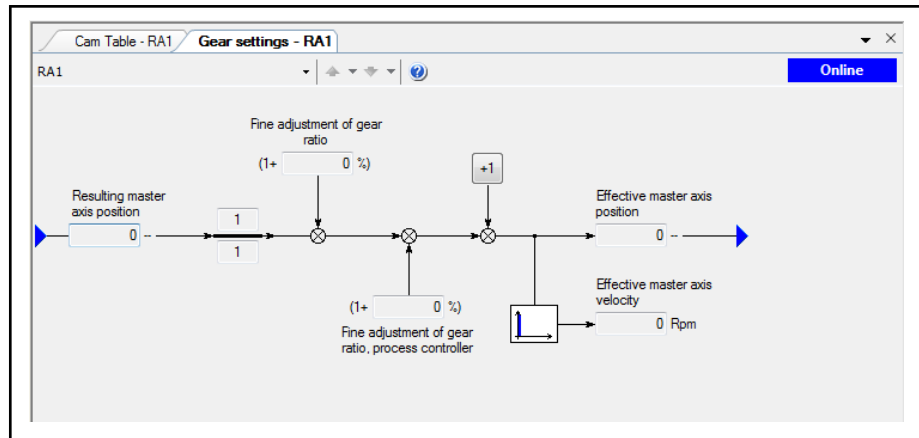


Fig. 6-88: "Gear settings" dialog in the "Cam table" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position	A-0-2650						
ELS, master axis gear, output revolutions	A-0-2721						
ELS, master axis gear, input revolutions	A-0-2720						
ELS, gear ratio fine adjust	A-0-2722						
ELS, Gear ratio fine adjustment process controller	A-0-2605						
Polarity of master axis position	A-0-2798						
ELS, effective master axis position	A-0-2651						
ELS, effective master axis velocity	A-0-2652						

* only for MLC

Cam table phase offset

Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity" as well as "A-0-2620, ELS, phase offset of table beginning, process controller".

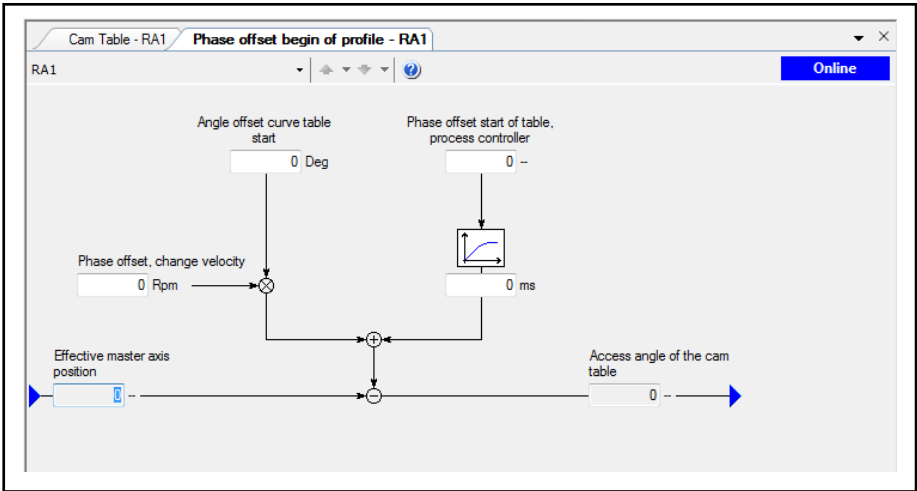


Fig. 6-89: Dialog "Phase offset begin of profile" in the "Cam Table"

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, PhasingTableAngle, cam table beginning	A-0-2730						
ELS, PhasingTableAngle, change velocity	A-0-2731						
ELS, phase offset of table beginning, process controller	A-0-2620						
ELS, filter constant, phase offset of table	A-0-2621						

* only for MLC

Dynamic phase offset

This functionality is currently not supported by the IndraLogic XLC/ IndraMotion MLC system.

Cam table selection

Selection and download of a cam table created with the CamBuilder to a cam table of the drive. It is possible to load a different cam table in any of the eight cam tables. The cam table to be edited is selected in the "MC_CamIn" Motion function block. Furthermore, for each cam table, either linear and cubic spline interpolation can be selected.

Cam tables can be loaded from a parameter file via the  icon.

Cam tables can be stored as parameter file via the  icon.

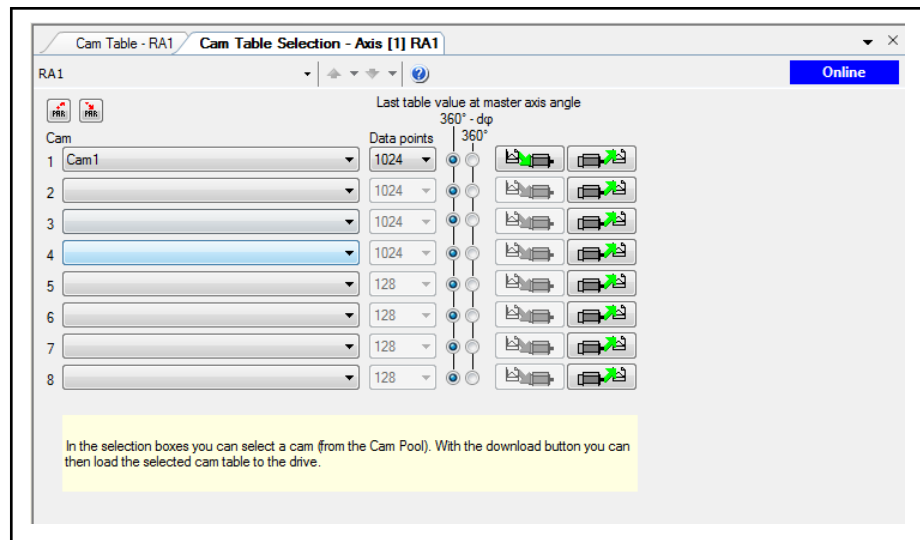


Fig. 6-90: "Cam table selection" dialog in the "Cam table" dialog

Dynamic synchronization - phase synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2761, ELS, PhasingSlaveVel, additive command velocity" and "A-0-2610, ELS, additive position command value, process controller".

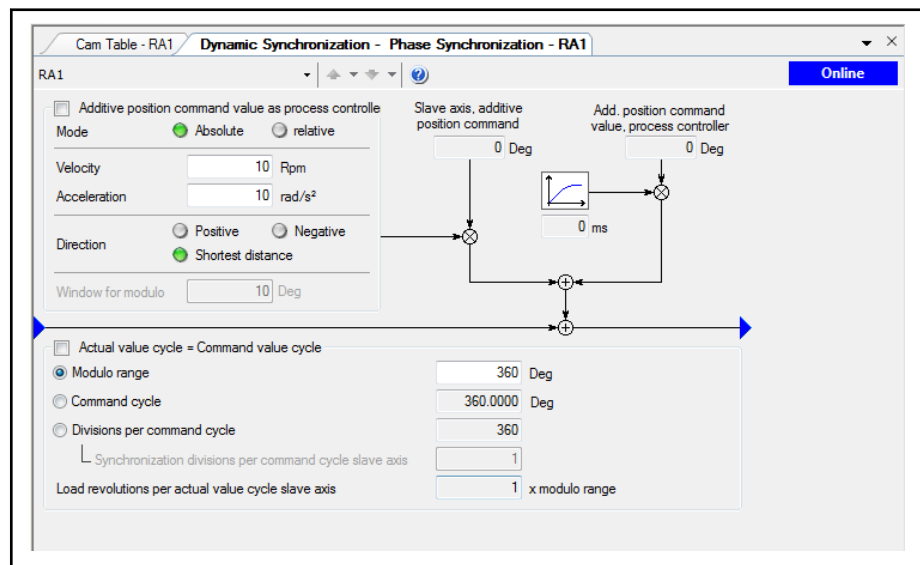


Fig. 6-91: "Dynamic synchronization - Phase synchronization" dialog in the "Cam table" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Synchronization mode	P-0-0155	A-0-2794					
ELS, synchronization mode (SercosDrive and virtual axes)	A-0-2794						
ELS, synchronization velocity	A-0-2790						

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, synchronization acceleration	A-0-2791						
ELS, synchronization direction	A-0-2793						
Scaling type for position data	A-0-0059						
Modulo value	A-0-0045						
Command value cycle	P-0-0754						
Load revolutions per actual value cycle of the slave axis	P-0-0752						
ELS, PhasingSlave, additive position command value	A-0-2750						
ELS, additive position command value, process controller	A-0-2610						
ELS, filter time constant, additive position command value	A-0-2611						

* only for MLC

6.8.21 MotionProfile

General information



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis.

If a real axis (IndraDrive) operates as slave in the MB_MotionProfile Motion function block, the drive runs in the operating state "MotionProfile with real/virtual master axis". In this operating state, there is a fixed relation between a given master axis position and a slave axis. Master axes can be real, virtual or encoder axes.

Based on the virtual master axis position (actual position value, master), the position command value is created for the real axis "Master Axis Position Offset", "Gear" and "Dynamic Synchronization".

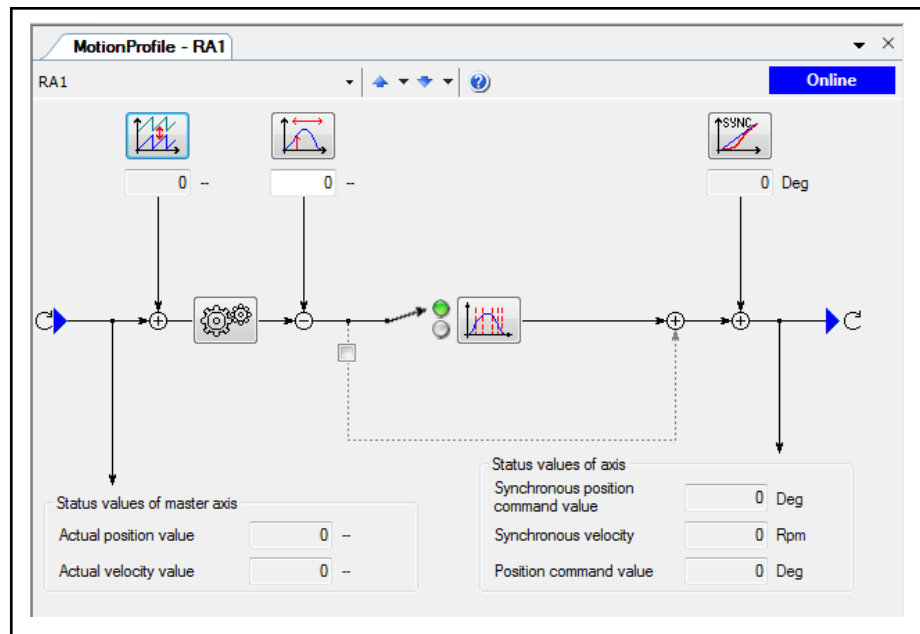


Fig. 6-92: "MotionProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, master axis, axis number			A-0-2701				
ELS, phasing, additive position command value			A-0-2710				
ELS, PhasingTableAngle, cam table beginning			A-0-2730				
ELS, PhasingSlave, additive position command value			A-0-2750				
ELS, synchronous position command value			A-0-2653				
ELS, synchronous velocity			A-0-2654				
ELS, position command value			A-0-2655				
Master axis, actual position value			A-0-0300				
Master axis, actual velocity value			A-0-0302				
MotionProfile, basic configuration			A-0-2904				
Scaling type for position data			A-0-0059				

* only for MLC

The MotionProfile dialog displays the relevant parameters when the control is in the operating state "MotionProfile with real/virtual master axis". The parameters can be modified by the settings made in the PLC program for the MB_MotionProfile Motion function block.

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".

Gear settings	Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".
Cam table phase offset	Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity" as well as "A-0-2620, ELS, phase offset of table beginning, process controller".
Dynamic phase offset	This functionality is currently not supported by the IndraLogic XLC/ IndraMotion MLC system.
MotionProfile overview	Selection and download of a MotionProfile created with a CamBuilder on the real axis.
Dynamic synchronization - Phase synchronization	Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2750, ELS, PhasingSlave, additive position command value" and "A-0-2610, ELS, additive position command value, process controller".

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710 ELS, phasing, additive position command value" and "A-0-2600, Additive master axis position, process controller". With the "P-0-0750, Master axis revolutions per master axis cycle", the modulo range of the master axis position is specified.

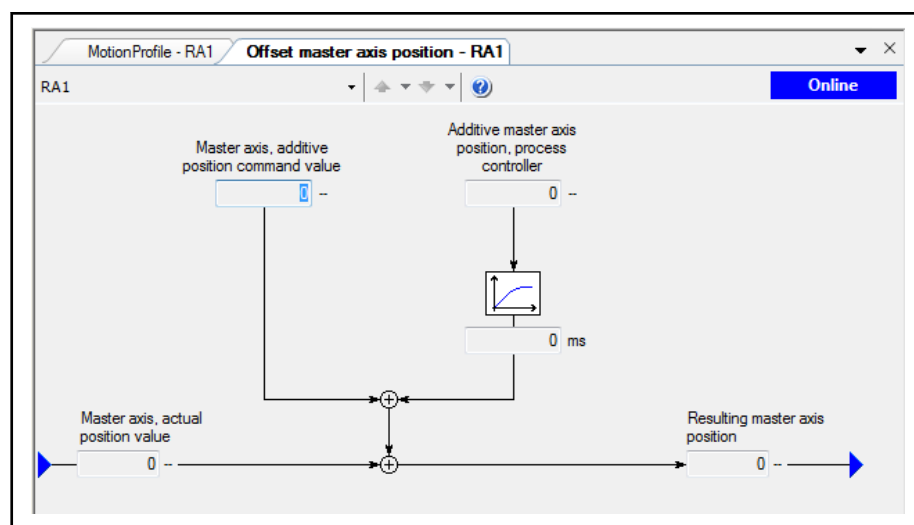


Fig. 6-93: "Offset master axis position" dialog in the "MotionProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value		A-0-2710					
ELS, filter constant, additive master axis position		A-0-2601					
ELS, resulting master axis position		A-0-2650					
Master axis, actual position value		A-0-0300					

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Additive master axis position, process controller			A-0-2600				
Master axis revolutions per master axis cycle			P-0-0750				

* only for MLC

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".

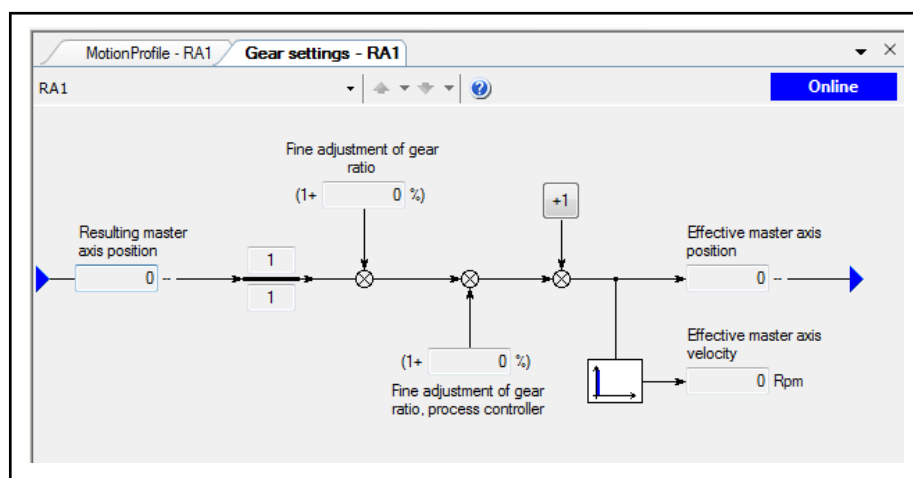


Fig. 6-94: "Gear settings" dialog in the "MotionProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position			A-0-2650				
ELS, master axis gear, input revolutions			A-0-2720				
ELS, master axis gear, output revolutions			A-0-2721				
ELS, gear ratio fine adjust			A-0-2722				
ELS, Gear ratio fine adjustment process controller			A-0-2605				
Polarity of master axis position			A-0-2798				
ELS, effective master axis position			A-0-2651				
ELS, effective master axis velocity			A-0-2652				

* only for MLC

Cam table phase offset

Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity"

as well as "A-0-2620, ELS, phase offset of table beginning, process controller" and "A-0-2621, ELS, filter constant, phase offset of table".

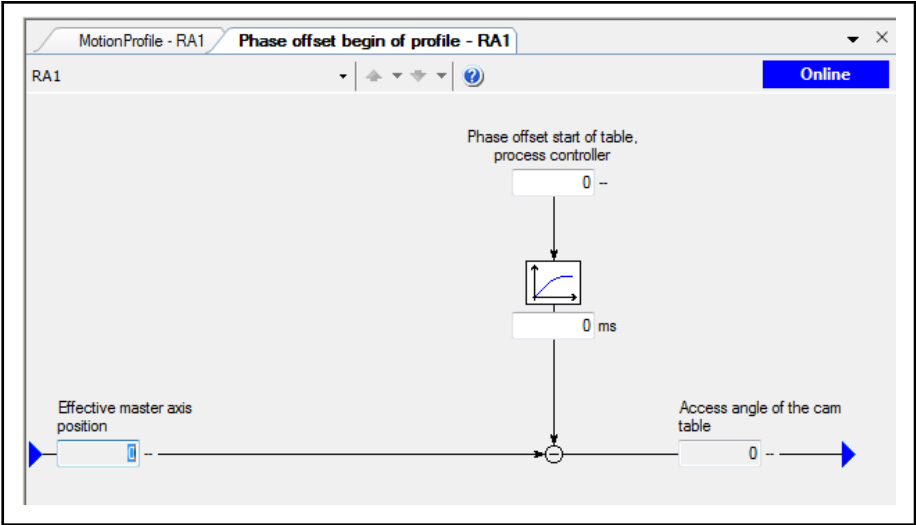


Fig. 6-95: Dialog "Phase offset begin of profile" in the "MotionProfile"

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, PhasingTableAngle, cam table beginning		A-0-2730					
ELS, PhasingTableAngle, change velocity		A-0-2731					
ELS, phase offset of table beginning, process controller		A-0-2620					
ELS, filter constant, phase offset of table		A-0-2621					

* only for MLC

Dynamic phase offset

This functionality is currently not supported by the IndraLogic XLC/ IndraMotion MLC system.

MotionProfile overview

Selection and download of a MotionProfile created with CamBuilder to the axis. For each axis, a maximum of two MotionProfiles can be stored. With the dialog, MotionProfiles already stored on the axis can return to the CamBuilder. The MotionProfile to be processed is selected in the "MB_MotionProfile" Motion function block.

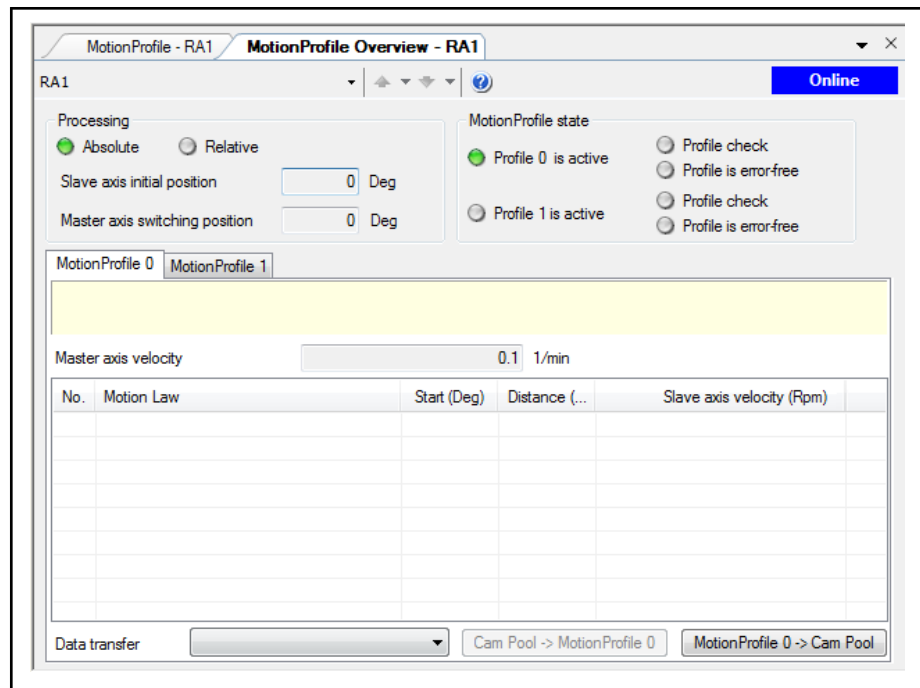


Fig. 6-96: "MotionProfile overview" dialog in the "MotionProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
MotionProfile, master axis switching position			A-0-2900				
MotionProfile, motion step 1, initial slave axis position			A-0-2901				
MotionProfile, control word			A-0-2930				
MotionProfile, status word			A-0-2931				
MotionProfile 0			x				
MotionProfile 0, number of motion steps			A-0-2910				
MotionProfile 0, master axis velocity			A-0-2911				
MotionProfile 0, list of initial master axis positions			A-0-2912				
MotionProfile 0, list of motion laws			A-0-2913				
MotionProfile 0, list of distances			A-0-2914				
MotionProfile 0, list of slave axis velocities			A-0-2915				
MotionProfile 1			x				
MotionProfile 1, number of motion steps			A-0-2920				
MotionProfile 1, master axis velocity			A-0-2921				
MotionProfile 1, list of initial master axis positions			A-0-2922				
MotionProfile 1, list of motion laws			A-0-2923				

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
MotionProfile 1, list of distances				A-0-2924			
MotionProfile 1, list of slave axis velocities				A-0-2925			

* only for MLC

Dynamic synchronization – Phase synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2750, ELS, PhasingSlave, additive position command value" and "A-0-2610, ELS, additive position command value, process controller".

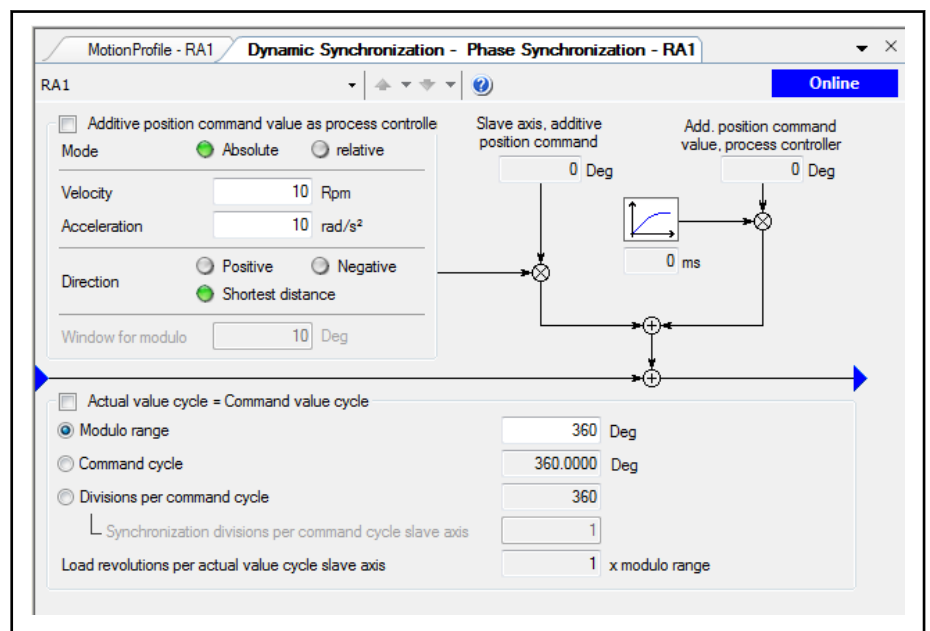


Fig. 6-97: "Dynamic synchronization - Phase synchronization" dialog in the "MotionProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Synchronization mode		P-0-0155					
ELS, synchronization mode Synchronization mode				A-0-2794			
ELS, synchronization velocity				A-0-2790			
ELS, synchronization acceleration				A-0-2791			
ELS, synchronization direction				A-0-2793			
ELS, PhasingSlave, additive position command value				A-0-2750			
ELS, additive position command value, process controller				A-0-2610			

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, filter time constant, additive position command value		A-0-2611					
Modulo value		A-0-0045					
Command value cycle		P-0-0754					
Load revolutions per actual value cycle of the slave axis		P-0-0752					

*

only for MLC

6.8.22 FlexProfile

General information



This dialog is available for all axis types with interpolation on the control. These are: IndraDrive (IPO control), SercosDrive, virtual axis, controller axis.

In addition to the MotionProfile, the "FlexProfile" is available on the control for 04VRS and higher. Apart from a series of new motion laws, different switching and synchronization options as well as links to events are provided. In addition to the master axis as position master, the time master is also available. Up to four of these new FlexProfiles can be created per axis and thus allow a faster switching to the prepared profiles.

How to use the FlexProfile is described in the documentation "IndraLogic XLC/IndraMotion MLC14VRSPLCopen Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

If a real axis (IndraDrive) operates as slave in the ML_FlexProfile Motion function block, the drive runs in the operating state "FlexProfile". In this operating state, there is a fixed relation between a given master axis position and a slave axis. Master axes can be real, virtual or encoder axes.

Based on the master axis position (actual position value, master), the position command value is created for the real axis "Master Axis Position Offset", "Gear" and "Dynamic Synchronization".

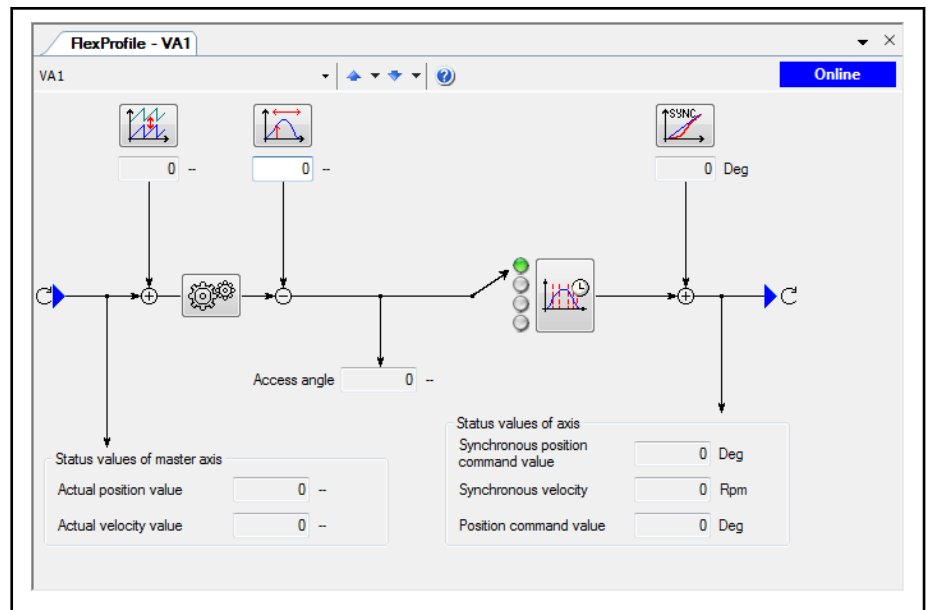


Fig. 6-98: "FlexProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Scaling type for position data			A-0-0059				
ELS, master axis, axis number			A-0-2701				
ELS, phasing, additive position command value			A-0-2710				
ELS, PhasingTableAngle, cam table beginning			A-0-2730				
ELS, PhasingSlave, additive position command value			A-0-2750				
ELS, synchronous position command value			A-0-2653				
ELS, synchronous velocity			A-0-2654				
ELS, position command value			A-0-2655				
Master axis, actual position value			A-0-0300				
Master axis, actual velocity value			A-0-0302				

* only for MLC

The FlexProfile dialog displays the relevant parameters when the control is in the operating state "FlexProfile". The parameters can be modified by the settings made in the PLC program for the ML_FlexProfile Motion function block.

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".

Cam table phase offset

Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity" as well as "A-0-2620, ELS, phase offset of table beginning, process controller".

FlexProfile overview

Selection and download of a FlexProfile to a real axis.

Dynamic synchronization - Phase synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2750, ELS, PhasingSlave, additive position command value" and "A-0-2610, ELS, additive position command value, process controller".

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller". With the "P-0-0750, Master axis revolutions per master axis cycle", the modulo range of the master axis position is specified.

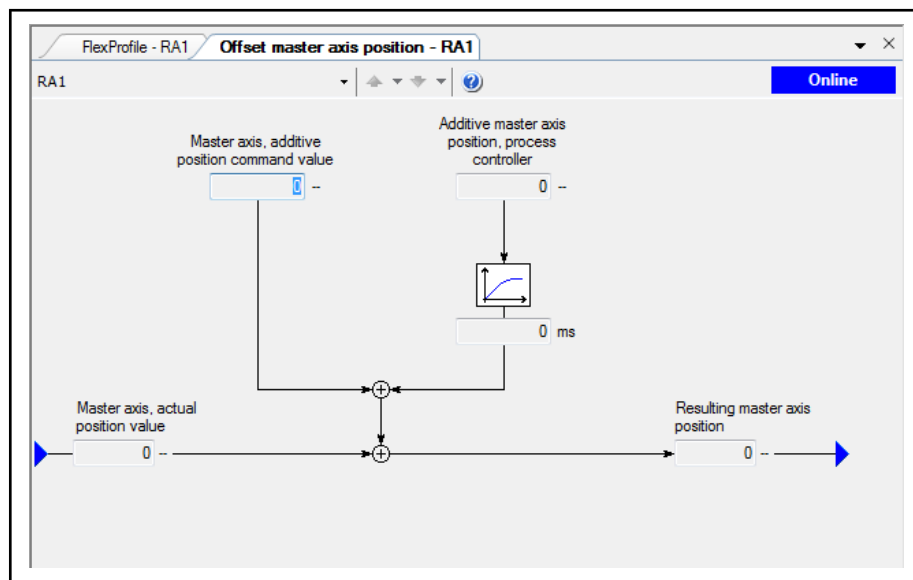


Fig. 6-99: "Offset master axis position" dialog in the "FlexProfile" dialog
Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value			A-0-2710				
Additive master axis position, process controller			A-0-2600				
ELS, filter constant, additive master axis position			A-0-2601				
ELS, resulting master axis position			A-0-2650				
Master axis, actual position value			A-0-0300				

* only for MLC

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".

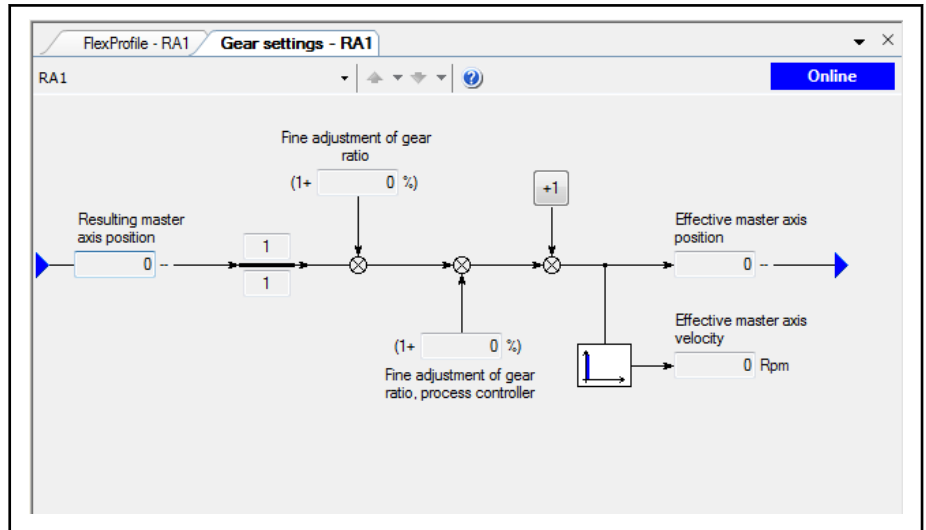


Fig. 6-100: "Gear settings" dialog in the "FlexProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position			A-0-2650				
ELS, master axis gear, input revolutions			A-0-2720				
ELS, master axis gear, output revolutions			A-0-2721				
ELS, gear ratio fine adjust			A-0-2722				
ELS, Gear ratio fine adjustment process controller			A-0-2605				
Polarity of master axis position			A-0-2798				
ELS, effective master axis position			A-0-2651				
ELS, effective master axis velocity			A-0-2652				

* only for MLC

Cam table – Phase offset, begin of table

Determining the phase offset with "A-0-2730, ELS, PhasingTableAngle, cam table beginning" and "A-0-2731, ELS, PhasingTableAngle, change velocity" as well as "A-0-2620, ELS, phase offset of table beginning, process controller" and "A-0-2621, ELS, filter constant, phase offset of table".

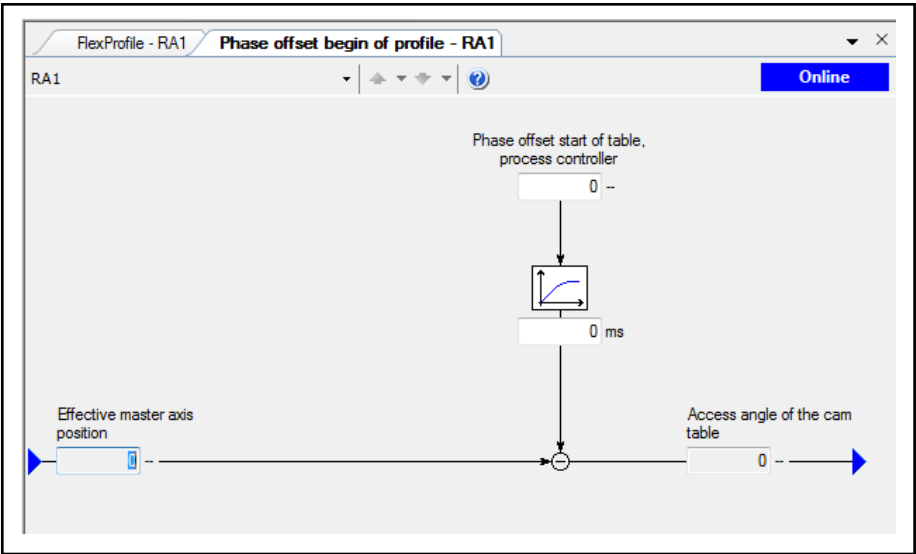


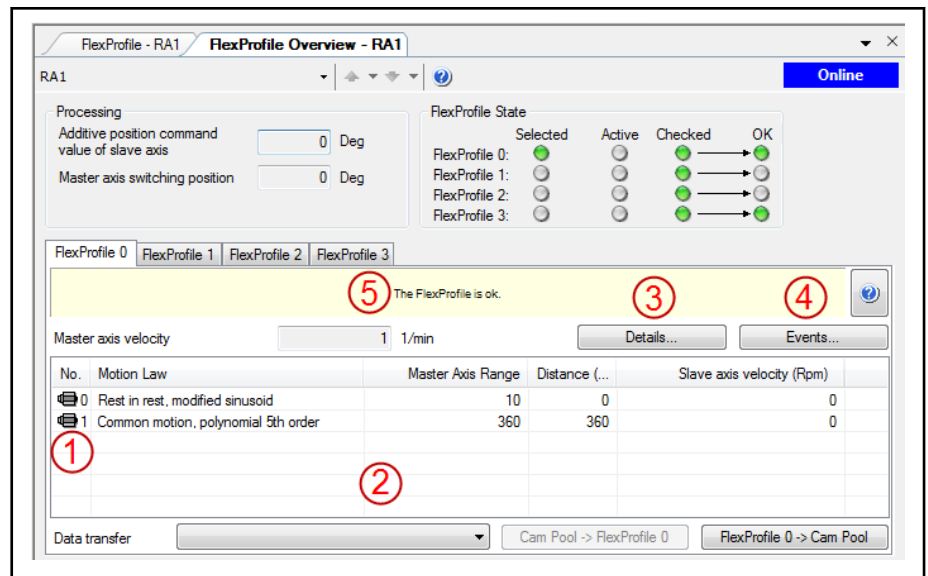
Fig. 6-101: Dialog "Phase offset begin of profile" in the "FlexProfile"
Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, PhasingTableAngle, cam table beginning			A-0-2730				
ELS, PhasingTableAngle, change velocity			A-0-2731				
ELS, phase offset of table beginning, process controller			A-0-2620				
ELS, filter constant, phase offset of table			A-0-2621				

* only for MLC

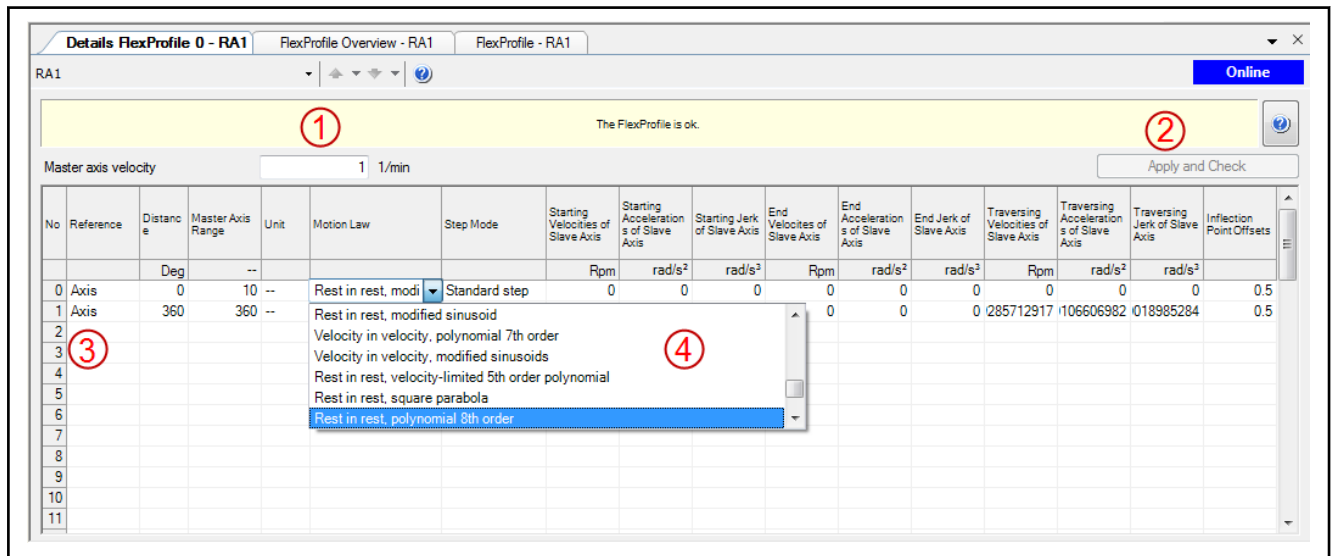
FlexProfile overview

Selection and download of a FlexProfile to the axis. For each axis, up to four FlexProfiles can be stored. The FlexProfile to be processed is selected in the ML_FlexProfile Motion function block.



- ① Symbolic representation of the segment type (axis or time)
- ② Configuration display
- ③ FlexProfile configurator
- ④ Event configurator
- ⑤ Status display

Fig. 6-102: Dialog "FlexProfile overview" in "FlexProfile" dialog



- ① Master axis velocity
- ② Apply to axis and check configuration
- ③ Master axis source selection
- ④ Motion laws can be selected from a list

Fig. 6-103: Configuration of FlexProfile

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
FlexProfile, master axis switching position			A-0-3002				
FlexProfile, slave axis, additive command position value			A-0-3003				
FlexProfile 0			x				
FlexProfile 0, list of master axis sources			A-0-3021				
FlexProfile 0, list of slave axis distances			A-0-3022				
FlexProfile 0, list of master axis ranges			A-0-3023				
FlexProfile 0, list of motion laws			A-0-3025				
FlexProfile 0, list of slave axis end velocities			A-0-3030				
FlexProfile 1			x				
FlexProfile 1, list of master axis sources			A-0-3051				
FlexProfile 1, list of slave axis distances			A-0-3052				
FlexProfile 1, list of master axis ranges			A-0-3053				
FlexProfile 1, list of motion laws			A-0-3055				
FlexProfile 1, list of slave axis end velocities			A-0-3060				
FlexProfile 2			x				
FlexProfile 2, list of master axis sources			A-0-3081				
FlexProfile 2, list of slave axis distances			A-0-3082				
FlexProfile 2, list of master axis ranges			A-0-3083				
FlexProfile 2, list of motion laws			A-0-3085				
FlexProfile 2, list of slave axis end velocities			A-0-3090				
FlexProfile 3			x				
FlexProfile 3, list of master axis sources			A-0-3111				
FlexProfile 3, list of distances			A-0-3112				
FlexProfile 3, list of master axis ranges			A-0-3113				
FlexProfile 3, list of motion laws			A-0-3115				
FlexProfile 3, list of slave axis end velocities			A-0-3120				

* only for MLC

Dynamic synchronization - Phase synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2750, ELS, PhasingSlave, additive position command value" and "A-0-2610, ELS, additive position command value, process controller".

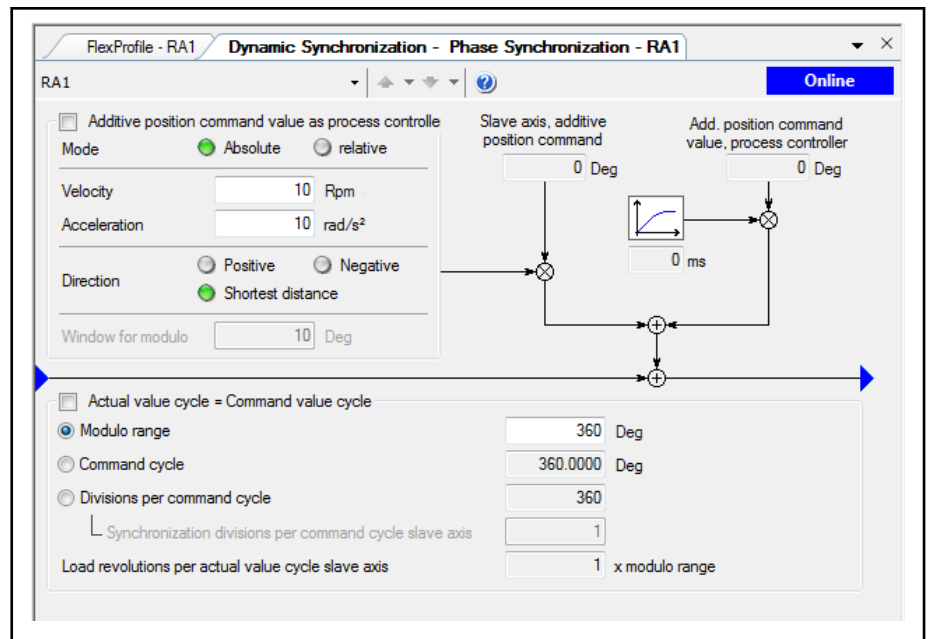


Fig. 6-104: "Dynamic synchronization - Phase synchronization" dialog in the "FlexProfile" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Synchronization mode		P-0-0155					
ELS, synchronization mode			A-0-2794				
ELS, synchronization velocity			A-0-2790				
ELS, synchronization acceleration			A-0-2791				
ELS, synchronization direction			A-0-2793				
ELS, PhasingSlave, additive position command value			A-0-2750				
ELS, additive position command value, process controller			A-0-2610				
ELS, filter time constant, additive position command value			A-0-2611				
Modulo value			A-0-0045				
Command value cycle		P-0-0754					
Load revolutions per actual value cycle of the slave axis		P-0-0752					

* only for MLC

6.8.23 Gear with velocity synchronization

General information



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis (only for MLC).

If a real axis operates as a slave axis in the MC_GearIn Motion function block, the drive runs in the operating state "Velocity synchronization with real/virtual master axis". In this operating state, the drive velocity-synchronously follows a given master axis velocity. Master axes can be real, virtual or encoder axes.

Based on the master axis velocity "A-0-0302, Master axis, actual velocity value", the velocity command value "A-0-2657, ELS, effective velocity command value" is created for the real axis using the "Master axis position offset", "Gear" and "Dynamic synchronization".

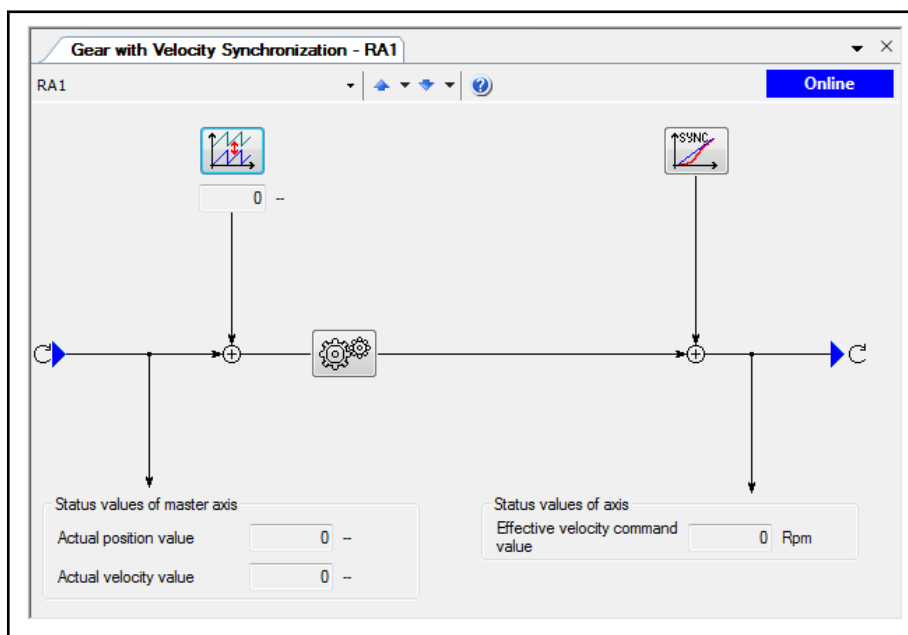


Fig. 6-105: "Gear with velocity synchronization" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value	A-0-2710						
Master axis, actual position value	A-0-0300						
Scaling type for position data	A-0-0059						
Modulo value	A-0-0045						
Master axis, actual velocity value	A-0-0302						
ELS, effective velocity command value	A-0-2657						

* only for MLC

The "Gear with velocity synchronization" displays the effective parameters when the drive is in the operating state "Velocity synchronization with real/virtual master axis". The parameters can be modified by the settings made in the PLC program for the MC_GearIn Motion function block.

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".

- Gear settings** Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".
- Dynamic synchronization** Determining "A-0-2791, ELS, synchronization acceleration", "A-0-2761, ELS, PhasingSlaveVel, additive command velocity" and "A-0-2615, ELS, additive velocity command value, process controller".
- Application** The velocity synchronization is used with simple feed rolls of printing presses for example. The drive runs synchronously to the master axis velocity. The web velocity at the perimeter of the feed roll or of a winding support is preset by the electric gear. A defined tension can be set via the gear fine adjustment.

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".

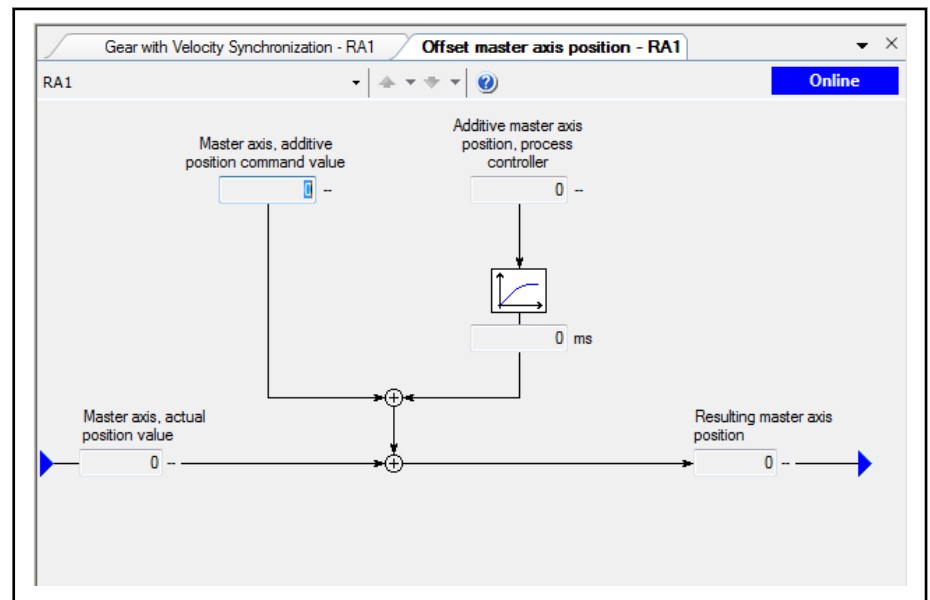


Fig. 6-106: Dialog "Offset master axis position" in the dialog "Gear with velocity synchronization"

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Master axis, actual position value		A-0-0300					
ELS, phasing, additive position command value		A-0-2710					
Additive master axis position, process controller		A-0-2600					
ELS, filter constant, additive master axis position		A-0-2601					

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position	A-0-2650						
Modulo value	A-0-0045						

* only for MLC

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as "A-0-2722, ELS, gear ratio fine adjust" and determination of "A-0-2652, ELS, effective master axis velocity".

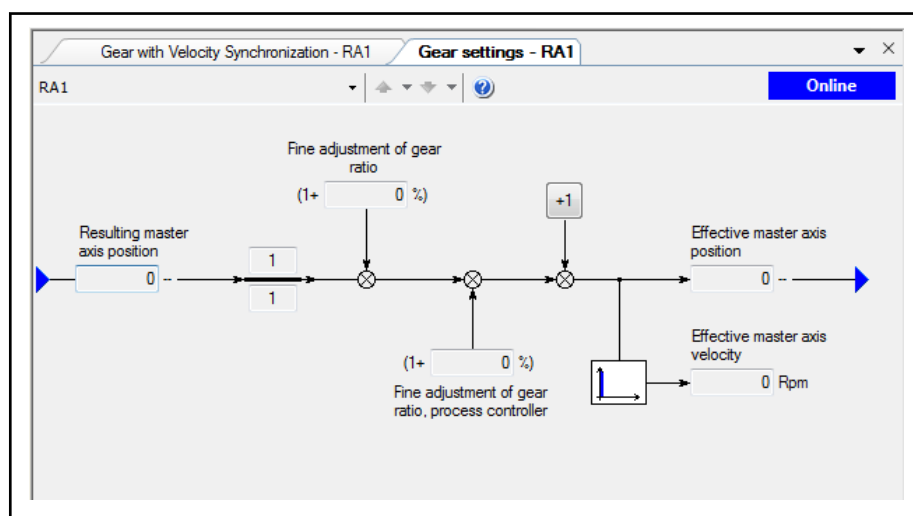


Fig. 6-107: "Gear settings" dialog in the "Gear with velocity synchronization" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position	A-0-2650						
ELS, master axis gear, input revolutions	A-0-2720						
ELS, master axis gear, output revolutions	A-0-2721						
ELS, gear ratio fine adjust	A-0-2722						
ELS, Gear ratio fine adjustment process controller	A-0-2605						
Polarity of master axis position	A-0-2798						
ELS, effective master axis position	A-0-2651						
ELS, effective master axis velocity	A-0-2652						

* only for MLC

Dynamic synchronization

Determining "A-0-2791, ELS; synchronization acceleration", "A-0-2761, ELS, PhasingSlaveVel, additive command velocity" and "A-0-2615, ELS, additive velocity command value, process controller".

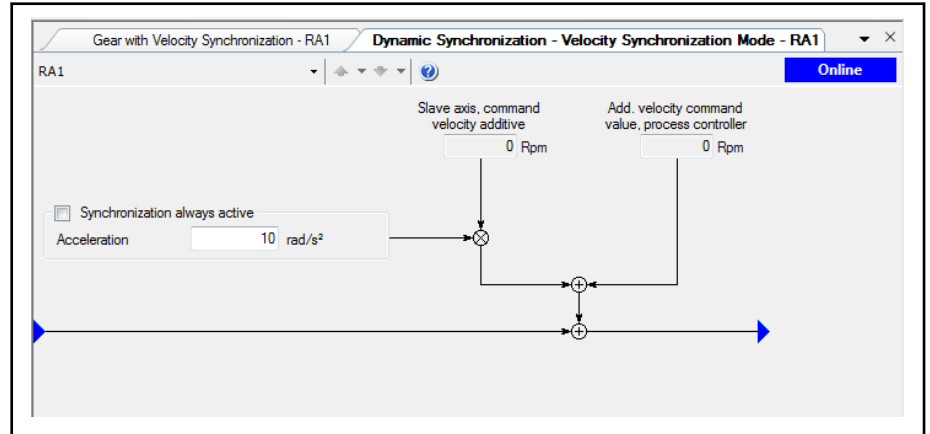


Fig. 6-108: Dialog "Dynamic synchronization - Velocity synchronization" in the dialog "Gear with velocity synchronization"

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Synchronization mode	P-0-0155						
ELS, synchronization acceleration	A-0-2791						
ELS, PhasingSlaveVel, additive command velocity	A-0-2761						
ELS, additive velocity command value, process controller	A-0-2615						

* only for MLC

6.8.24 Gear with phase synchronization

General information



This dialog is available for all commanding axis types. These are: IndraDrive, SercosDrive, virtual axis, controller axis (only for MLC).

If a real axis operates as slave axis in the MB_GearInPos Motion function block, the drive runs in the operating state "Phase synchronization with real/virtual master axis". In this operating state, the drive follows a given master axis position either absolutely or relative phase-synchronously. Master axes can be real, virtual or encoder axes.

Based on the master axis position "A-0-0300, Master axis, actual position value", the effective position command value "A-0-2655, ELS, position command value" is generated for the real axis with "Master axis position offset", "Gear" and "Dynamic synchronization".

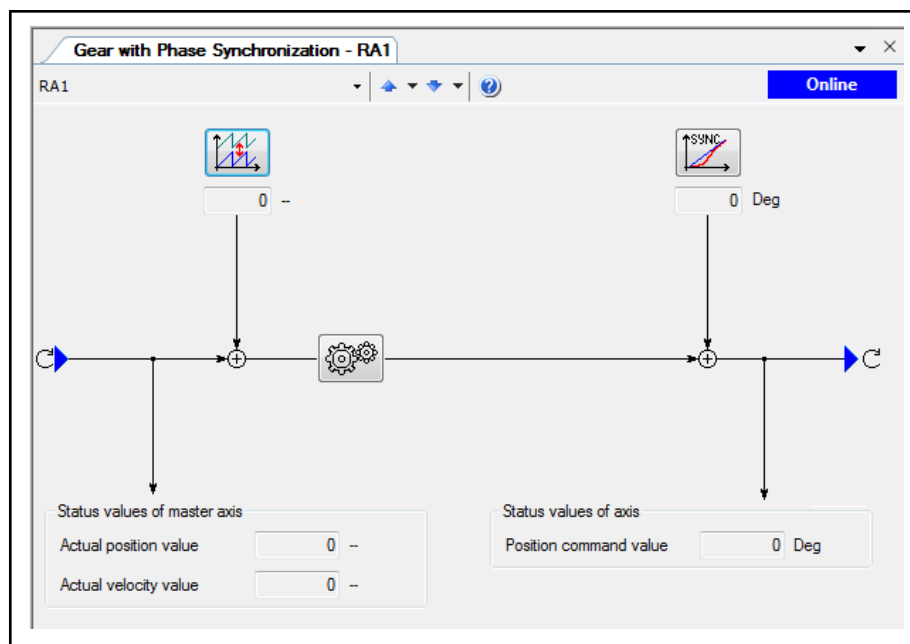


Fig. 6-109: "Gear with phase synchronization" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value		A-0-2710					
Master axis, actual position value		A-0-0300					
Scaling type for position data		A-0-0059					
Modulo value		A-0-0045					
ELS, position command value		A-0-2655					
ELS, PhasingSlave, additive position command value		A-0-2750					
Master axis, actual velocity value		A-0-0302					

* only for MLC

The "Gear with phase synchronization" displays the relevant parameters when the drive is in the operating state "Phase synchronization with real/virtual master axis".

The parameters can be modified by the settings made in the PLC program for the MB_GearInPos Motion function block.

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller".

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as "A-0-2722, ELS, gear ratio fine adjust" and determination of "A-0-2652, ELS, effective master axis velocity".

Dynamic synchronization Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2761, ELS, PhasingSlaveVel, additive command velocity" and "A-0-2615, ELS, additive velocity command value, process controller".

Master axis position offset

Determining the resulting master axis position from "A-0-0300, Master axis, actual position value" and "A-0-2710, ELS, phasing, additive position command value" as well as "A-0-2600, Additive master axis position, process controller". With the "P-0-0750, Number of master axis revolutions per master axis cycle", the modulo range of the master axis position is specified.

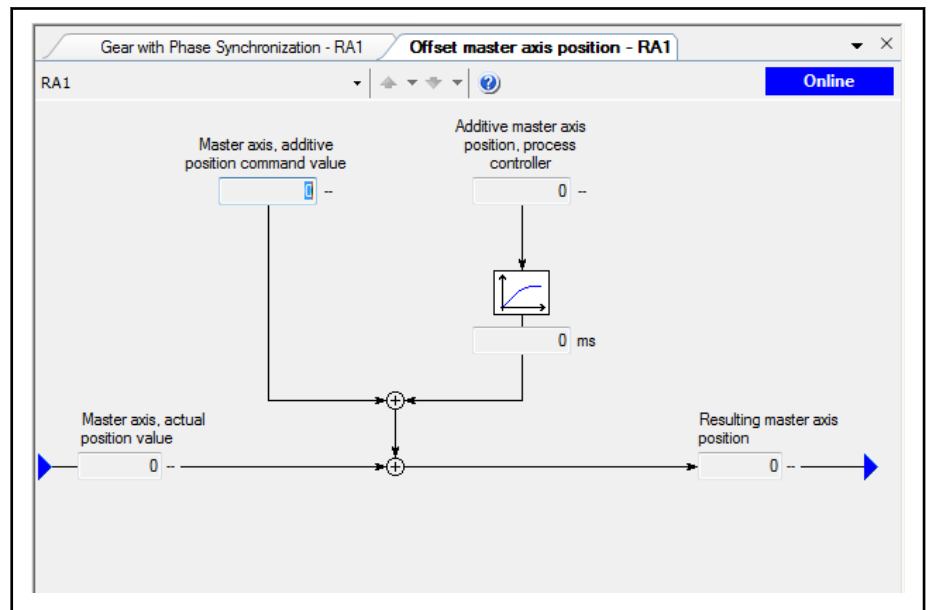


Fig. 6-110: Dialog "Offset master axis position" in the dialog "Gear with phase synchronization"

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, phasing, additive position command value		A-0-2710					
Master axis, actual position value		A-0-0300					
ELS, phasing, additive position command value		A-0-2710					
Additive master axis position, process controller		A-0-2600					
ELS, filter constant, additive master axis position		A-0-2601					
ELS, resulting master axis position		A-0-2650					

* only for MLC

Gear settings

Definition of the gear transmission ratio of the master axis gear with "A-0-2720, ELS, master axis gear, input revolutions" and "A-0-2721, ELS, master axis gear, output revolutions" as well as gear fine adjustment and determination of "A-0-2652, ELS, effective master axis velocity".

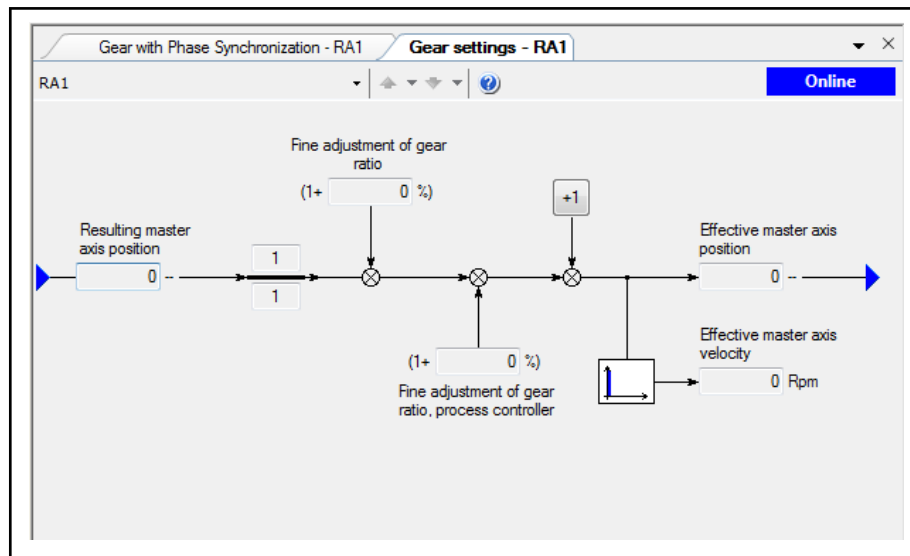


Fig. 6-111: "Gear settings" dialog in the "Gear with phase synchronization" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
ELS, resulting master axis position		A-0-2650					
Polarity of master axis position		A-0-2798					
ELS, effective master axis position		A-0-2651					
ELS, master axis gear, input revolutions		A-0-2720					
ELS, master axis gear, output revolutions		A-0-2721					
ELS, gear ratio fine adjust		A-0-2722					
ELS, Gear ratio fine adjustment process controller		A-0-2605					
ELS, effective master axis velocity		A-0-2652					

* only for MLC

Dynamic synchronization

Determining "A-0-2794, ELS, synchronization mode", "A-0-2790, ELS, synchronization velocity", "A-0-2791, ELS, synchronization acceleration" as well as "A-0-2793, ELS, synchronization direction", "A-0-2750, ELS, PhasingSlave, additive position command value" and "A-0-2610, ELS, additive position command value, process controller".

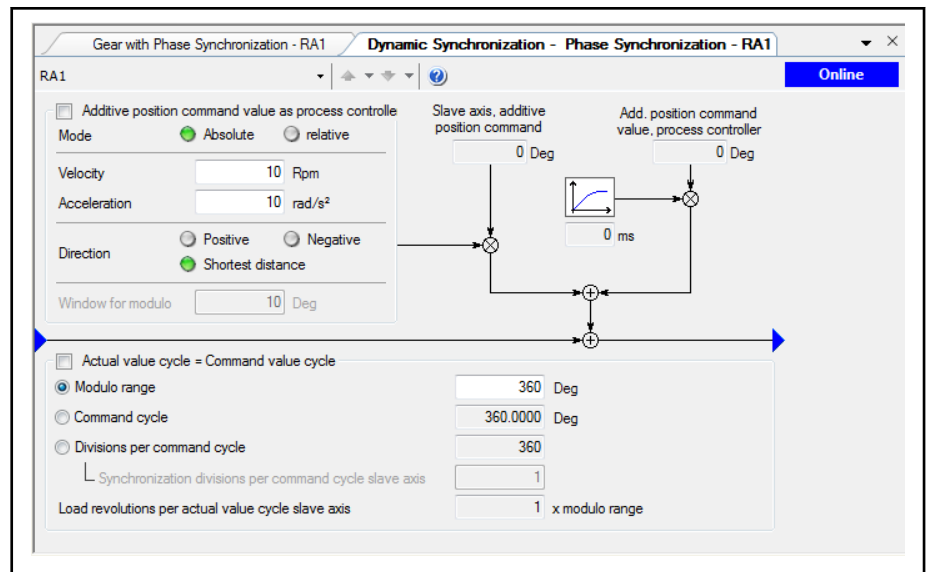


Fig. 6-112: "Dynamic synchronization - Phase synchronization" dialog in the "Gear with phase synchronization" dialog

Parameters used:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Synchronization mode	P-0-0155						
ELS, synchronization mode	A-0-2794						
ELS, synchronization velocity	A-0-2790						
ELS, synchronization acceleration	A-0-2791						
ELS, synchronization direction	A-0-2793						
Scaling type for position data	A-0-0059						
Modulo value	A-0-0045						
Command value cycle	P-0-0754						
Load revolutions per actual value of the slave axis	P-0-0752						
ELS, PhasingSlave, additive position command value	A-0-2750						
ELS, additive position command value, process controller	A-0-2610						
ELS, filter time constant, additive position command value	A-0-2611						

* only for MLC

6.8.25 Axis configuration



This dialog is only available for encoder and link axes.

The axis is configured via the following dialog:

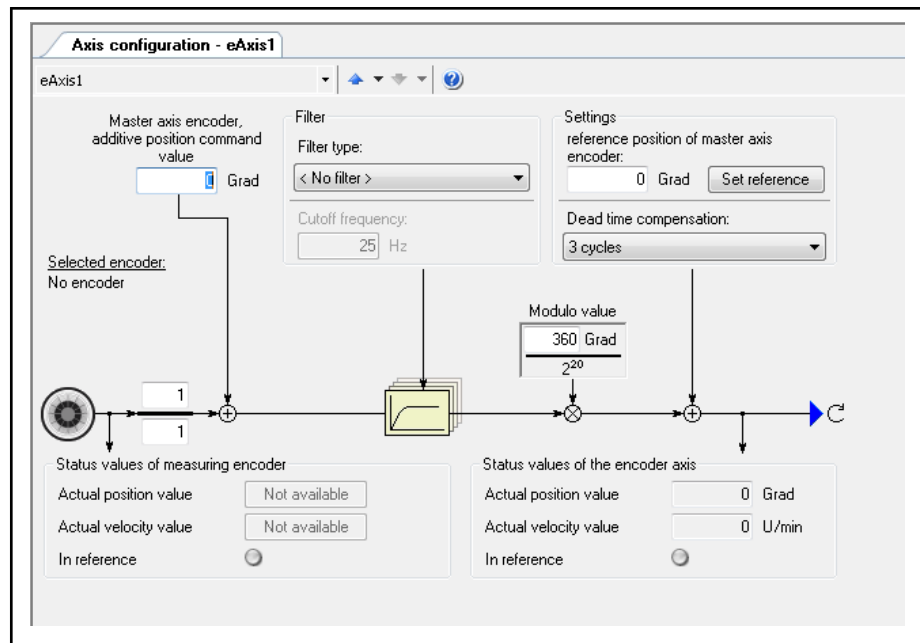


Fig. 6-113: Dialog "Axis configuration"

The following parameters are analyzed:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Master axis encoder						x	
Master axis encoder, configuration						A-0-2800	
Master axis encoder, status						A-0-2801	
Master axis encoder, input revolutions						A-0-2802	
Master axis encoder, output revolutions						A-0-2803	
Master axis encoder, filter type						A-0-2804	
Master axis encoder, filter cutoff frequency						A-0-2805	
Reference position						A-0-2806	
Master axis encoder, additive position command value						A-0-2808	
Position/velocity						x	
Actual position value						A-0-0100	
Actual velocity value						A-0-0102	
Scaling type for position data						A-0-0059	
Actual velocity value of the measuring encoder						P-0-0332	
Scaling exponent for torque/force data						P-0-0052	
Commands						x	
Command: Set absolute position						A-0-2807	

* only for MLC

The transmission of the electronic measuring gear results from the ratio "A-0-2803, Master axis encoder, output revolutions" to "A-0-2802, Master axis encoder, input revolutions", i.e. $\text{RatioNumerator} / \text{RatioDenominator}$.

The adjustment range is between 65,535 : 1 and 1 : 65535.

The position value **after** the measuring gear is increased by the "A-0-2808, Master axis encoder, additive position command value" value.

A filter - selectable and configurable by the user - is displayed. Via "A-0-2804, Master axis encoder, filter type", the following selection can be made:

Value	Filter type
0	Filter deactivated
1	40 ms average value filter
2	1st order low-pass filter
3	2nd order low-pass filter
4	2nd order Butterworth
5	2nd order low-pass filter with velocity feedforward (dead time compensation)
6	3rd order low-pass filter
7	3rd order low-pass filter with velocity and acceleration feedforward (dead time compensation)
8	3rd order Butterworth

Tab. 6-20: Filter type specification

The "A-0-2805, Master axis encoder, filter cutoff frequency" parameter to store the filter cutoff frequency completes the component.

In the end, the position value can be set to the reference position via the reference command ("A-0-2806, Reference position", "A-0-2807, Command: Set absolute position", "A-0-2801, Master axis encoder, status").

The fact that the referencing was successful is indicated in "A-0-2801, Master axis encoder, status (bit 0 = 1)".

As with the other axis types (encoder axis, real axis and virtual axis), the actual values for the link axis can also be used from the following parameters:

- A-0-0100, Actual position value
- A-0-0102, Actual velocity value

6.8.26 Drive-integrated safety engineering



This dialog is available for IndraDrive for interpolation in the drive and in the control.

This dialog is only available if the drive is provided with the option module "Safety" or "S4" or "S5". The functions in the drive can be configured via this dialog.

The hardware functions of the safety engineering is described in the manual "Rexroth IndraDrive Drive Controllers Control Sections CSB01, CSH01, CDB01" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.27 Position switching point



This dialog is available for IndraDrive for interpolation in the drive and in the control.

This dialog configures a virtual position-dependent switch.

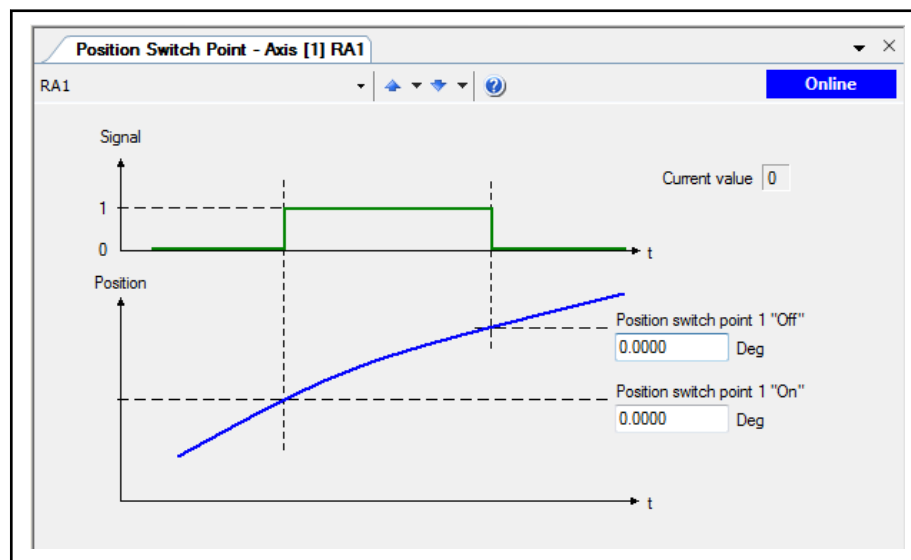


Fig. 6-114: "Position Switch Point" dialog

The following parameters are analyzed:

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
Position switching point 1 On	S-0-0060	
Position switching point 1 Off	S-0-0460	
Position switching point parameter	S-0-0059 (Bit 0)	

The switching positions for the drive are preset in "S-0-0060, Position switching point 1 "On"" and "S-0-0460, Position switching point 1 "Off"".

Between these positions, the virtual switch is in status "1"; outside the two positions, the virtual switch is in status "0".

The value can be read from the parameter "S-0-0059, Position switching point parameter (bit 0)".

The basics of the "position switching points" of the "dynamic programmable limit switch" are described with the corresponding products "Rexroth IndraDrive Firmware for Drive Controllers MPH-, MPB-, MPD-, MPC-08" and "Rexroth IndraDrive MPx-18 Functions", chapter "Drive-integrated command value generators" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.28 Touch probe



This dialog is available for IndraDrive for interpolation in the drive and in the control.

Touch probes measure absolute actual position values as well as actual position value differences and record time intervals between measuring signals.

Subject to the hardware design of the controller unit, up to two touch probe inputs can be defined per axis.

Measuring signals can either be actual position values of motor encoders, external encoders and measuring encoders or master axis position values or cam table values.

A measurement can be triggered by positive and/or negative touch probe signal edges.

Single shot measurements or continuous measurements are possible as well as counting the measuring events during the continuous measurement.

Furthermore, a position value range ("expectation window") can be defined for each touch probe, in which measurements can be executed, including the activation of a "Failure counter" when running through the expectation window without measuring event.

The sample time for touch probe signals is approx. 0.05 ms (for sufficient noise immunity, a signal edge change has to continue at least 4.0 ms in order to be detected!).



The function is only active in the operating mode (BB).

Fig. 6-115: Dialog "Touch Probe"

The following parameters are analyzed:

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
Touch probe, control parameter	S-0-0169	
Touch probe, extended control word	P-0-0226	
Command touch probe cycle	S-0-0170	
Touch probe 1	x	
Signal selection	S-0-0426	
Starting position active	P-0-0204	

Setting	IndraDrive (interpolation in the drive)	IndraDrive (interpolation in the control)
End position active	P-0-0205	
Enabled	S-0-0405	
Touch probe 2	x	
Signal selection	S-0-0427	
Starting position active	P-0-0200	
End position active	P-0-0201	
Enabled	S-0-0406	

Working in the dialog starts and ends with enabling or disabling the touch probe evaluation.

For enabling, the parameter "S-0-0170, Command touch probe cycle"" is used to set the command in the drive and, at the same time, the command execution is enabled.

When disabling, the command in the drive is deleted and, at the same time, the command execution is interrupted.



Only if the touch probe evaluation is activated, the remaining areas of the dialog are active.

Selecting signal sources

The signal sources are selected via a selection window. The selected sources are determined in the parameters "S-0-0426, Signal selection touch probe 1" or "S-0-0427, Signal selection touch probe 2".

Basic settings

The remaining basic settings, single shot measurement/continuous measurement, positive and/or negative edge, are stored in the parameters "S-0-0169, Touch probe control parameter" and "P-0-0226, Touch probe, extended control word" for both sources.

Enabling touch probe evaluation

If the touch probe evaluation (S-0-0170) is activated, the touch probes 1 and 2 can be enabled/disabled separately: "S-0-0405, Touch probe 1 enabled" or "S-0-0406, Touch probe 2 enabled".

The settings can be extended for one or the other touch probe:

- **Activating an expectation window:** The expectation window restricts the position range of an axis or shaft in which touch probe signal edges are used for the measured value acquisition.

Therefore, the starting and end positions of the respectively selected touch probe are stored in the parameters "P-0-0204, Starting position, touch probe function 1 enabled"/"P-0-0205, End position, touch probe function 1 enabled" or "P-0-0200, Starting position, touch probe function 2 enabled"/"P-0-0201, End position, touch probe function 2 enabled".

- **Marker failure monitoring:** Recording marker failures if expectation window is activated:

If the actual position value is outside the range of expected values, touch probe signal edges do not lead to a measured value acquisition!

If no "marker" was detected after a complete run (exceeding both position limits) which triggered a measured value, this status can be stored in the parameter "P-0-0224, Touch probe, number of marker failures" and can be displayed. If repeated, the value of (P-0-0224) increases incrementally. When registering a measured value trigger in the "expectation window", the value in the parameter (P-0-0224) is deleted.



The "expectation window" cannot be used for the time measurement!

The additional "Touch Probe Status" dialog that can be selected in the "Touch Probe" dialog, provides information on both touch probes.

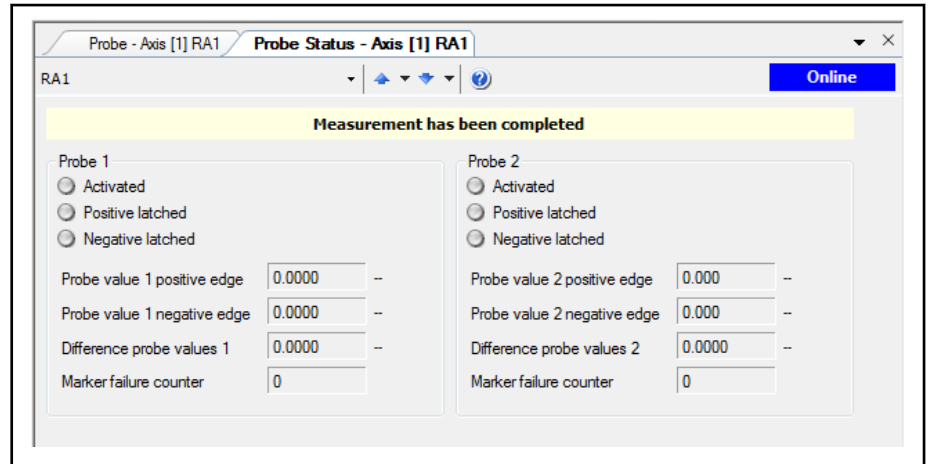


Fig. 6-116: "Touch Probe Status" dialog in the "Touch Probe" dialog

For more touch probe function basics, refer to the corresponding products "Rexroth IndraDrive Firmware for Drive Controllers MPH-, MPB-, MPD-, MPC-08" and "Rexroth IndraDrive MPx-18 Functions", chapter "Touch probe function" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

6.8.29 Jogging (Robot Control V1)



This dialog is available for all IndraDrive axes as well as virtual axes.



The parameters of this dialog are only available for kinematics of type Robot Control V1.

Thus, the dialog cannot be used for kinematics of type Robot Control V2.

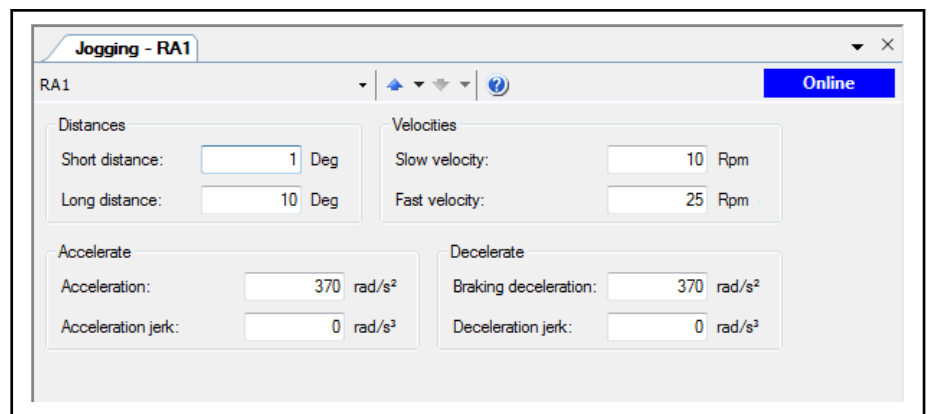


Fig. 6-117: "Jogging" dialog

This dialog is used to preset the following velocities of an axis for jogging (manual mode):

- Velocity

- Acceleration
- Acceleration jerk
- Deceleration

The following parameters are analyzed:

Setting	IndraDrive (IPO in the drive)	IndraDrive (IPO in the control)	Sercos- Drive	VA	RA *	EncA	LnkA *
Jog	x			x			
Jogging, short distance	A-0-0080			A-0-0080			
Jogging, long distance	A-0-0081			A-0-0081			
Jogging, low velocity	A-0-0082			A-0-0082			
Jogging, high velocity	A-0-0083			A-0-0083			
Jogging, acceleration	A-0-0084			A-0-0084			
Jogging, deceleration	A-0-0085			A-0-0085			
Jogging, acceleration jerk	A-0-0086			A-0-0086			
Jogging, deceleration jerk	A-0-0087			A-0-0087			

* only for MLC

The parameter units depend on the settings made for "Advanced scaling/units" in the dialog (see [chapter 6.8.8 "Scaling/units extended" on page 449](#)).

6.9 Drive as PLC device

6.9.1 General information

In contrast to an axis, a drive as PLC device has no motion functionality and no A-parameters. The drive is PLC-commanded and freely programmable.



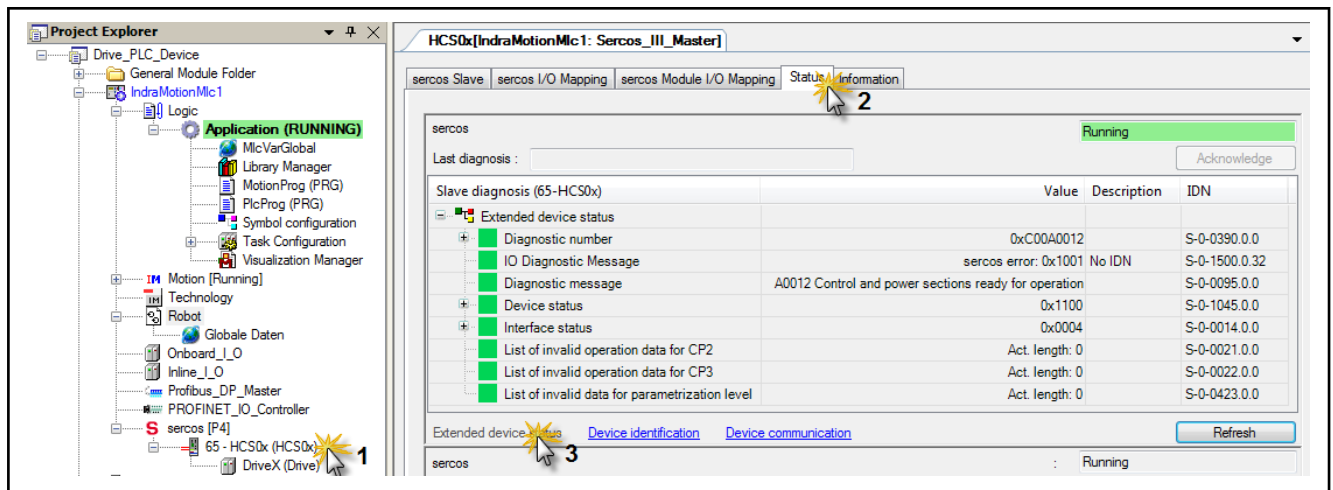
The function blocks for the operation modes "Velocity control", "Torque control" and "Drive-internal interpolation" are provided in the "RMB_SercosIII_Util.library" (refer to the documentation "IndraWorks 14VRS Field Bus Libraries" in [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

The drive is created in the IndraWorks project by dragging the device from the library window (Periphery folder, folder for the respective field bus) to the "Field bus" node.

For Sercos, the IndraDrive devices MPx20VRS and higher are located in the library of the periphery devices "Sercos". Example: IndraDrive Cs single-axis device as HCS0x.

Drives of any manufacturers can be subsequently installed in the device database.

To configure the cyclic communication and diagnostics of the PLC devices, IndraWorks dialogs are provided.



- 1 Double-click on the Sercos device
- 2 Select "Status" tab
- 3 Click on "Extended device status"

Fig. 6-118: Example: Diagnostic dialogs on the Sercos PLC devices

For IndraDrive, configure the communication and parameterization of the drives via IndraWorks Ds. For other drives, use the manufacturer-specific tool.

6.9.2 Sercos II drive as PLC device

Sercos III drive as PLC device – Overview

The implementation of the following motion sequence is exemplarily shown in the following:

- Positioning to an absolute position
- Relative positioning (target position = current position + position specification)
- Additive positioning (target position = last target position + position specification)
- Velocity control
- Drive Halt (AH)

Any number of motion sequences and drive-related functions can be implemented. In this example, only a small part of the IndraDrive functionality is used.

The drive commissioning steps can be followed using this section. At the end, it should be possible to move the drive with the described motion sequence using the listing (see [chapter "Sercos III drive as PLC device – PLC parameterization" on page 508](#)). The required steps are described at the end of the respective section.



The usage as real axis has many advantages compared to the usage as PLC device with free programming described here. For usage as PLC device, advanced knowledge on the Sercos parameters used and additional programming effort is required.

As an alternative to the free programming described here, the function blocks for the operation modes "Velocity control", "Torque control" and "Drive-internal interpolation" are provided in the "RMB_SercosIII_Util.library" (refer to the documentation "IndraWorks 14VRS Field Bus Libraries" in [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).



The RMB_PLCOpenFieldbus.library cannot be used for Sercos drives. When using PLCopen function blocks for programming, the drive has to be operated as real axis (e.g. as Sercos Drive). Thus, the Motion functionalities and dialogs to parameterize in IndraWorks are available.

Creating the project

IndraWorks is installed. A control (IndraLogic XLC/IndraMotion MLC) is available. A Sercos drive is available. The corresponding device description file is installed. The steps 4 and 5 are only required if a direct connection is to be used to parameterize the Sercos drive.

1. Creating an IndraWorks project with suitable control.
2. Dragging drive from the library window (folder "Periphery", folder "Sercos") to the "Sercos" node.
3. Switching the control online, synchronizing it (download Motion configuration on the device) and switching it to P2.
4. Right-click on **Control ► Communication ► Interfaces**.
Noting down IP address of the bridge for the communications settings for the parameterization.
5. Right-click on **Drive ► Parameter Editor**.

Note down the IP address of the drive from S-0-1020 for the communications settings for the parameterization.

Sercos II drive as PLC device – Parameterization

For IndraDrive, parameterize the drives via IndraWorks Ds. For other drives, use the manufacturer-specific tool.



Right-click on the Sercos device and on the "IndraWorks Ds here..." item to open the parameterization tool for Bosch Rexroth devices.

In contrast to "IndraWorks Ds here...", it can be communicated directly between PC and drive. The PC can be connected to a free Sercos port or communicate via a "Sercos III NetSwitch" (ordering no.: R911328254 HAWA HGS NS-S3-1NRT). The Windows command "route" can also route the IP communication via the control.

The IP addresses are preset by the control. The presetting depends on the control address C-0-0031 and the Sercos address if the Sercos device is provided with the corresponding parameters (class SCP_NRT or SCP_NRTPC in S-0-1000).

- Default address of the Sercos device if C-0-0031=0: 172.31.254.<SercosAddress>. Otherwise, 172.31.<C-0-0031>.<SercosAddress>
- Default address of the control via a Sercos port if C-0-0031=0: 172.31.254.254. Otherwise, 172.31.<C-0-0031>.254



Instead of using IndraWorks Ds, an IndraDrive can also be dragged from the library to the main node (parallel to the control) in the IndraWorks project of the control. A previously created parameter file using IndraWorks Ds is useful for the configuration.

The cyclically applied parameters are configured at Sercos and - in contrast to other field buses - below the "Sercos" node in IndraWorks.

To implement the motion sequences given in [chapter "Sercos III drive as PLC device – Overview" on page 501](#), the following parameterization has to be made at least using IndraWorks Ds:

- Primary operation mode "Drive-controlled positioning"
- 1. Secondary mode "Velocity control"

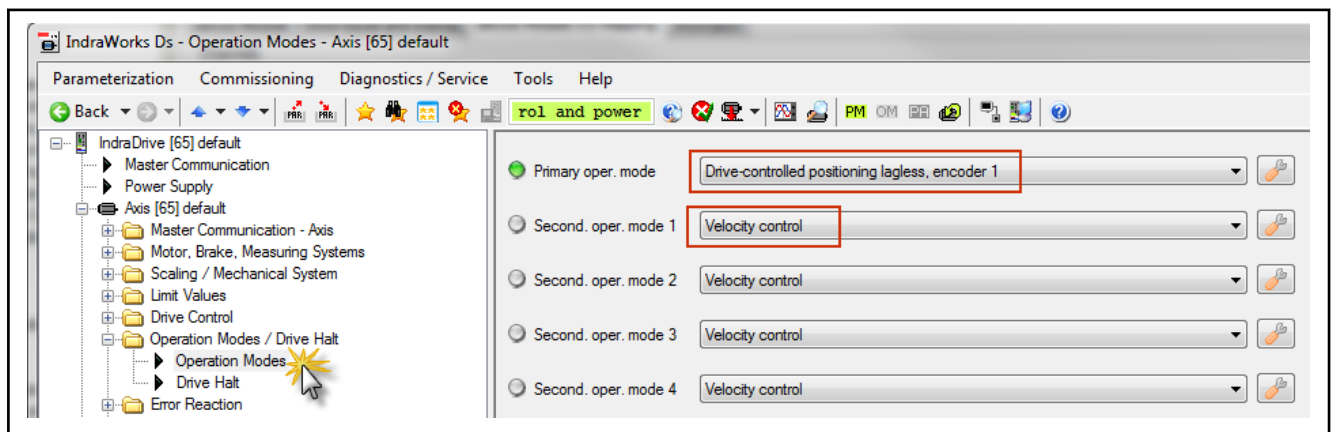


Fig. 6-119: Parameterizing operation modes using IndraWorks Ds

- Signal control word
 - Bit 0: S-0-0346, bit 0 "Applying position command value via toggling"
 - Bit 1: S-0-0346, bit 3 "Type of position command value, 0:: absolute, 1: relative (depends on bit 4)"
 - Bit 2: S-0-0346, bit 4 "Reference point for position command values, 0: Latest effective target position (S-0-0430), 1: Active actual position value (S-0-0386)"
- Signal status word:
 - Bit 0: S-0-0331, bit 0 "Message n_actual = 0"
 - Bit 1: S-0-0342, bit 0 "Target position reached"
 - Bit 2: S-0-0330, bit 0 "Message n_actual = n_command"
 - Bit 3: S-0-0403, bit 0 "Status of the reference encoder "actual position value" (encoder 1 or 2), 0: relative, 1: referenced"

Axes

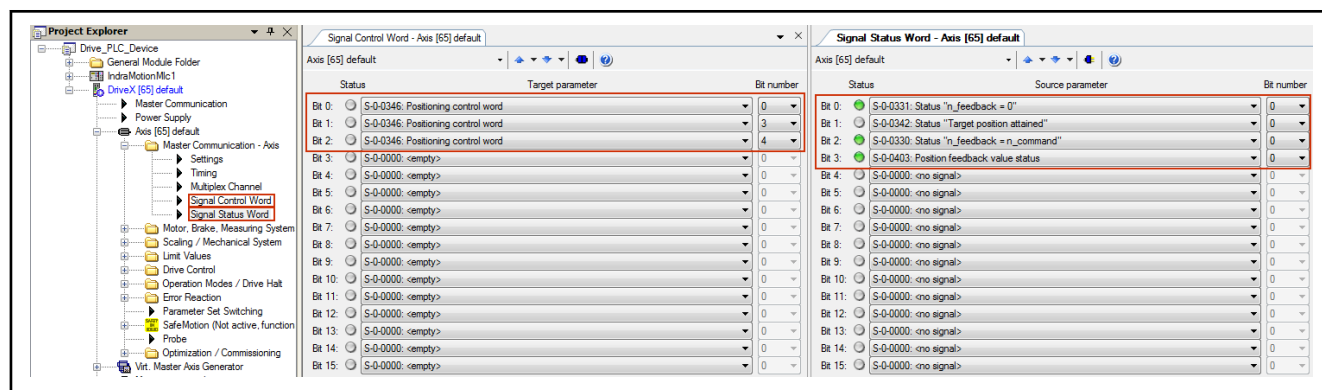


Fig. 6-120: Parameterizing signal control and signal status words using IndraWorks

Also make further parameterization of the drive, e.g. motion limit values.



To read or write parameters of a PLC device from the PLC program, use function blocks from the RIL_SERCOSIII.library, folder "AcyclicCommunication".

Parameterizing the drive with direct connection

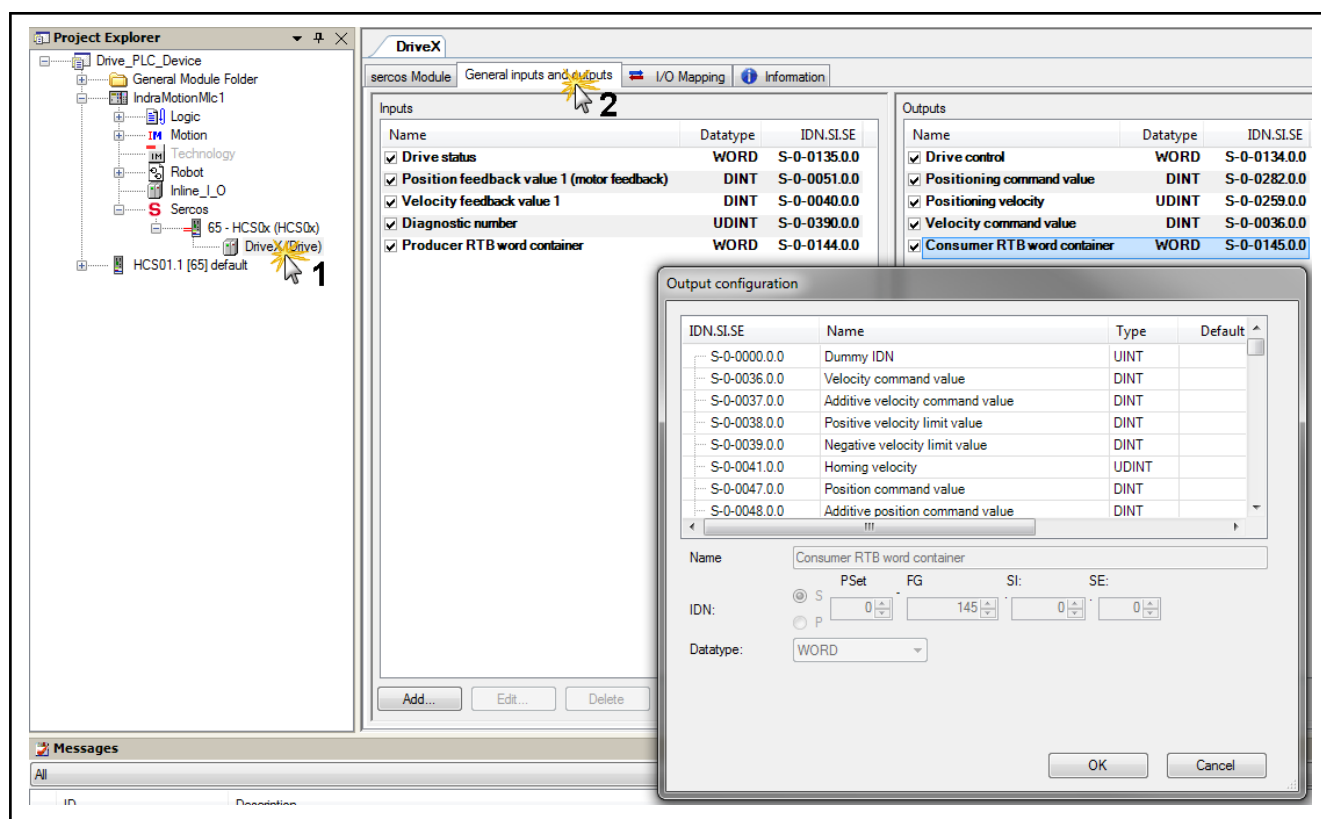
When using "IndraWorks Ds here..." (right-click on the Sercos device), the steps 1 and 2 are omitted.

Only for direct connection: The PC is connected to an open Sercos port or via a "Sercos III NetSwitch". The IP address of the PC is configured with an address matching the control and drive IP address.

1. Enter the bridge address noted down in "Creating the project" on page 502, point 4, into the IndraWorks project as IP address of the control. Switching online should be possible again.
2. Start IndraWorks Ds. Select connection -> IP address search. Enter and search IP address of the drive (in "Creating the project" on page 502, point 5, noted down). Connect to drive.
3. Parameterizing operation modes in IndraWorks Ds as described in fig. 6-119 "Parameterizing operation modes using IndraWorks Ds" on page 503.
4. Parameterizing signal control word and signal status word in IndraWorks Ds as described in fig. 6-120 "Parameterizing signal control and signal status words using IndraWorks" on page 504.
5. Further parameterization of the drive is to be executed in IndraWorks Ds. Motion limit values, rapid stop deceleration, controller parameters, status messages, etc.

Sercos III drive as PLC device – Configuring cyclic data

Cyclically applied data is configured in IndraWorks below the "Sercos" node in the dialog "General inputs and outputs".



- 1 Double-click on the "Drive" node below the Sercos device
- 2 Select the general inputs and outputs

Fig. 6-121: Example configuration of cyclic parameters in the drive diagram AT (inputs) and master data telegram MDT (outputs)

In this example, the parameters required for the operation modes "Positioning" and "Velocity control" are configured.



If the device description file contains the required information (e.g. which parameters can be configured cyclically, name and attribute of the parameters), the configurator provides a drop-down list and suggests the required settings. If this information is not available, no drop-down list is provided and the user has to make the settings.

The entered name is subsequently output in the "Channel" column in [fig. 6-122 "Assigning PLC variables to the configured parameters" on page 507](#).

Select the correct data type with the suitable length and without or with sign depending on the attribute.

Data length in the attribute	Format in the attribute	Data type in the PLC
2 bytes	BIN or HEX	WORD
4 bytes	BIN or HEX	DWORD
2 bytes	DEC_MV	INT
4 bytes	DEC_MV	DINT

Data length in the attribute	Format in the attribute	Data type in the PLC
2 bytes	DEC_OV	UINT
4 bytes	DEC_OV	UDINT

Tab. 6-21: Assignment: Parameter attribute <> Data type in the PLC

The parameters are assigned to the PLC variables in the "I/O Mapping" tab. New variables can be created or the input and output parameters can be mapped on existing PLC variables.

Variables are created in the following.

DriveX

sercos Module | General inputs and outputs | I/O Mapping | Information

Channels

Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
Drive control							
wDriveX_ControlWord		Drive cont...	%QW0	WORD			
Positioning command value							
diDriveX_PositionCmdValue		Positionin...	%QD4	DINT			
Positioning velocity							
udiDriveX_PositionVelocity		Positionin...	%QD8	UDINT			
Velocity command value							
diDriveX_VelocityCmdValue		Velocity c...	%QD12	DINT			
Consumer RTB word container							
boDriveX_PosToggel		Consumer...	%QW16	WORD			
boDriveX_PosRelNotAbs		Bit0	%QX1...	BOOL	FALSE		
boDriveX_PosRelNotAdd		Bit1	%QX1...	BOOL	FALSE		
		Bit2	%QX1...	BOOL	FALSE		
		Bit3	%QX1...	BOOL	FALSE		
		Bit4	%QX1...	BOOL	FALSE		
		Bit5	%QX1...	BOOL	FALSE		
		Bit6	%QX1...	BOOL	FALSE		
		Bit7	%QX1...	BOOL	FALSE		
		Bit8	%QX1...	BOOL	FALSE		
		Bit9	%QX1...	BOOL	FALSE		
		Bit10	%QX1...	BOOL	FALSE		
		Bit11	%QX1...	BOOL	FALSE		
		Bit12	%QX1...	BOOL	FALSE		
		Bit13	%QX1...	BOOL	FALSE		
		Bit14	%QX1...	BOOL	FALSE		
		Bit15	%QX1...	BOOL	FALSE		
Drive status							
wDriveX_StatusWord		Drive status	%IW0	WORD			
Position feedback value 1 (motor feedback)							
diDriveX_ActualPosition		Position fe...	%ID4	DINT			
Velocity feedback value 1							
diDriveX_ActualVelocity		Velocity fe...	%ID8	DINT			
Diagnostic number							
dwDriveX_DiagnosisNumber		Diagnostic...	%ID12	UDINT			
Producer RTB word container							
boDriveX_StandStill		Producer...	%IW16	WORD			
boDriveX_InPosition		Bit0	%IX16.0	BOOL	FALSE		
boDriveX_InVelocity		Bit1	%IX16.1	BOOL	FALSE		
boDriveX_Homed		Bit2	%IX16.2	BOOL	FALSE		
		Bit3	%IX16.3	BOOL	FALSE		
		Bit4	%IX16.4	BOOL	FALSE		
		Bit5	%IX16.5	BOOL	FALSE		

= Create new variable = Map to existing variable

Fig. 6-122: Assigning PLC variables to the configured parameters



The variable names of the example configuration can be copied from the listing below.

Configuring cyclic data

1. Double-click on the "Drive" node of the drive in the IndraWorks project. Select the "General Inputs and Outputs" tab.
2. Configure the parameter S-0-0135 "Drive status".
Check for attribute in the help of S-0-0135:
 - Length of 2 bytes
 - Format: BIN
 - Select "Add" at the inputs
 If there is no drop-down list, fill out the fields as follows:
 - Field name: "Statusword"
 - Field FG: "135"
 - Data type: Select "WORD"
3. Configure the parameter S-0-0051 "Actual position value, encoder 1".
Check for attribute in the help of S-0-0051:
 - Length of 4 bytes
 - Format: DEC_MV
 - Select "Add" at the inputs
 If there is no drop-down list, fill out the fields as follows:
 - Field name: "PositionActValue"
 - Field FG: "51"
 - Data type: Select "DINT"
4. Enter more parameters until all parameters are configured as shown in [fig. 6-121 "Example configuration of cyclic parameters in the drive diagram AT \(inputs\) and master data telegram MDT \(outputs\)" on page 505](#).
5. Go to the "I/O mapping" tab and enter the PLC variables into the "Variable" column as shown in [fig. 6-122 "Assigning PLC variables to the configured parameters" on page 507](#).
6. Load PLC program. Switching to "P4" should be possible via IndraWorks now.

Sercos III drive as PLC device – PLC parameterization

The configured PLC variables of the cyclically configured parameters can now be freely connected in the PLC.

It does not have to be programmed in a specific task. Only in case of specific requirements, as for Gantry axes, the specifications have to be made in the motion-synchronous or Sercos-synchronous task.

Program example

This sequence was implemented in the following example:

- Start in MODE_OFF = AB. Set the variable "OpMode" to 20 (ABS_POS_MODE) to start the sequence
- ABS_POS_MODE = AF, absolute positioning with 4 rpm to 42 degrees
- REL_POS_MODE = AF, relative positioning with 2 rpm by 142 degrees in clockwise direction

- ADD_POS_MODE = AF, relative positioning with 3 rpm by 42 degrees in anti-clockwise direction
- VEL_MODE = AF, velocity control with 42 rpm for 5 seconds
- MODE_AH = AH, stopping with parameterized "deceleration rapid stop" S-0-0372
- End again in Mode_OFF = AB. Switch-off controller enabled when standstill is reached

By writing one of the values REL_POS_MODE, ADD_POS_MODE or VEL_MODE to the "OpMode" variable, the sequence can also be started at these positions.

PLC programming

1. Open "PlcProg" in the IndraWorks project.
2. Copy the first program code "Declaration" below the declaration part.
3. Copy the second program code "Implementation" below the implementation part. Do not copy page break or delete it subsequently.
4. Compile, load and start PLC program.
5. Adding performance bb -> Ab at the drive. Check reference (boDriveX_Homed in the PLC project).
6. Set breakpoints at the transitions to the next operation mode (comment "// set breakpoint here to check") to check the correct processing.
7. Set the "OpMode" variable to 20. This starts the sequence and the first motion to the breakpoint can be executed.
8. Restart the PLC program up to the next breakpoint and check the motion sequence. Repeat until all steps are processed.
9. Set the "OpMode" variable to 30, 40 or 50. This starts the sequence of the respective operation mode.
10. For the final program implementation, sections can be copied and used from this program.

Declaration

```

PROGRAM PlcProg
VAR
  OpMode:INT:=MODE_DRV_OFF; // selection operation mode and state machine
  fbTON: TON;
  rActPosition: REAL; // actual position as real
  rActVelocity: REAL; // actual velocity as real
  boError: BOOL; // error flag from status word
  boWarning: BOOL; // warning flag from status word
END_VAR

VAR CONSTANT
  // operation modes and state machine
  MODE_DRV_OFF :INT:=10;
  ABS_POS_MODE :INT:=20; ABS_POS_MODE_1 :INT:=21; ABS_POS_MODE_2 :INT:=22;
  REL_POS_MODE :INT:=30; REL_POS_MODE_1 :INT:=31; REL_POS_MODE_2 :INT:=32;
  ADD_POS_MODE :INT:=40; ADD_POS_MODE_1 :INT:=41; ADD_POS_MODE_2 :INT:=42;
  VEL_MODE :INT:=50; VEL_MODE_1 :INT:=51;
  MODE_DRV_AH :INT:=60;
  // control word S-0-0134
  CTRL_WORD_OFF:WORD :=16#0000;
  CTRL_WORD_AH:WORD :=16#C000;
  CTRL_AF_PRIMARY_OP_MODE:WORD :=16#E000;
  CTRL_AF_SECONDARY_OP_MODE:WORD:=16#E100;
  // status word S-0-0135
  MASK_STATUS_AF_OP_MODE:WORD :=16#C700;
  STATUS_AF_PRIMARY_OP_MODE:WORD :=16#C000;
  STATUS_AF_SECONDARY_OP_MODE:WORD:=16#C100;
  // Weighting
  WEIGHTING_FACTOR_POS: DINT:=10000; // S-0-0078 = -4

```

Axes

```
WEIGHTING_FACTOR_VEL: DINT:=10000; // S-0-0046 = -4
END_VAR
```

Implementation

```
CASE OpMode OF
  MODE_DRV_OFF:
    // Ab, switched OFF
    wDriveX_ControlWord := CTRL_WORD_OFF; // all OFF...

  ABS_POS_MODE:
    // start absolute positioning to 42°
    boDriveX_PosRelNotAbs:=FALSE; // S-0-0346.3 0=absolute Pos, 1=relative Pos
    //boDriveX_PosRelNotAdd; // S-0-0346.4 0=additive (last target), 1=rel. (actual pos.)
    udiDriveX_PositionVelocity:=DINT TO UDINT(4*WEIGHTING_FACTOR_VEL); // 4 rpm * 10000
    diDriveX_PositionCmdValue:=42*WEIGHTING_FACTOR_POS; // 42 degree * 10000
    wDriveX_ControlWord := CTRL_AF_PRIMARY_OP_MODE; // AF and primary operation mode
    boDriveX_PosToggel := NOT boDriveX_PosToggel; // start positioning
    OpMode:=ABS_POS_MODE_1;

  ABS_POS_MODE_1:
    // check acknowledge power AND homed
    IF (wDriveX_StatusWord AND MASK_STATUS_AF_OP_MODE) = STATUS_AF_PRIMARY_OP_MODE
    AND boDriveX_Homed = TRUE
    THEN
      IF boDriveX_InPosition = FALSE THEN // in position can be set from last command
        OpMode:=ABS_POS_MODE_2; // next
      END_IF
    END_IF

  ABS_POS_MODE_2:
    // check in position
    IF boDriveX_InPosition THEN
      // here we should be at 42°
      OpMode := REL_POS_MODE; // set breakpoint here to check
    END_IF

  REL_POS_MODE:
    // start relative positioning 142° clockwise
    boDriveX_PosRelNotAbs:=TRUE; // S-0-0346.3 0=absolute Pos, 1=relative Pos
    boDriveX_PosRelNotAdd:=TRUE; // S-0-0346.4 0=additive (last target), 1=rel. (actual pos.)
    udiDriveX_PositionVelocity:=DINT TO UDINT(2*WEIGHTING_FACTOR_POS); // 2 rpm
    diDriveX_PositionCmdValue:=142*WEIGHTING_FACTOR_VEL; // 142 degree * 10000
    wDriveX_ControlWord := CTRL_AF_PRIMARY_OP_MODE; // AF and primary operation mode
    boDriveX_PosToggel := NOT boDriveX_PosToggel; // start positioning
    OpMode:=REL_POS_MODE_1;

  REL_POS_MODE_1:
    // check acknowledge power
    IF (wDriveX_StatusWord AND MASK_STATUS_AF_OP_MODE) = STATUS_AF_PRIMARY_OP_MODE THEN
      IF boDriveX_InPosition = FALSE THEN // in position can be set from last command
        OpMode:=REL_POS_MODE_2; // next
      END_IF
    END_IF

  REL_POS_MODE_2:
    // check in position
    IF boDriveX_InPosition THEN
      // here we should be at 42°+142°=184°
      OpMode := ADD_POS_MODE; // set breakpoint here to check
    END_IF

  ADD_POS_MODE:
    // start additive positioning 42° counterclockwise
    boDriveX_PosRelNotAbs:=TRUE; // S-0-0346.3 0=absolute Pos, 1=relative Pos
    boDriveX_PosRelNotAdd:=FALSE; // S-0-0346.4 0=additive (last target), 1=rel. (actual pos.)
    udiDriveX_PositionVelocity:=DINT TO UDINT(3*WEIGHTING_FACTOR_VEL); // 3 rpm
    diDriveX_PositionCmdValue:=-42*WEIGHTING_FACTOR_POS; // -42 degree * 10000
    wDriveX_ControlWord := CTRL_AF_PRIMARY_OP_MODE; // AF and primary operation mode
    boDriveX_PosToggel := NOT boDriveX_PosToggel; // start positioning
    OpMode:=ADD_POS_MODE_1;

  ADD_POS_MODE_1:
    // check acknowledge power
    IF (wDriveX_StatusWord AND MASK_STATUS_AF_OP_MODE) = STATUS_AF_PRIMARY_OP_MODE THEN
      IF boDriveX_InPosition = FALSE THEN // in position can be set from last command
        OpMode:=ADD_POS_MODE_2; // next
      END_IF
    END_IF
```

```

ADD_POS_MODE_2:
    // check in position
    IF boDriveX_InPosition THEN
        // here we should be at 42°+142°-42°=142°
        OpMode := VEL_MODE; // set breakpoint here to check
    END_IF

VEL_MODE:
    // start velocity control with 42 rpm
    diDriveX_VelocityCmdValue:=42*WEIGHTING_FACTOR_VEL; // 42 rpm * 10000
    wDriveX_ControlWord := CTRL_AF_SECONDARY_OP_MODE; // AF and secondary operation mode 1
    OpMode := VEL_MODE_1;

VEL_MODE_1:
    // check acknowledge power
    IF (wDriveX_StatusWord AND MASK_STATUS_AF_OP_MODE) = STATUS_AF_SECONDARY_OP_MODE THEN
        fbTON(IN := TRUE, PT:= T#5S);
        // 5 seconds in velocity control
        IF boDriveX_InVelocity AND fbTON.Q=TRUE THEN
            // here we should rotate with 42rpm
            OpMode := MODE_DRV_AH; // set breakpoint here to check
            fbTON(IN := FALSE);
        END_IF
    END_IF

MODE_DRV_AH:
    // stop the drive untill StandStill is reached
    wDriveX_ControlWord := CTRL_WORD_AH; // AH
    IF boDriveX_StandStill THEN
        OpMode := MODE_DRV_OFF; // set breakpoint here to check
    END_IF

END_CASE

//actual values
rActPosition := DINT_TO_REAL(diDriveX_ActualPosition)/DINT_TO_REAL(WEIGHTING_FACTOR_POS);
rActVelocity := DINT_TO_REAL(diDriveX_ActualVelocity)/DINT_TO_REAL(WEIGHTING_FACTOR_VEL);

boError:= wDriveX_StatusWord.13;
boWarning:=wDriveX_StatusWord.12;
// dwDriveX_DiagnosisNumber; // diagnosis number
// Clear error: write S-0-0099 to b0011 with IL_SIIISvcWrite()

```

6.9.3 Drive as PLC device – More field buses

Free programming	Drives can be freely programmed at all other available field bus master connections as described for Sercos III drives. In contrast to Sercos III, not the parameters S-0-0134/S-0-0135 are configured as control/status word for the IndraDrive, but the parameters P-0-4077/P-0-4078 field bus: control/status word. Thus, some bits are already configured in the control/status word as described in chapter "Sercos II drive as PLC device – Parameterization" on page 502 for Sercos in the signal control/signal status word.
RMB_PLCOpenFieldBus	Instead of programming freely, the RMB_PLCOpenFieldbus.library can be used to program with the function blocks according to the PLCopen.
RMB_PLCOpenEtherCAT_SoE	Instead of programming freely, useRMB_PLCOpenFieldbus.library to program with the function blocks according to the PLCopen or via EtherCAT.

6.10 PowerSupply as PLC device

6.10.1 General information

Power supply devices with a separate master communication (e.g. for IndraDrive C an HMV05, for IndraDrive Mi a KMV03) are available for the drive firmware MPx19 and higher.

An "intelligent" power supply is provided with a bus address and a parameter block to set functionalities (e.g. device control word and device status word).

For more information on the device, refer to the Functional Description "Parameter Description for Power Supplies" of the drive documentation.

Such power supply units are supported as PLC device by IndraLogic XLC/IndraMotion MLC.

As for "Drive as PLC device", no A-parameters are available for this device. Control and commanding is executed via PLC ([chapter 6.9 "Drive as PLC device" on page 500](#)).

The supply unit is created in the IndraWorks project by dragging the device from the library window ("Periphery" folder, folder for the respective field bus) to the "Field Bus" node.

The individual supply unit for Sercos is located in the library of the Sercos peripherals library.

6.10.2 Power supply as PLC device – Parameterization

A dialog-supported parameterization of the power supply is performed via IndraWorks Ds.

(A parameterization using individual parameters is possible via the IndraLogic XLC/IndraMotion MLC system).



Right-click on the Sercos device and on the "IndraWorks Ds here..." item to open the parameterization tool for Bosch Rexroth devices.

In contrast to "IndraWorks Ds here...", it can be communicated directly between PC and supply unit. The PC can be connected at a free Sercos port or communicate via a "Sercos III NetSwitch" (ordering no.: R911328254 HAWA HGS NS-S3-1NRT). The Windows command "route" can also route the IP communication via the control.

The IP addresses are preset by the control. The presetting depends on the control address C-0-0031 and the Sercos address if the Sercos device is provided with the corresponding parameters (class SCP_NRT or SCP_NRTPC in S-0-1000).

- Default address of the Sercos device if C-0-0031=0: 172.31.254.<SercosAddress>. Otherwise, 172.31.<C-0-0031>.<SercosAddress>
- Default address of the control via a Sercos port if C-0-0031=0: 172.31.254.254. Otherwise, 172.31.<C-0-0031>.254

The cyclically applied parameters are configured at Sercos and - in contrast to other field buses - below the "Sercos" node in IndraWorks.

Set "Voltage control" as primary operation mode for the supply unit. This is also the default value.

Parameterizing the power supply

When using "IndraWorks Ds here..." (right-click on the Sercos device), the steps 1 and 2 are omitted.

1. PC with second network card or USB <-> Ethernet adapter. Set IP address of the network card or adapter to the power supply range 172.31.x.x.
2. Start IndraWorks Ds. Select connection -> IP address search. Enter IP address of the drive and search. Connect to device.
3. Check operation modes (primary operation mode) in IndraWorks Ds:

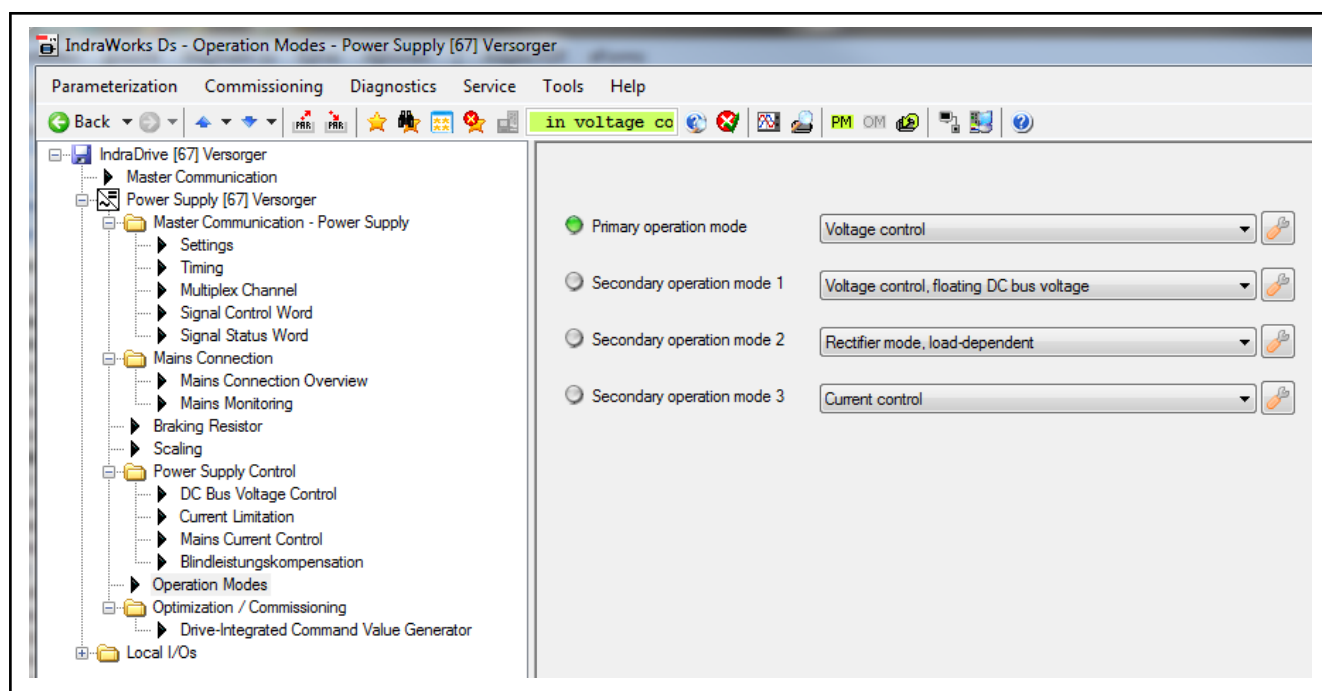
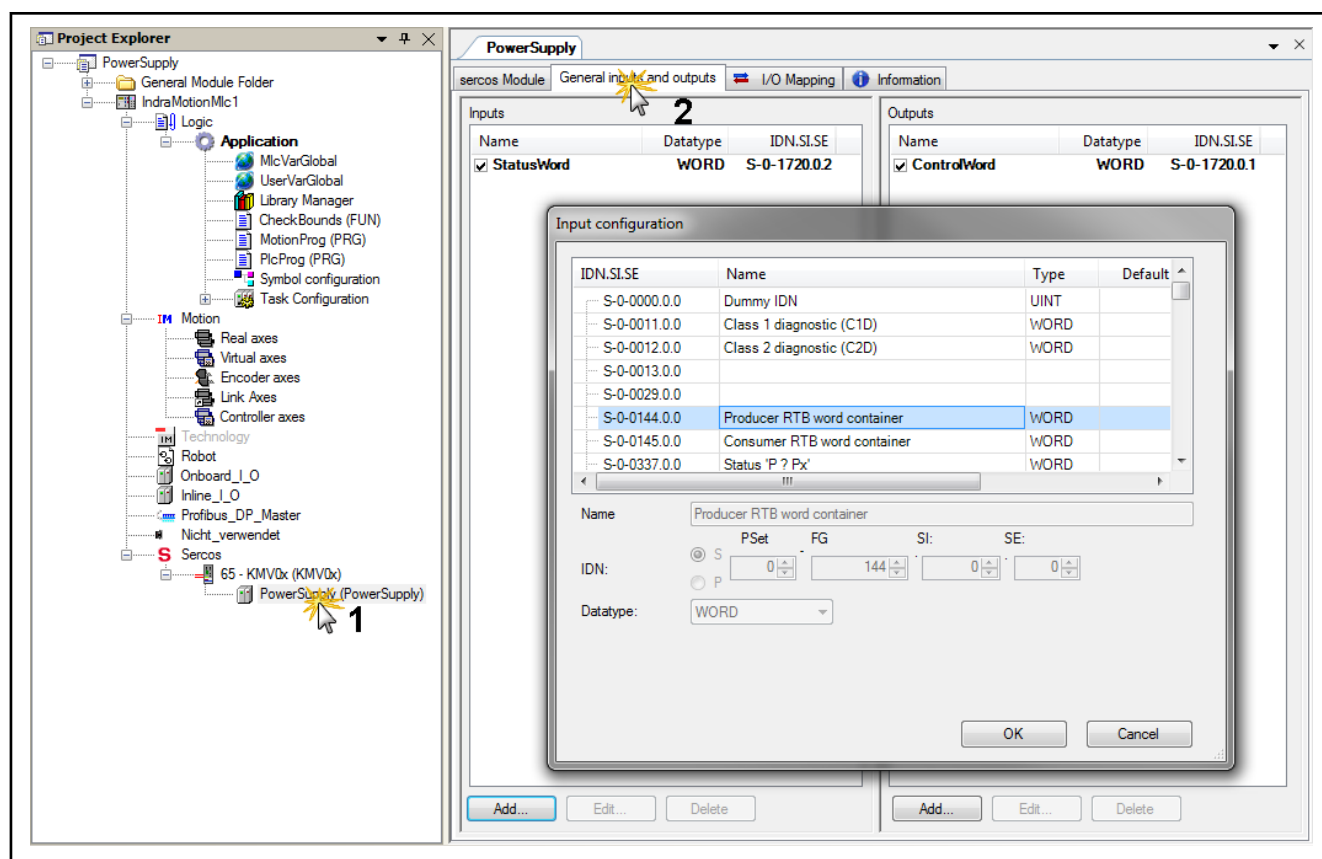


Fig. 6-123: Dialog: IndraWorks Ds, operation modes

- If required, perform another parameterization of the power supply in IndraWorks.

6.10.3 Power supply as PLC device – Configuring cyclic data

Cyclically applied data is configured in IndraWorks below the "Sercos" node in the dialog "General inputs and outputs".



- 1 Double-click on the "PowerSupply" node below the Sercos device
- 2 Select the general inputs and outputs

Fig. 6-124: Example configuration of cyclic parameters in the drive diagram AT (inputs) and master data telegram MDT (outputs)

This is the minimum configuration with the status word S-0-1720.0.2 "Power supply status word" as PLC input (data type: WORD) as well as the control word S-0-1720.0.1 "Power supply control " as PLC output (data type: WORD). These parameters are required to command the supply unit to retrieve the status.



If the device description file contains the required information (e.g. which parameters can be configured cyclically, name and attribute of the parameters), the configurator provides a drop-down list and suggests the required settings. If this information is not available, no drop-down list is provided and the user has to make the settings.

The entered name is subsequently output in the "Channel" column in [fig. 6-125 "Assigning PLC variables to the configured parameters" on page 515](#).

Select the correct data type with the suitable length and without or with sign depending on the attribute.

Data length in the attribute	Format in the attribute	Data type in the PLC
2 bytes	BIN or HEX	WORD
4 bytes	BIN or HEX	DWORD

Data length in the attribute	Format in the attribute	Data type in the PLC
2 bytes	DEC_MV	INT
4 bytes	DEC_MV	DINT
2 bytes	DEC_OV	UINT
4 bytes	DEC_OV	UDINT

Tab. 6-22: Assignment: Parameter attribute <-> Data type in the PLC

The parameters are assigned to the PLC variables in the "I/O Mapping" tab. New variables can be created or the input and output parameters can be mapped on existing PLC variables.

Variables are created in the following:

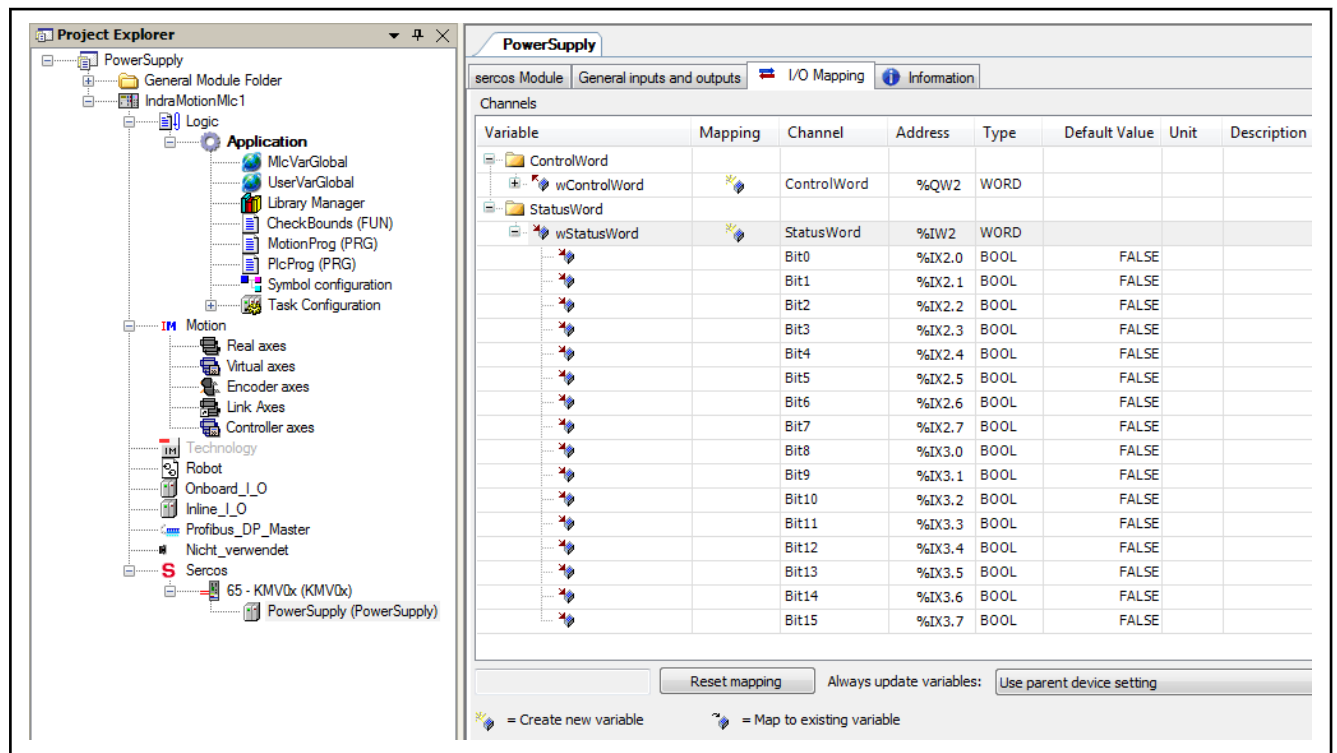


Fig. 6-125: Assigning PLC variables to the configured parameters

Configuring cyclic data

1. Double-click on the node of the power supply in the IndraWorks project. Select the driver inputs and outputs.
2. Parameter S-0-1720.0.2 "Power supply status word" has to be configured.

Check for attribute in the help of S-0-1720.0.2:

- Length of 2 bytes
- Format: BIN
- Select "Add" at the inputs

If there is no drop-down list, fill out the fields as follows:

- Field name: "StatusWord"
- Field FG: "1720.0.2"
- Data type: Select "WORD"

3. Parameter S-0-1720.0.1 "Power supply control word" has to be configured.

Check for attribute in the help of S-0-1720.0.1:

- Length of 2 bytes
- Format: BIN
- Select "Add" at the inputs

If there is no drop-down list, fill out the fields as follows:

- Field name: "ControlWord"
- Field FG: "1720.0.1"
- Data type: Select "WORD"

4. Enter more parameters until all parameters are configured as shown in [fig. 6-125 "Assigning PLC variables to the configured parameters" on page 515](#).
5. Go to the "I/O mapping" tab and enter the PLC variables into the "Variable" column as shown in [fig. 6-124 "Example configuration of cyclic parameters in the drive diagram AT \(inputs\) and master data telegram MDT \(outputs\)" on page 514](#).
6. Load PLC program. Switching to "P4" should be possible via IndraWorks now.

6.10.4 Power supply as PLC device – PLC programming

The configured PLC variables of the cyclically configured parameters for control and status word can now be used in the PLC program.

For the bit assignment of the power supply parameters

- S-0-1720.0.1 "Power supply control word"
- S-0-1720.0.2 "Power supply status word"

refer to the "Parameter Description" of the drive.

The power supply can be commanded in any cyclic task. (e.g. PlcTask and PlcProg).

Program example

Switching on and off power can be seen in the following:

- **1st state: Activate main contactor**
Set control word, bit 12 (16#1000)
Query status word, bits 4, 5 and 7 (16#00B0); Continue switching state
- **2nd state: Activate switch connector (load DC voltage)**
Set control word, bits 12 and 14 (16#5000)
Query status word, bits 4, 5, 6 and 7 (16#40F0); switch state
- **3rd state: Enable operation mode -> constant intermediate circuit voltage**
Set control word, bits 12, 14 and 15. Bits 8 and 9 are not set for primary mode selection (16#D000)
Status word, bits 4, 5, 6, 7, 14 and 15 (16#C0F0)
Connected axes can be commanded
- **4th state: Switch off power**
Control word deletes all bits (16#0000)

PLC programming

1. Open the "PlcProg" program in the IndraWorks project.
2. Copy the first program code "Declaration" below the declaration part.
3. Copy the second program code "Implementation" below the implementation part. Do not copy page break or delete it subsequently.
4. Compiling, loading and starting the PLC program
5. Set power request "bSetPower".
6. Check whether power was added (status word, bits 4, 5, 6, 7, 14 and 15).
7. For the final program implementation, sections from this program can be copied and used.

Declaration

```

PROGRAM PlcProg
VAR
    iStatePowerSupply: INT;          (* state for power supply *)
    bSetPower: BOOL;                 (* set power *)
END_VAR

VAR CONSTANT
    STATE_ENABLE_MAINS_CONTACTOR : INT := 1;      (* state enable mains contactor *)
    STATE_ENABLE_POWER_SUPPLY     : INT := 2;      (* state enable power supply, load dc voltage *)
    STATE_ACTIVATE_POWER_SUPPLY   : INT := 3;      (* state activate power supply *)
    STATE_POWER_OFF               : INT := 4;      (* state power off *)
END_VAR

(* S-0-1720.0.1 Power supply control *)
(* Bit 15: power supply activation *)
(* Bit 14: power supply enable *)
(* Bit 13: reserved *)
(* Bit 12: mains contactor *)
(* Bit 11: reserved *)
(* Bit 10: DC discharging *)
(* Bit 09: selection of OpMode *)
(* Bit 08: selection of OpMode *)
(* Bit 07: reserved *)
(* Bit 06: reserved *)
(* Bit 05: reserved *)
(* Bit 04: reserved *)
(* Bit 03: reserved *)
(* Bit 02: reserved *)
(* Bit 01: reserved *)

(* S-0-01720.0.2 Power supply status *)
(* Bit 15: voltage boost ON/OFF *)
(* Bit 14: DC bus okay *)
(* Bit 13: error *)
(* Bit 12: warning *)
(* Bit 11: brake resistor *)
(* Bit 10: DC discharging *)
(* Bit 09: selection of OpMode *)
(* Bit 08: selection of OpMode *)
(* Bit 07: feedback signal of mains contactor *)
(* Bit 06: mains barrage *)
(* Bit 05: hardware enable *)
(* Bit 04: mains status *)
(* Bit 03: reserved *)
(* Bit 02: reserved *)
(* Bit 01: reserved *)

```

Implementation

```

(* set power request and check status *)
IF bSetPower AND wStatusWord = 16#00A0 OR wStatusWord = 16#0020 THEN
    iStatePowerSupply := STATE_ENABLE_MAINS_CONTACTOR;
ELSIF bSetPower AND wStatusWord = 16#00B0 THEN
    iStatePowerSupply := STATE_ENABLE_POWER_SUPPLY;
ELSIF bSetPower AND wStatusWord = 16#40F0 THEN
    iStatePowerSupply := STATE_ACTIVATE_POWER_SUPPLY;
ELSIF bSetPower AND wStatusWord = 16#C0F0 THEN
    iStatePowerSupply := STATE_POWER_OFF;
END_IF

(* state machine for power supply *)
CASE iStatePowerSupply OF

    STATE_ENABLE_MAINS_CONTACTOR: (* enable mains contactor *)

        wControlWord := 16#1000;    (* set bit 12 *)

        IF wStatusWord = 16#00B0 THEN (* check bit 4, 5, 7 *)
            iStatePowerSupply := STATE_ENABLE_POWER_SUPPLY;
        ELSE
            iStatePowerSupply := STATE_ENABLE_MAINS_CONTACTOR;
        END_IF

    STATE_ENABLE_POWER_SUPPLY: (* enable power supply, load DC voltage *)

        wControlWord := 16#5000;    (* set bit 12, 14 *)

```

Axes

```
IF wStatusWord = 16#40F0 THEN      (* check bit 4, 5, 6, 7 *)
  iStatePowerSupply := STATE_ACTIVATE_POWER_SUPPLY;
ELSE
  iStatePowerSupply := STATE_ENABLE_POWER_SUPPLY;
END_IF

STATE_ACTIVATE_POWER_SUPPLY: (* enable poser supply, operation mode constant DC voltage *)

  wControlWord := 16#D000;      (* set bit 12, 14, 15 *)

  IF wStatusWord = 16#C0F0 THEN  (* check bit 4, 5, 6, 7, 14, 15 *)
    iStatePowerSupply := STATE_POWER_OFF;
  ELSE
    iStatePowerSupply := STATE_ACTIVATE_POWER_SUPPLY;
  END_IF

STATE_POWER_OFF: (* power off *)

  IF NOT bSetPower THEN
    wControlWord := 16#0000;    (* reset bits *)
  END_IF

  IF NOT wStatusword = 16#0040 THEN      (* check bit 6 *)
    iStatePowerSupply := STATE_POWER_OFF;
  END_IF

END_CASE
```

7 Motion functionality

7.1 General information

This chapter describes the various axis modes. First, the single-axis modes, such as the positioning and velocity control, are described. Subsequently, synchronous modes, such as velocity and synchronous axis motions and cams and complex MotionProfiles are described. In the following, the functionality of the programmable limit switch and the touch probe are described.

For a more detailed introduction into the programming of axis motions, refer to the manuals "IndraLogic XLC IndraMotion MLC 14VRS PLCopen Libraries" and "IndraLogic XLC IndraMotion MLC 14VRS Generic Application Template" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

7.2 Cycle times

To support the task management (see also [chapter 5.4 "Task system " on page 329](#)), this dialog displays the settings of the Motion cycle time and the Sercos cycle time for the Motion calculation sensitivity and for the current load values of the Motion.

This dialog is available as soon as the control is switched to online mode. The settings can be changed in the parameterization mode (P2).

	Minimum	Current	Maximum	
Current Motion cycle time		2000		µs
Time for actual value recording	10	26	153	µs
Interruption caused by motion-synchronous PLC task	0	0	61	µs
Time for command value generation	3	15	81	µs
Total time	14	42	173	µs

Fig. 7-1: "Cycle times" dialog

The Motion cycle time and the Sercos cycle time can be set in "Cycle time settings". The Motion cycle time describes the intervals after which the Motion control provides new command values for the connected periphery. The Sercos cycle time indicates after which intervals new data is available in the Sercos ring. The Sercos cycle time is only active in the operating mode (BB).

The Motion cycle time has to be equal to or a multiple of the Sercos cycle time. The Motion cycle time as well as the Sercos cycle time are initially set to 2,000 µs.

The sensitivity of the Motion watchdog is set in "Sensitivity of the Motion calculation". The sensitivity describes the number of successive cycles accepting a timeout. Additionally, the absolute number of Motion errors and the number of successive Motion errors are displayed. Both the counters can be reset to "0" via the **Reset error counter** button.

The actual value of the Motion cycle time and the current values as well as the minima and maxima of the Motion times are displayed in the "Motion time display". The actual value of the Motion cycle time can deviate from the set command value if it is smaller than one millisecond. In this case, the set value becomes only active in the operating mode (**BB**). The Motion time is divided into the actual value acquisition, the interruption by Motion-synchronous PLC tasks, the command value generation and the total time. The total time consists of the other three Motion times. The minimum and maximum Motion times can be reset to "0" via the **Reset minimum/maximum** button.



If many axes are used, corresponding error messages (cycle timeout) can occur when switching from the "parameterization mode" (**P2**) to the "operating mode" (**BB**). The reason is that the Motion calculation is not able to provide that high number of axes in such a short time with command values via the Sercos ring. In this case, the cycle time has to be increased gradually (2 ms, 4 ms, 8 ms... 40 ms).

Another reason for the increase of this value can be watchdog errors of the PLC, i.e. the PLC cannot process the time-controlled tasks in the available period of time. These watchdog errors can be activated separately for each task.

The following cycle time are set by default and can be changed:

L45	L65	L75	VPB	XM21	XM22	XM42
4 ms	2 ms	2 ms	2 ms	4 ms	2 ms	2 ms

Parameters involved

- C-0-0400, Motion, cycle time, command value
- C-0-0503, sercos master, cycle time
- C-0-0410, Motion, cycle time (Tcyc), actual value
- C-0-0412, List of current time slot measurements
- C-0-0413, List of maximum time slot measurements
- C-0-0414, List of minimum time slot measurements
- C-0-0420, Motion, watchdog sensitivity
- C-0-0421, Motion, absolute error counter
- C-0-0422, Motion, number of successive errors
- C-0-1050, Command: Reset parameter C-0-0413 and C-0-0414

7.3 Parameters

The control and the drives communicate - with very few exceptions - using parameters.

The parameters perform the following tasks:

- Determining the configuration
- Parameterizing the control loop
- Triggering and controlling drive functions and commands
- Applying command and actual values (demand-controlled, cyclic or acyclic)

Parameters can be read and transferred if necessary. If it can be written on parameters by the user depends on the properties of the parameter and the communication phase. Certain parameter values (operating data) are checked for validity by the control.

The following tools are used to retrieve, modify and save parameters into a file or to load the file and write the parameters:

- [chapter "Parameter editor" on page 222](#)
- [chapter "Parameter group" on page 224](#)
- [chapter "Parameters - Export" on page 231](#)
- [chapter "Parameters - Import" on page 232](#)

Parameters can only be accessed in the following modes:

- Online mode - Access to the real parameters of the control, axes or drives
- Offline parameterization mode - Access to the parameters of the emulated control, axes or drives

7.4 Parameter overview

This dialog displays a list of all or of the parameters of the controls, axes and kinematics to be restored and allows to change the parameter values. The parameters in the device (online) as well as the parameters in the project (offline) can be seen and modified.

Call Context menu of the device (control, axis or kinematics) → **Parameters** ► **Parameter overview**.

"Parameter overview" dialog Use this dialog to display and change all parameters of a device.

IDN	Name	Value	Unit
A-0-0002	Achsbezeichnung	vAxis1	--
► A-0-0013	IDN-Liste der A-Prüfsummenparameter		--
A-0-0016	Projektidentifikationsnummer	cd390c94b76f4095933af630ef6ad7a	--
A-0-0028	Fahrbereichsgrenzscharter	0b0000.0000.0000.0000	--
A-0-0029	Positionspolaritäten	0b0000.0000.0000.0000	--
A-0-0030	Positionsgrenzwert, positiv	36000	Grad
A-0-0031	Positionsgrenzwert, negativ	-36000	Grad
A-0-0032	Geschwindigkeitsgrenzwert, positiv	1000	U/min
A-0-0033	Geschwindigkeitsgrenzwert, negativ	-1000	U/min
A-0-0034	Beschleunigungsgrenzwert, bipolar	1000	rad/s²
A-0-0035	Geschwindigkeitsgrenzwert, bipolar	1000	U/min
A-0-0036	Ruckgrenzwert, bipolar	0	rad/s³
A-0-0045	Modulowert	360	Grad
A-0-0046	Vorschubweg des Folgeantriebs	10	mm/U

144 lines

Fig. 7-2: "Parameter overview" dialog

Description Either all parameters or the parameters required for the restoration are displayed in the dialog. The parameter set is selected in the upper left section of the dialog.

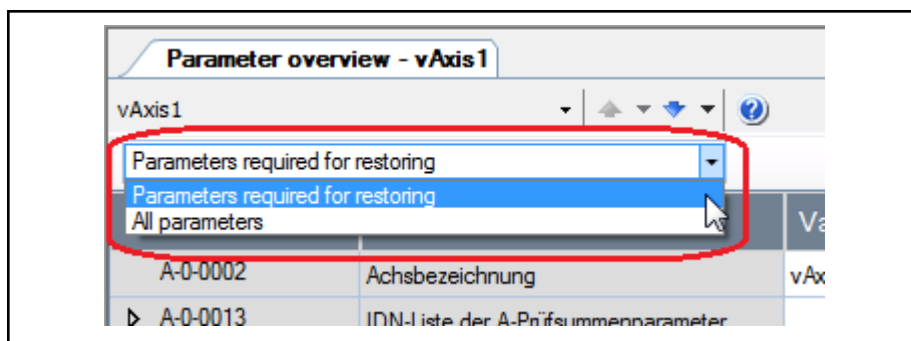


Fig. 7-3: "Parameter overview" dialog - Parameter set selection

The main window of the dialog displays all parameters of the selected parameter set.

The parameter values can be changed in the "Value" column. If a value cannot be written due to write protection for example, a corresponding error message is displayed when writing.

All values of a list parameter are displayed in a line separated by a space. To display the individual elements and their indices, collapse and expand the list using the arrow on the left of the parameter name (refer to the parameter A-0-0200 in the following figure).

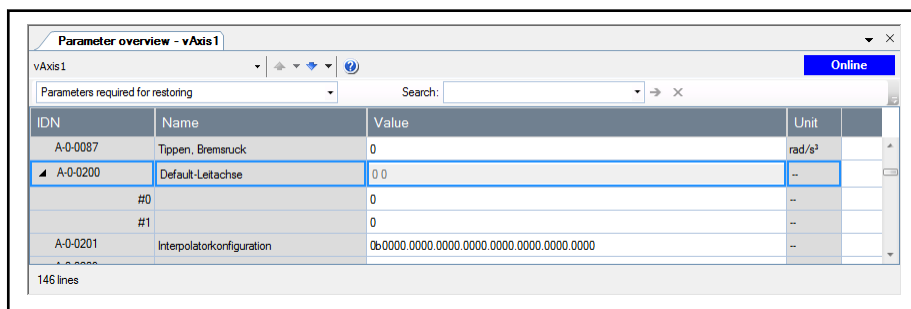


Fig. 7-4: "Parameter overview" dialog - List parameter display

The parameter overview also allows to search for parameters. Enter the term into the "Search" text field. Click on the arrow or press <Enter> to start searching from the currently selected line in the list to the bottom. The values in the columns IDN, Name and Value are considered. If the searched term is found, the respective line is highlighted. To continue searching from the last position found, click again on the arrow or press <F3>. If the search reached the end of the list, it is automatically jumped back to the beginning and the search continues.

If the term could not be found, the search field is highlighted in color and a corresponding tooltip is displayed.

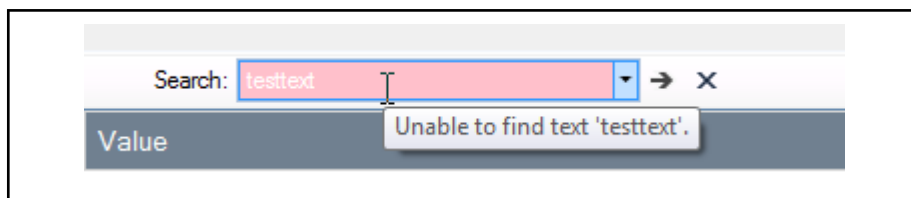


Fig. 7-5: "Parameter overview" dialog - No search result

7.5 Parameterization level

Irrespective of the control and communication phase, devices can be configured via the parameterization level. Thus, axes can be moved further, the

I/Os can continue to exchange cyclic data and the PLC program keeps running. Thus, these devices support two modes:

- **Parameterization mode**

In the parameterization mode, all device parameters - that are not write-protected - can be changed. This does not apply to communication parameters such as configuration, timing or user-defined data containers. If a device is in the parameterization mode, it remains irrespective of the communication phase

- **Operating mode**

Only parameters without write protection in this mode can be changed in the operating mode. The parameter crosscheck is performed when switching from parameterization to operating mode. The adjustment of A- to S-/P-parameter is also executed

Supporting the parameterization level

For information on whether a device supports the parameterization level, refer to the parameter A-0-0004 "Axis type".

Switching the modes

It is switched between the two modes for one device via the parameter A-0-0024 "Axis state". To switch multiple devices, use the parameter C-0-1070 "Command: Switch PM/OM". To switch an axis, the corresponding axis has to be in the "Standstill" state. Furthermore, the real axis has to be in the "Power off" state. An axis in the parameterization mode cannot be traversed.

7.6 Modes for project editing

7.6.1 Introduction

Offline mode

In offline mode, all data saved on your PC can be entered into the project. That is data not requiring any data exchange with a control or drive. Firmware is also only downloaded to the control in offline mode.

If a project is opened or a new one is created, IndraWorks is automatically in offline mode.

The IndraWorks dialogs and behavior are as in online mode. A parameter export or import is also possible at any time. Not all dialogs are available in offline mode and only the parameters required to project a device can be exported in offline mode. Command values are for example included, but no actual values.

In offline mode, the offline values from the project are displayed in the dialogs. This is labeled in the dialogs in the upper right with "Offline".

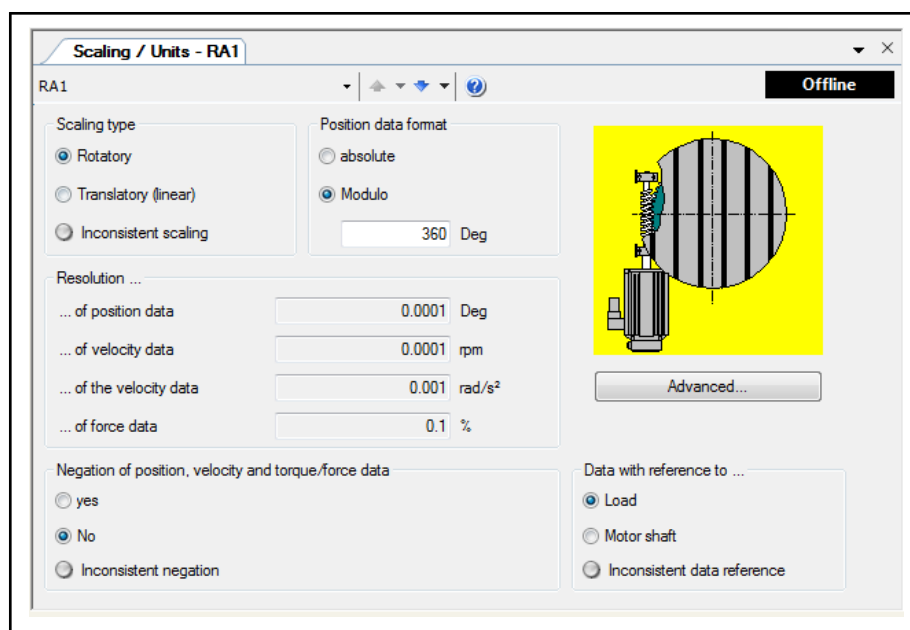


Fig. 7-6: Dialog with offline values

Exception: If a dialog in offline mode displays values from the device, such as the "Diagnostic/error memory" dialog, this is displayed in the dialog in the upper right with "Online".

Parameters changed in offline mode are saved with the project and can be compared to the parameters of the control or the drives in online mode via the context menu item **Parameter Adjustment** (also refer to [chapter "Parameter adjustment" on page 226](#)).

Online mode

Data requiring a communication between the programming device and the control or drive can be changed in online mode. This data is stored - at least partially - in the control or drive or is retrieved from them and is thus only available if a communication is established. No devices can be created or deleted in online mode. An axis can only be created or deleted in offline mode.

There are different options to go to the online mode:

1. **Switching online:** This operation establishes a communication to the control without changing the control configuration. Even at system run-time, specified control data changes can be made or the system state can be diagnosed. Switch online either via the respective button in the "Project" toolbar or via the context menu of the control.

If the projected configuration matches the configuration in the control, control data and all connected devices can be subsequently accessed. If the two configurations differ, IndraWorks indicates the difference with a warning in the message window and the text "[partially synchronized]" at the control node. In this case, only the following online functions are permitted:

- Start of the "Error/diagnostic memory" dialog
Remark: For the control version 13V02 and higher, this dialog can also be started without switching online before
- Switch the control mode and thus the Sercos bus
- Start of the parameter editor of the control. The parameter editors of the individual devices are locked. However, their parameters can be accessed via the parameter editor by specifying the logic num-

ber in the parameter name. The position limit value of the axis with the axis number 4 can for example be accessed by entering "A004:A-0-0030"

- Start of the control oscilloscope
 - Start the parameter import or export
 - Start the FTP Explorer
 - Open the communication settings of the control
 - Open the advanced settings of the control
 - Start the "Task viewer" dialog
2. **Downloading Motion configuration from PC to control:** This operation downloads the Motion configuration (e.g. projected axes and kinematics) to the control and connects subsequently to the control. The configuration download ensures that all online functions are available. If the configuration could not be completely loaded to the control (e.g. since the Sercos interface of the control is not connected and thus switching to P2 is not possible), the same restrictions as described under the point "Switching online" apply. The Motion configuration can be downloaded via the "Synchronize" context menu of the control as well as via the corresponding button in the "XLC/MLC Info" toolbar.
 3. **Uploading Motion configuration from control to PC:** This operation applies the Motion configuration from the control to the project. The previous configuration in the project is then deleted except for the control. A communication is then established to the control. The Motion configuration can be uploaded via the "Synchronize" context menu of the control as well as via the corresponding button in the "XLC/MLC Info" toolbar.

WARNING

Uploading the Motion configuration changes data in the project. Thus, when switching online, no differences are detected between the projected configuration and the control configuration. Currently, not all data can be uploaded, e.g. all icon assignments and parameters are lost for I/O devices. When logging in to the PLC application, the respective data is also lost in the control.

Only upload a Motion project from the control if there is no matching project on the PC. After uploading a Motion project from the control, check the PLC configuration before logging in to the application.

Comparing Motion configuration of PC to control: IndraWorks checks in all three cases, whether the Motion configuration in the project matches the configuration in the control. If there are configuration settings that do not match, IndraWorks only enables a subset of the available online functions. These differences can be displayed to decide for example whether to download, upload or manually adjust the project. Select the corresponding entry in the "Synchronize" context menu of the control or press the corresponding button in the "XLC/MLC Info" toolbar. The dialog is described under [chapter 7.6.3 "Comparing control and project configuration" on page 532](#).

Access to control or drive data also depends on the device state (P0/P2 parameterization mode/BB operating mode) of the Motion component and (STOP/RUN) of the PLC.

The following rules apply in **online mode**:

1. If no axes are active, the PLC can be stopped and restarted.
2. If at least one axis is active, stopping the PLC causes a forced stop of all active axes.
3. If no axes are active, the user can switch between operating and parameterization mode.
4. If axes are active, the control is in the operating mode. Switching to parameterization mode is not possible.

Many parameters of a control or drive can only be changed if a certain device state is present, e.g. only in "operating mode **BB**" or "parameterization mode **P2**" (also refer to "Parameter Attributes").

7.6.2 Transitions between modes

Mode switching

It can be switched between both modes as follows:

- To switch online/offline, use the toolbar or the context menu of the control, e.g. **Switch Online**, **Synchronize** ► **Download Motion configuration from PC to Control** or **Synchronize** ► **Upload Motion Configuration to PC** or **Switch Offline**
- Use the context menu item **Parameter Adjustment...** of the control to apply the current parameter state in the device to the control and vice versa

To switch to online mode, the following prerequisites have to be met:

- **Switching online:** The type of the projected control has to match the real control. Thus, it is not possible to switch a project online with a projected control of type IndraMotion MLC L45 to an actually connected control of the type IndraLogic XLC L45
- **Download Motion configuration, Upload Motion configuration:** In addition to the previous condition, the projected firmware version has to match the connected control. Thus, it is for example not possible to switch a project online with the projected firmware version MLC 12VRS to a connected control with the firmware MLC 14VRS

If there are deviations, the projected control has to be adjusted to the actual conditions (also refer to the "Device type" section in [chapter 3.10 "Creating a control" on page 113](#)).

Adjustment of command/actual configuration



If IndraWorks is operated with controls with a firmware lower than 14V06, adjust the command and actual configuration of the Sercos devices to load the Motion configuration to the control. For controls with the firmware version 14V06 and higher, this adjustment is not required anymore. Thus, for controls with the firmware version 14V06 and higher, this chapter is not relevant.

To adjust the command and actual configuration of the Sercos devices, use the dialog "Sercos configuration". This dialog can be opened in online and offline mode via the context menu of the Sercos node. Additionally, the dialog is displayed when downloading the Motion configuration if the Sercos configuration check found a warning or an error (refer to the following figure).

Case 1: Downloading Motion configuration from PC to control

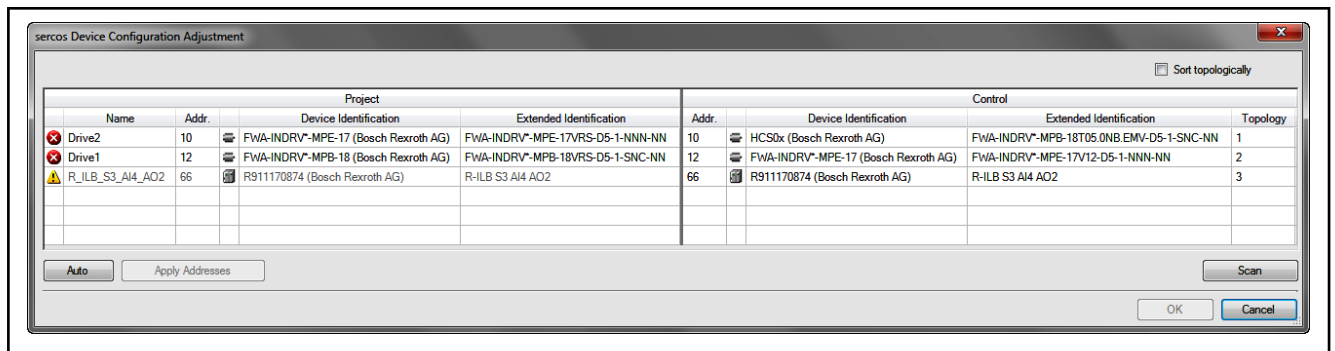


Fig. 7-7: Example of the Sercos configuration dialog when switching online

The left part of the table displays all projected devices and the right part all devices connected to the Sercos bus. The devices are assigned via the Sercos address.



To exactly identify a device in the field, let its Sercos LED flash. Therefore, go to the "Control" column and select the context menu item "Identify device visually (flashing)". As long as a device is visually identified, the device icon is highlighted in green. When closing the dialog, scanning the Sercos bus or switching the phase, the visual identification of the device is automatically switched off.

Note that not all Sercos devices support the command "Visual identification". In this case, the device does not respond to the command, even though the device is highlighted as "Visually identified" in the dialog.

To solve the conflicts in this example, proceed as follows:

1. If the Sercos bus cabling has been changed in the meantime, the found devices on the right side of the table can be updated via the **Scan** button, see [chapter "Context menu item Scan Bus Configuration" on page 197](#) and [chapter "Scanning bus configuration" on page 530](#).
2. The first column displays error and warning icons. More detailed information is provided in the tooltip on the respective icon. This information is significant for a further analysis. The icons have the following significance:
 - **No icon:** Device and configuration match. There are neither warnings nor errors
 - **Yellow warning icon:** There are discrepancies in the configuration (e.g. an I/O device is disabled, but connected to the control), but the Motion configuration could still be downloaded. However, it can be possible that the Sercos bus cannot be switched to the operating mode later on
 - **Red error icon:** The difference between the projected and the connected Sercos device is so big that the Motion configuration cannot be downloaded, as the firmware version of a drive does not match for example. Adjust the configuration to download the Motion configuration

The columns "Device identification" or "Extended identification" contain information from the electronic type plate or the device firmware. To compare the projected and the connected device, only the content of the "Device identification" column for PLC devices and only the content of the "Extended identification" column for drives are compared.

The device activation is shown by a grey font color. I/O devices are enabled and disabled via a context menu in the "Project" column, drive axes via a context menu in the "Control" column.

In this case, the I/O device is disabled in the project, but connected to the control. In addition, the firmware of the projected drives does not match the actually configured drives. It seems to be the case that the Sercos addresses of the drives were exchanged in the assignment.

3. Click on **Auto**. IndraWorks tries to adapt the activation of the projected devices to the actually found devices to match them the best possible (see fig. 7-8 "Sercos device Configuration" dialog after pressing **Auto** on page 528).

I/O devices are differently activated than drive axes. The activation of an I/O device is saved in the project and set according to the existence of the actually connected I/O device. For drive axes, the activation is saved in the control. Saving in the control is only possible if the drive axis is already configured in the control. In this case, press the **Auto** button causes to adjust the activation in the control and thus, the project remains unchanged.

In this case, press **Auto** to adjust the activation of the I/O device in the project.

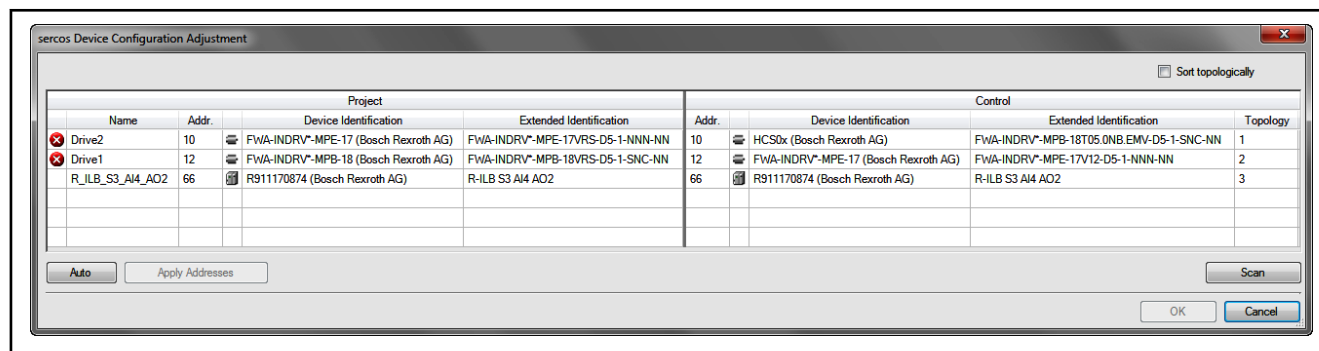


Fig. 7-8: "Sercos device Configuration" dialog after pressing **Auto**

4. The problem of the non-matching firmware of both the drives was not solved by pressing the **Auto** button. Obviously, the Sercos addresses of both drives are exchanged. This cannot be solved by changing the activation. There are different approaches to solve this problem:
 - Adapt the Sercos addresses in the project to the connected drive axes by changing the Sercos addresses in the "Project" column. Then, press the **Apply addresses** button. In the period between changing and pressing the button, the changed fields are highlighted in dark grey
 - The Sercos addresses of the connected drive axes can be changed directly at the display of the drives. Then, press the **Scan** button. This is generally not possible for I/O devices, as I/O devices are normally not provided with a display
 - Adapt the Sercos addresses of the connected drive axes to the axes in the project by changing the Sercos addresses in the "Control" column. Then, press the **Apply addresses** button. In the period between changing and pressing the button, the changed fields are highlighted in dark grey. This method can also be used to assign a new Sercos address to I/O devices

In this example, the problem is solved as described in the latest option. Thus, the Sercos addresses of the connected drives are adapted to the specifications in the project.

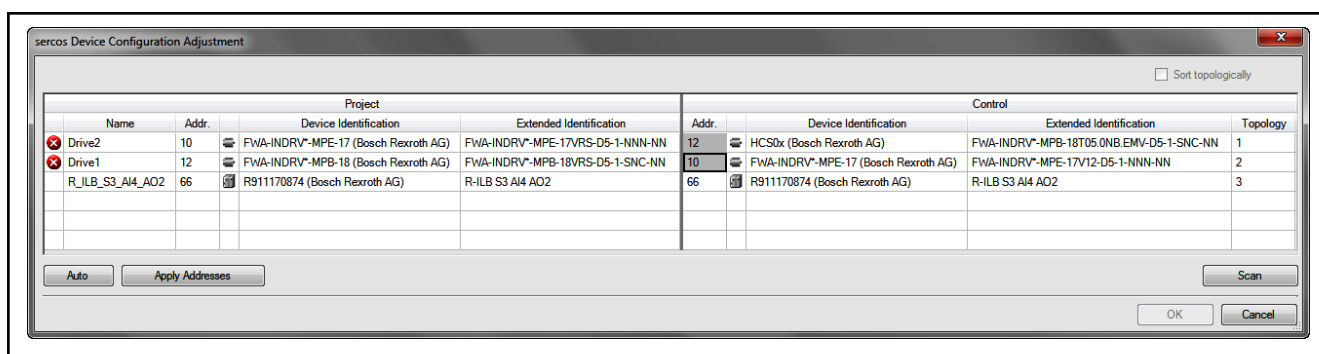


Fig. 7-9: "Sercos device configuration" dialog after shifting the devices (drives)

- Press **Apply Addresses** and the conflicts are recovered and the **OK** button is enabled. Press this button to close the dialog and to continue the Motion configuration download. The button is only available if the Sercos configuration is correct.

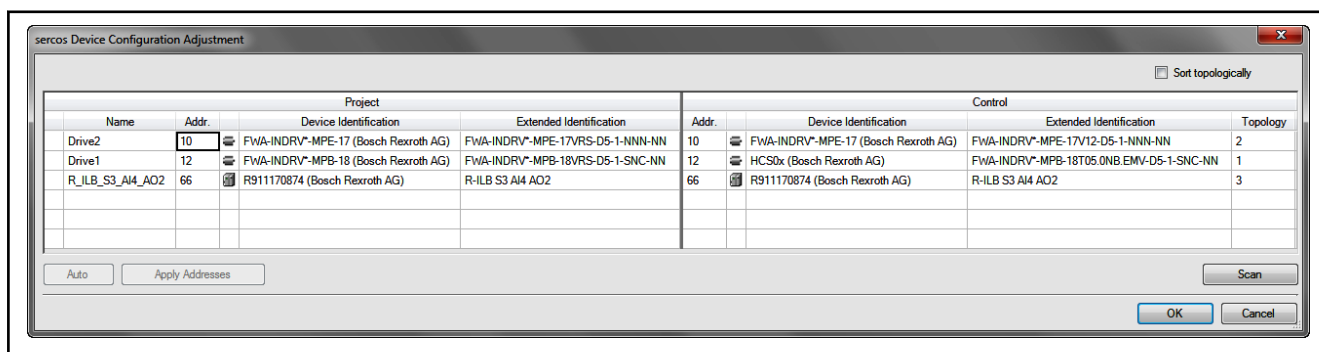


Fig. 7-10: Correct Sercos device configuration

Case 2: Online mode

In this case, the command configuration can no longer be changed. Addresses of connected devices and the activation of drive axes are still possible.

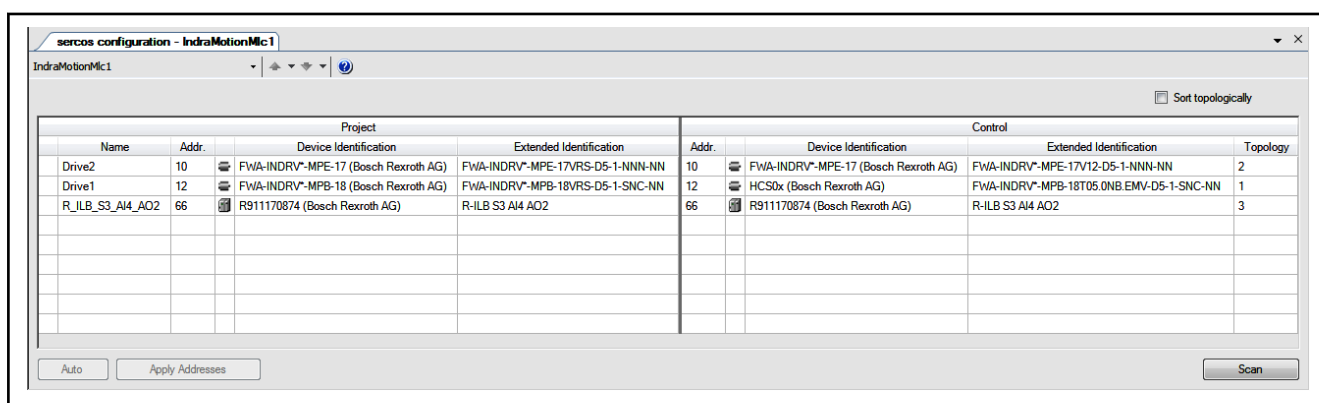


Fig. 7-11: Sercos device configuration dialog in online mode

Case 3: Offline mode

In this case, the dialog is as in case 1 "Download Motion configuration". The essential difference is that the buttons **OK** and **Cancel** are missing. If the dialog is opened, the right side of the table is empty. To fill the right side of the table, press **Scan**.

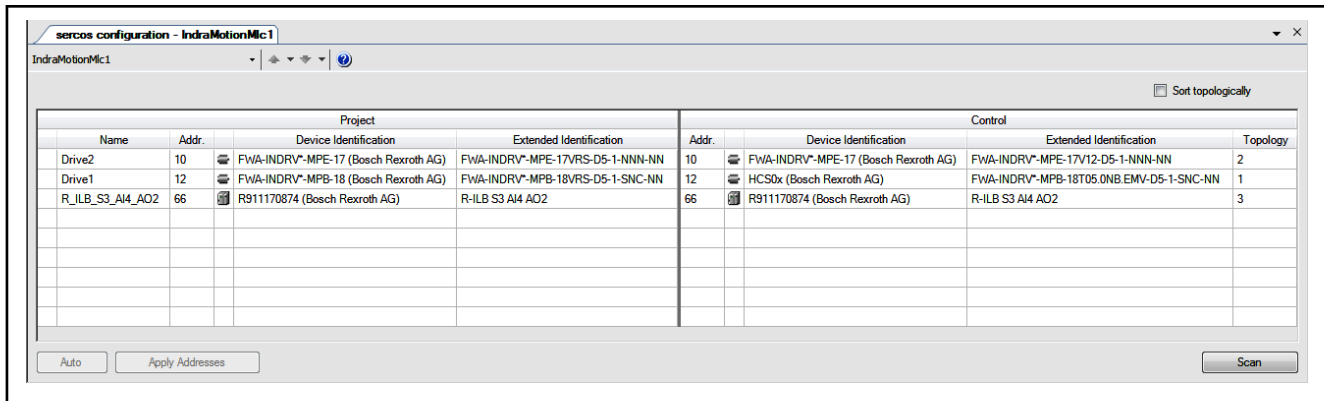


Fig. 7-12: "Sercos device configuration" dialog in offline mode

Scanning bus configuration

The "Scan bus configuration" context menu item determines the devices connected to the Sercos bus (see also [chapter "Context menu item Scan Bus Configuration" on page 197](#)).

Axis synchronization dialog

Switching online

The dialog to synchronize the axis configurations allows to adjust the axis configuration between IndraWorks and the control when switching online via the context menu item of the control "Synchronize-> Download Motion configuration from PC to control".

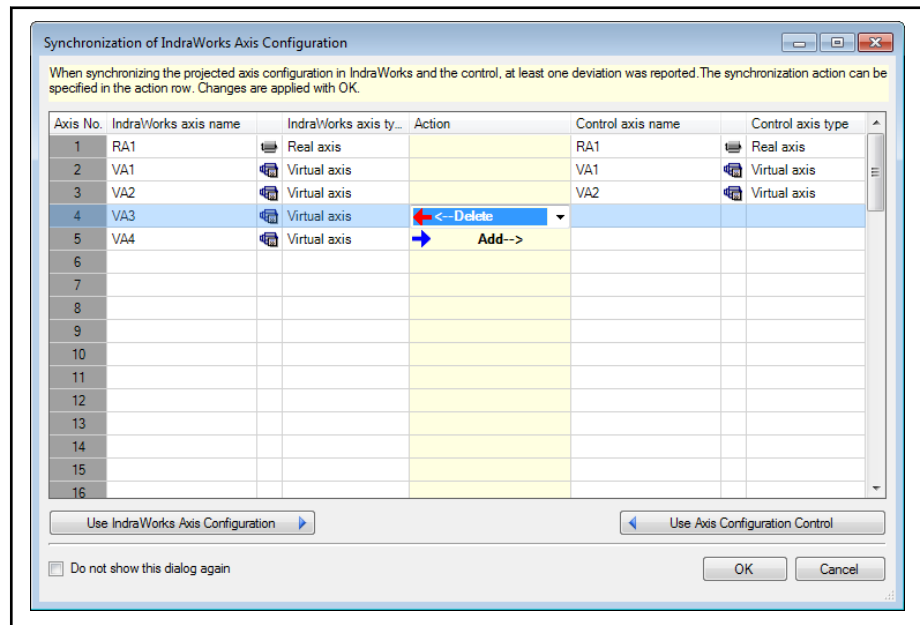


Fig. 7-13: Axis synchronization dialog

Axes can be overwritten, deleted and added to the control or to the IndraWorks project using this dialog.

In the "Action" column, the user can separately select the synchronization action for each axis. In case of multi-axes, all axes are seen as entity to ensure a consistent configuration.

Detailed information can be retrieved for each difference via the tooltip in the "Action" column.

Use the **Use IndraWorks Axis Configuration** or **Use Axis Configuration Control** buttons to select all synchronization actions in a way that the complete IndraWorks configuration or the control configuration is used.

Changes are made in the IndraWorks project or in the control if the dialog was exited with **OK**.

If the project was added to version control (see "Rexroth IndraWorks 14VRS Engineering" manual, chapter "Versions control", see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)) and changes are applied to the IndraWorks project, all axes and drives are checked out after asking the user.



If an axis is deleted in IndraWorks via this dialog or overwritten by a control, the axis parameters are not backed up.

Back up the axis parameters before!

Adjusting the behavior of the axis synchronization dialog

Adjust the behavior of the axis synchronization dialog via the IndraWorks menu item **Tools ► Options**.

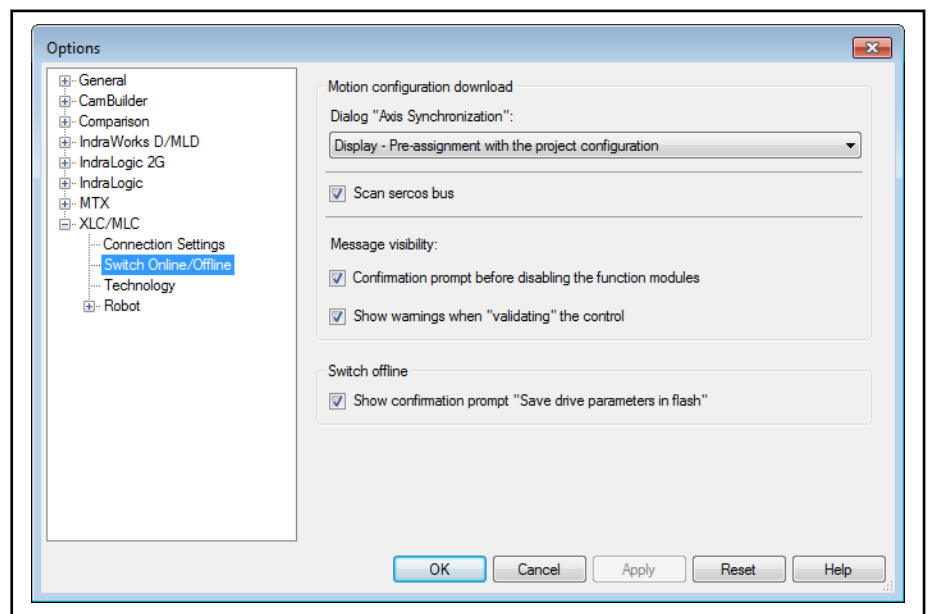


Fig. 7-14: IndraWorks menu item "Tools → Options → XLC/MLC → Switch On-line/Offline"

The following options are available:

1. Do not display - Applying the project configuration: The dialog is not shown when switching online. The axis configuration saved in the project is written to the control.
2. Display - Preassigned with the project configuration: The dialog is shown and all axes are preset. The axis configuration saved in the project is written to the control with **OK**.
3. Display - Preassigned with the control configuration: The dialog is shown and all axes are preset. The axis configuration saved in the control is written to the IndraWorks project with **OK**.

Check the following prompt via the option "Confirmation prompt before disabling function modules".

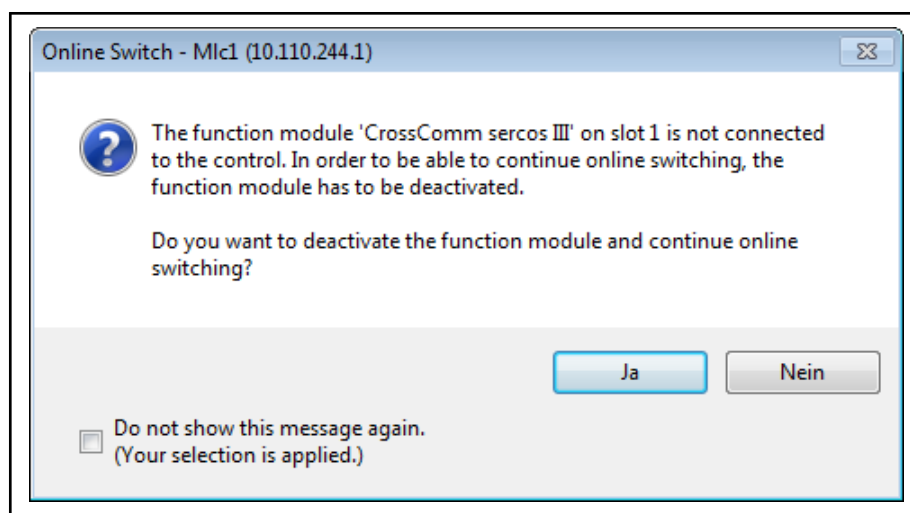


Fig. 7-15: Disabling dialog for function modules

This prompt is displayed if a projected, but not equipped function module (except for a master communication module) is used to initiate a Motion configuration download to the control. The user can thus also synchronize with the control, even though not all function modules are connected to the control.

7.6.3 Comparing control and project configuration

The dialog **Synchronize ► Comparing Motion configuration of PC with control** provides an overview on the Motion configuration differences between the connected control and the corresponding project data. Thus, the consequences can be assumed when downloading the Motion configuration to the control and it can be understood switching online is performed only partially synchronous.

The Motion configuration comparison shows an overview on all elements and their differences relevant for the Motion configuration download. Each deviation from the control and project data forcing a Motion configuration download is a difference.

For general operating information on this dialog, refer to the documentation "Rexroth IndraWorks 14VRSEngineering", chapter "Comparing project data" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

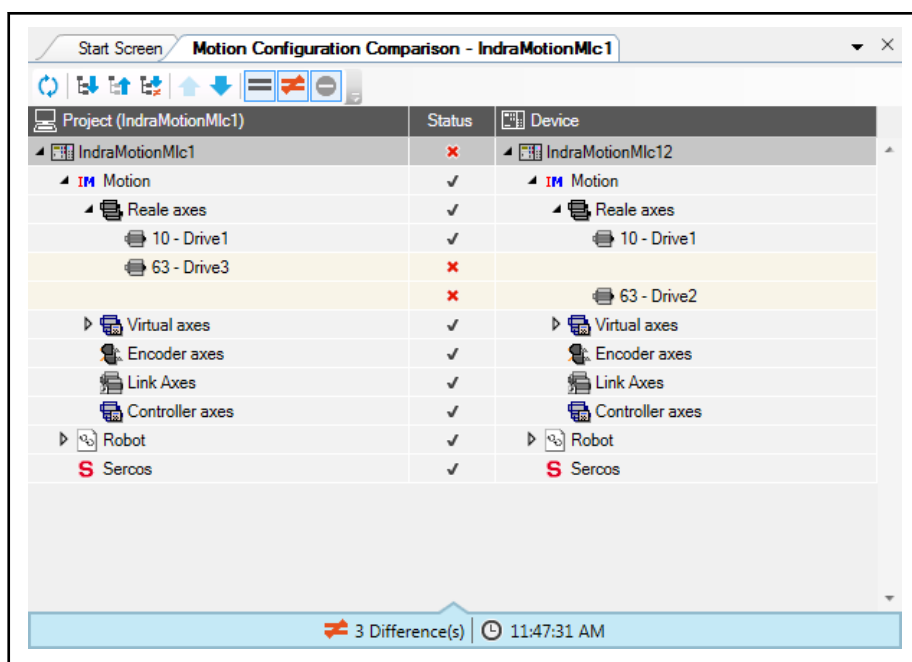


Fig. 7-16: Displaying differences in the control and two non-matching real axes



The control data refers to the **control configuration**, not to the connected devices. The upper screen shows only that two real axes are configured on the control. To ensure whether the devices are really connected to the control, check the Sercos configuration, see [chapter "Adjustment of command/actual configuration"](#) on page 526.

Double-click on the column in the middle to display the detailed properties for an element. Possible differences are highlighted.

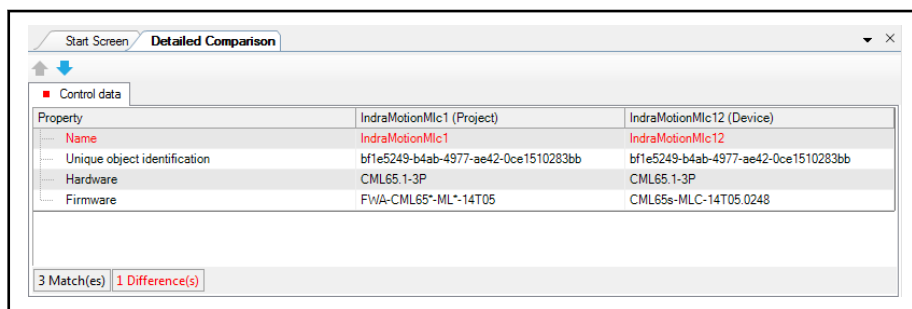


Fig. 7-17: Detailed display of the control for different control names

The property "Unique object identification" is displayed for many objects (e.g. the control and all axes). This internal property labels the identity of the object. This is comparable to a unique name. IndraWorks requires this identification to detect all changes in the configuration and to load them to the control. Even if the axis number or the Sercos address of an axis change, this identification remains unchanged. The actual value of the identification is of no significance. It is sufficient to know whether it matches between the project and the control. If the identification does not match, the object is different, even though all other properties match.



This dialog displays only data relevant for uploading and downloading the Motion configuration. Other data (e.g. parameters for the velocity limit values of axes) or PLC data are **not** part of this dialog.

7.6.4 Comparing Motion project data and control data

The **Online comparison** (for general information, refer to "Rexroth IndraWorks 14VRS Engineering", chapter "Comparing project data and device data") also displays the differences between Motion objects in the projects and those objects in the control. This comparison is always possible, irrespective of the connection state and the set options. When starting the comparison, all Motion objects are shown in a tree structure similar to the structure in the Project Explorer.

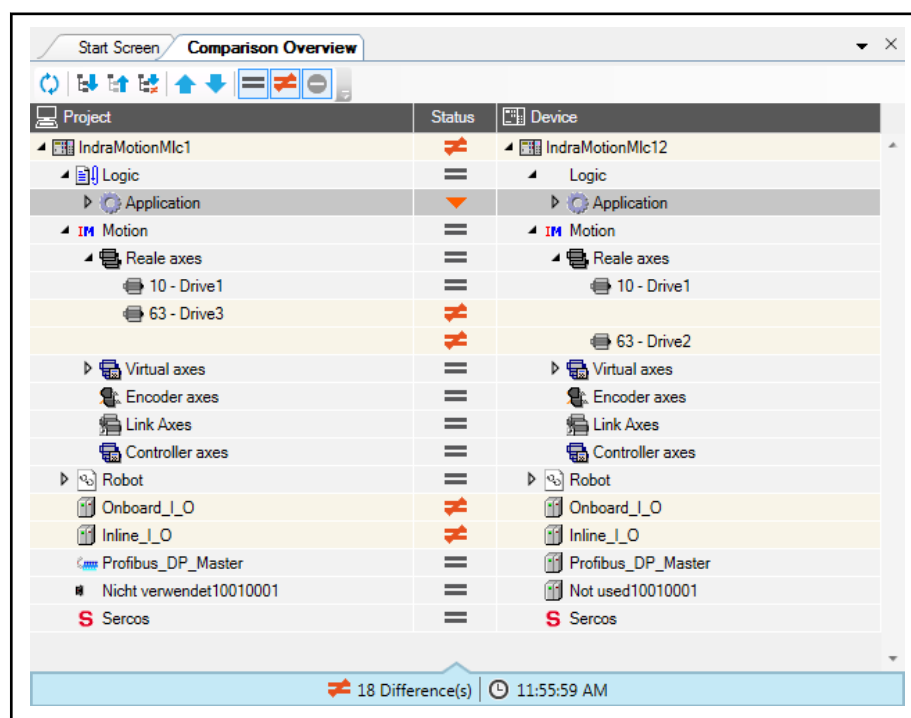


Fig. 7-18: Displaying differences in the control and two non-matching real axes



Data of drives including their parameters are not part of the online comparison. Currently, only data of real axes including their A-parameters can be compared.

Double-click on the column in the middle to display the detailed properties for an element. Possible differences are highlighted. Apart from the actual properties, differences between the parameters of each Motion object are also displayed.

Property	IndraMotionMlc1 (Project)	IndraMotionMlc12 (Device)
Name	IndraMotionMlc1	IndraMotionMlc12
Unique object identification	bf1e5249-b4ab-4977-ae42-0ce1510283bb	bf1e5249-b4ab-4977-ae42-0ce1510283bb
Author	thombay0	thombay0
Device family	MLC	MLC
Hardware	CML65 1-3P	CML65 1-3P
Firmware	FWA-CML65*-ML*-14T05	CML65s-MLC-14T05 0248
Parameters	--	--
C-0-0002 (Name of parameter file)	Parameter_EN.xml	Parameter_EN.xml
C-0-0003 (Name of diagnostic file)	Diagnoses_EN.xml	Diagnoses_EN.xml
C-0-0004 (Name of menu file)	Menue_EN.xml	Menue_EN.xml
C-0-0036 (Control configuration)	0b0000.0000.0000.0000.0000.0000.0000.0000	0b0000.0000.0000.0000.0000.0000.0000.0000
C-0-0060 (Switch-on delay time)	0	0
C-0-0080 (User-defined decimal number)	0	0
C-0-0081 (User-defined text)	User defined Text	User defined Text
C-0-0113 (IDN list of checksum C-parameters)		
C-0-0206 (TCP, time to live)	32	32
C-0-0209 (Sender timeout)	3000	3000
C-0-0210 (TCP, max. number of connection)	15	15
C-0-0250 (Engineering, DHCP configuration)	0b0000.0000.0000.0000.0000.0000.0000.0001	0b0000.0000.0000.0000.0000.0000.0000.0001
C-0-0254 (Engineering, DHCP lease time)	3600	3600
C-0-0264 (sercos master, DHCP lease time)	3600	3600

6 Match(es) 1 Difference(s)

Fig. 7-19: Detailed display of the control including its parameters

The property "Unique object identification" is displayed for many objects (e.g. the control and all axes). This internal property labels the identity of the object. This is comparable to a unique name. IndraWorks requires this identification to detect all changes in the configuration and to load them to the control. Even if the axis number or the Sercos address of an axis change, this identification remains unchanged. The actual value of the identification is of no significance. It is sufficient to know whether it matches between the project and the control. If the identification does not match, the object is different, even though all other properties match.

7.7 Axis modes

7.7.1 Deactivated axis

Disconnecting point: Between control and drive electronics.

Properties

The real axis is created in the control project. The "disabled" property can be assigned to the axis via the context menu and is then highlighted on the user interface with  in the Project Explorer.

Its A-parameters can be accessed.

For Sercos II applies:

- The drive does not have to exist physically

For Sercos III applies:

- The drive may not exist physically

The drive is always in **P0**, even if the Sercos ring is in **BB**.

Virtual axes and encoder axes cannot be "deactivated".

If the drive electronics is removed from the encoder axis by "deactivating" a real axis, it is also labeled as "deactivated".

Use cases

- While commissioning, only certain drives are to be moved. The other drives are configured and also programmed in the PLC program, but they do not yet exist physically or are currently designed.
- Master project: A machine manufacturer designs a scalable device series with different stages of expansion. To allow an effective software

production for the individual devices, the manufacturer creates a master project with the maximum state of expansion ($\leq 32/64$ axes). On devices with a lower stage of expansion, the non-existing axes are configured, but not activated. Thus, a subsequent device upgrade is possible without software modifications

7.7.2 Parking axis

Disconnecting point: Between drive electronics and motor.

Properties The real axis is created in the control project. The "parked" property can be assigned to the axis via the context menu and is then highlighted on the user interface with **P** in the Project Explorer.

The axis is active and provided with the "Parking" property.

The drive has to exist physically. The motor does not have to exist. The drive command "Parking Axis" is used.

The A-, S- and P-parameters can be accessed.

The drive follows the Sercos phase. No error messages are generated by the drive.

Virtual axes and encoder axes cannot be "parked".

- Use cases**
- It is prevented that a drive controller generates an error when switching to **BB** without a connected motor
 - The S-parameters and P-parameters remain reachable (e.g. writing in **P2** from the PLC program)

7.7.3 Notes on the use of deactivated and parking axes

Parking and deactivating is only possible in **P2**:

- When parking the axes, no phase switching to **P0** is required
- When deactivating the axes, a phase switch to **P0** is required (automatically executed by the firmware)



With the active axes in **P0**, the PLC program can temporarily not access S- and P-parameters.

The following conditions apply for all axes (active, parking or deactivated):

- Assigned axis number or Sercos address
- One global axis variable referencing the respective axis number has to exist for each axis in the PLC

axis	Can be traveled	Access to A-parameters	Access to S- /P-parameters	Phase switching	Commands possible	Function block response upon call in the PLC program	Parameter check in the drive
Active	Yes	Yes	Yes	Follows Sercos	Yes	Normally without error, "Done" when command value is reached	Activated
Parking	No	Yes	Yes	Follows Sercos	Partially	Error message	Deactivated
Deactivated	No	Yes	No	Always in P0	No	Error message	Always in P0

Tab. 7-1: Properties

7.7.4 Command value decoupling

Mode of operation

The command value decoupling allows the execution of traversing commands for a real axis **with interpolation in the control** but without a motion carried out in the drive. The command value decoupling is activated via the parameter "A-0-0024, Axis state".

The axis can assume the following states:

- 0 - Axis activated
- 1 - Axis parked
- 2 - Axis deactivated
- 4 - Axis activated without command value processing in the drive
- 5 - Axis activated with command value calculation. Drive is parked
- 6 - Axis activated with command value calculation. Drive deactivated (not in the ring)

The axis is subject to the normal PLCopen state machine with active command value decoupling for a real axis. This means that the "MC_Power" function block has to be executed before executing a motion command. Executing "MC_Power" does not cause the drive to be switched to **AF**. The **AB** state in the drive is not required for the execution of the function block.

In case of an active command value decoupling, the position command value calculated by the control are still written cyclically to the parameter S-0-0047. Since the drive is not in **AF**, the command values are not processed. The actual position value of the axis (A-0-0100) is not updated. The calculated command value of the axis can be read out via the parameter "A-0-0151, Interpolated position of the control".



Enabling the command value coupling is also possible if the MC_Power function block is active. Prerequisite is the PLCopen state "Standstill" or "PowerOff".

An axis operated with an active command value decoupling has the following properties:

- Use as master axis
- Bit 10 "Actual position value is relative/referenced" is set in the parameter A-0-0021.
- Bit 14 "Ab - Control and power section ready for operation" is set in the parameter A-0-0021
- Bit 31 "Command value decoupling active" is set in the parameter A-0-0021

If the command value decoupling is disabled, the parameter "A-0-0151, Interpolated position of the control" is set to the current actual value of the drive. This causes a jump in position.

If a slave axis follows a master axis operating with an active command value decoupling either in the parked or deactivated state, the error F2220231 "Invalid master axis data" is generated when the command value decoupling is deactivated. Thus, all slave axes are to be decoupled before deactivating the command value decoupling.

Displaying command value decoupling

The command value decoupling can be combined with the axis states "Activated", "Deactivated" and "Parked". The command value decoupling is sym-

bolized by an open switch that superimposes the icons of the axis states mentioned before. In the "Axis Status" dialog, the following icons are used for the visualization:

Axis status	Without command value decoupling	Command value decoupling active
Active		
Parked		
Deactivated		

Tab. 7-2: Icons to represent axis states

The command value decoupling is normally only activated for a short time by the control while the axes are synchronized. The command value decoupling can also be activated manually via the context menu of the axis.

SercosDrive

For Sercos-compliant drives (SercosDrive), the menu item "Command value decoupling active" is displayed in the context menu:

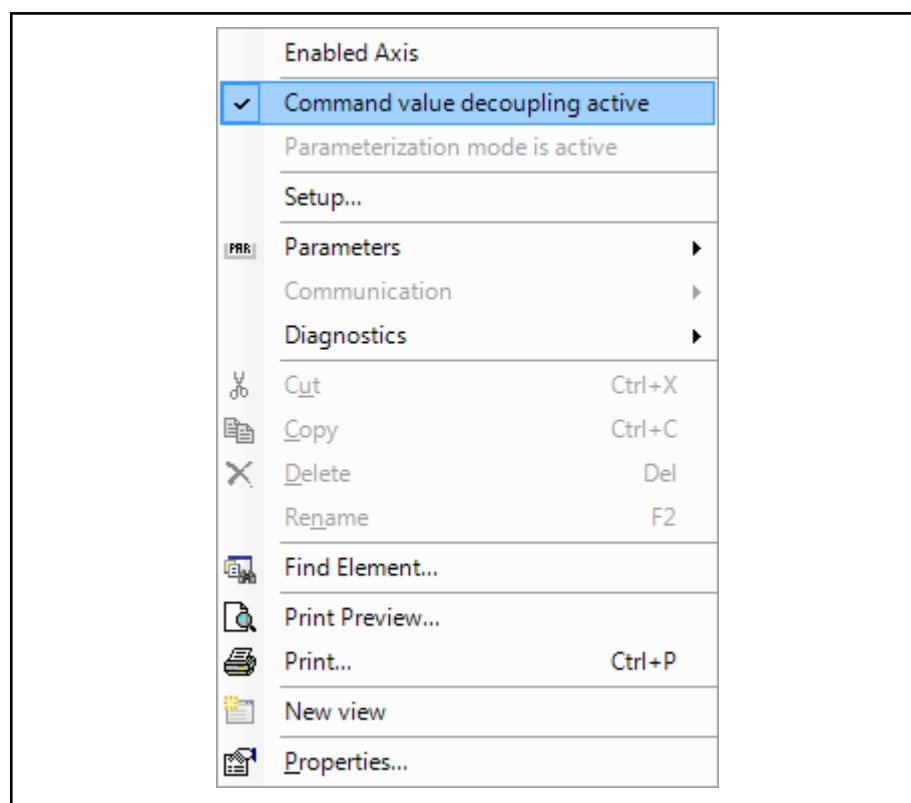


Fig. 7-20: Context menu of a Sercos drive

IndraDrive

The command value decoupling can only be selected if the **interpolation is executed in the control**. In this case, the context menu looks as follows (command value decoupling selected):

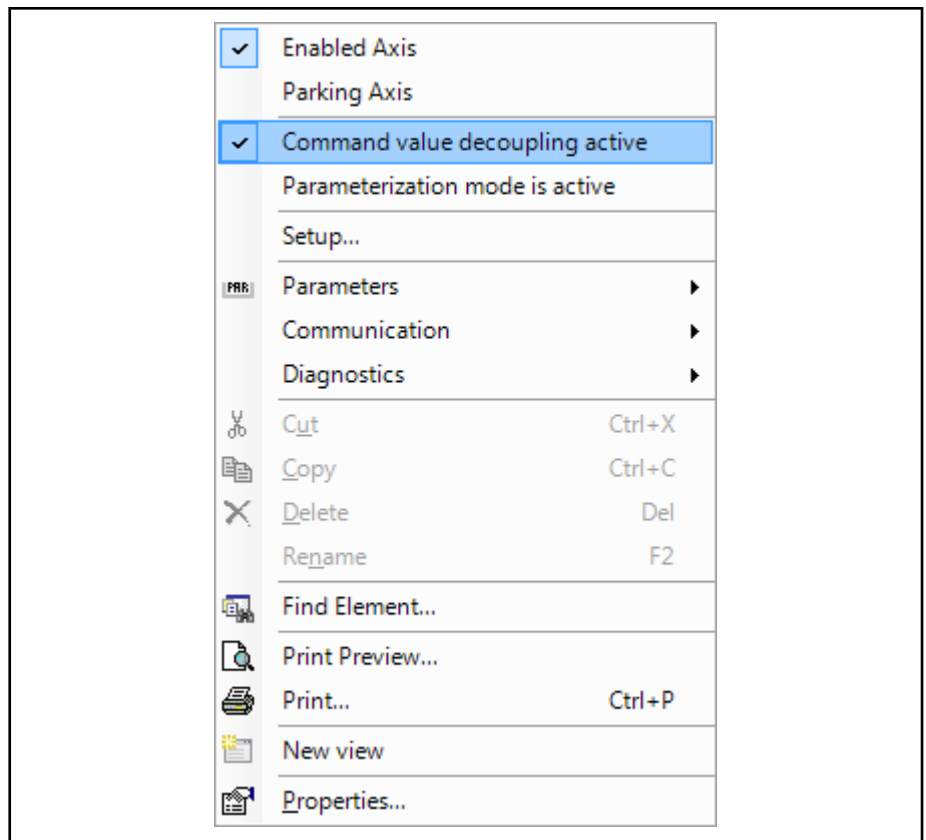


Fig. 7-21: Context menu of a IndraDrive drive



If the interpolation is in the drive, the menu item "Command Value Decoupling Active" is not available.

7.7.5 Axis in parameterization mode

Properties Enabling the parameterization mode of an axis causes that the parameters of the axis can be changed without switching the Sercos bus to P2. This reparameterizes individual axes while the rest of the system continues running. For further information, refer to [chapter 7.5 "Parameterization level" on page 522](#).

The parameterization mode of an individual axis can be enabled or disabled via its context menu. In the Project Explorer, an enabled parameterization level is labeled by an attached "[PM]".

7.8 Single-axis modes

7.8.1 Overview

This chapter describes the various single-axis modes. A single-axis mode is always active if the axis does not follow another axis (if its motion only depends on instructions from the user or the PLC program).

The following operation modes are described in this chapter:

- [chapter 7.8.2 "Operation modes" on page 540](#)
 - Positioning: Absolute, additive or relative
The axis moves to a specific position. The position value can be specified absolutely or relatively to the command or actual position
 - Velocity control

- Continuous axis motion with defined velocity
- Torque/force control
- Continuous axis motion with defined torque/force
- [chapter 7.9 "Operation modes for synchronous motions with electronic gear function" on page 546](#)
 - Velocity synchronization

In the "velocity synchronization" mode, the axis velocity-synchronously follows a specified master axis velocity
 - Phase synchronization

In the "phase synchronization" mode, the axis follows a specified master axis position either absolutely or relatively phase-synchronous
 - Electronic cam

In the "electronic cam" mode, there is a fixed relationship between the master axis position and the slave axis. This relationship is defined in a cam table by points
 - Electronic FlexProfile MotionProfile

The "FlexProfile" belongs to the group of electronic motion laws. These are described as analytic functions by mathematical motion laws

7.8.2 Operation modes

Absolute positioning

This operation mode enables the time-optimum positioning of a single axis. In "absolute positioning" mode, a target position is directly specified for the axis. In the interpolator, a position command value characteristic is created as input variable for the position controller using the specified value for the target position including the specified positioning data (velocity, acceleration and jerk).

Typical use cases:

- Control of infeed axes
- Manually triggered positioning for setup tasks
- Positioning a virtual master axis...

The following figure shows two examples of successive motions with absolute positioning using the MC_MoveAbsolute function block:

1. The left side of the time diagram shows the case in which Instance2 is called after Instance1. After Instance1 has implemented the position 6,000 (velocity 0), its "Done" output enables Instance2 with the target position 10,000.
2. The right side of the time diagram shows how Instance2 is already enabled while Instance1 is still running. The motion of Instance1 is stopped and aborted by the "Test" signal. Instance2 directly approaches its target position 10000 even though position 6000 has not yet been reached.

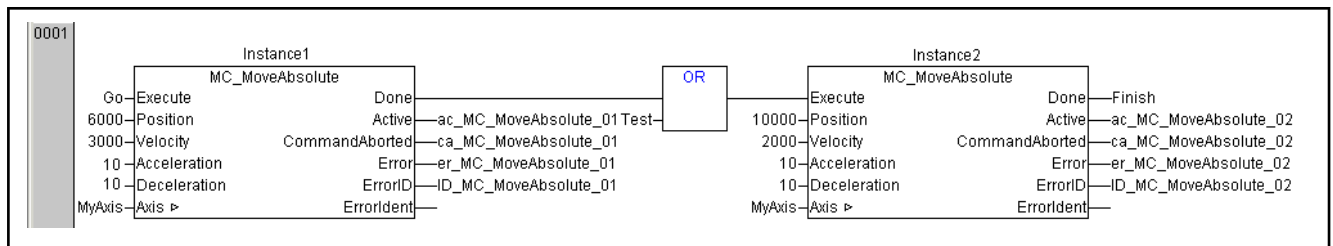


Fig. 7-22: Two instances of MC_MoveAbsolute

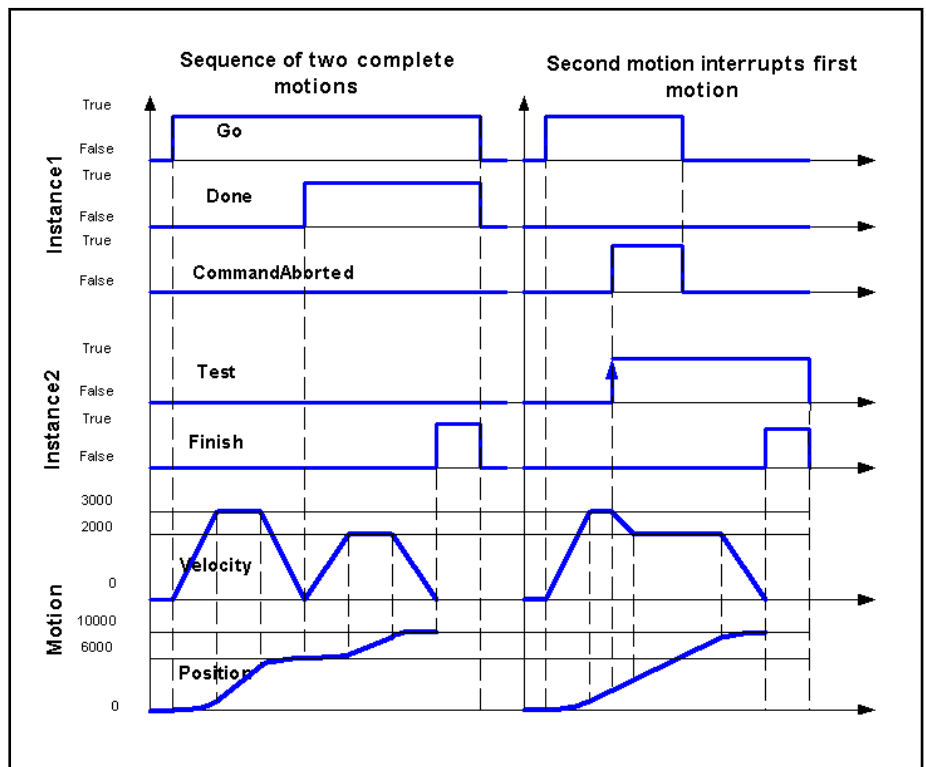


Fig. 7-23: Time diagram: Two successive motions of "absolute positioning" mode

Additive positioning

This operation mode enables the time-optimum positioning of a single axis. A distance is specified in the "additive positioning" mode. The distance is added to the current **target position** and transmitted to the interpolator as new target position. The interpolator calculates a position command value sequence for the position controller considering the given positioning data (velocity, acceleration and jerk).

Typical use cases:

- Clocking a stacker

The following figure shows two examples of the combination "absolute and additive positioning":



Two different function block types are used:

- Instance1: MC_MoveAbsolute
- Instance2: MC_MoveAdditive

1. The left part of the time diagram shows a case in which the second function block is started after the first one. The first function block reaches the distance 6,000 (at a velocity of 0). Subsequently, the "Done"

output causes the second function block to travel the distance up to 10,000.

- The right part of the time diagram shows a case in which the second function block is already started while the first function block is still active. In this case, the first motion is stopped and aborted by the "Test" signal at constant velocity. The second function block adds its distance of 4,000 to the originally commanded position of 6,000 and moves the axis to the resulting position 10,000 at a velocity specified at the second function block.

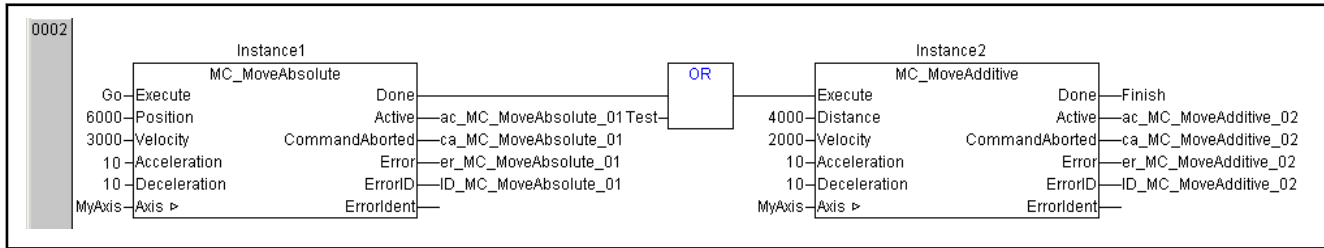


Fig. 7-24: Instances of MC_MoveAbsolute and MC_MoveAdditive

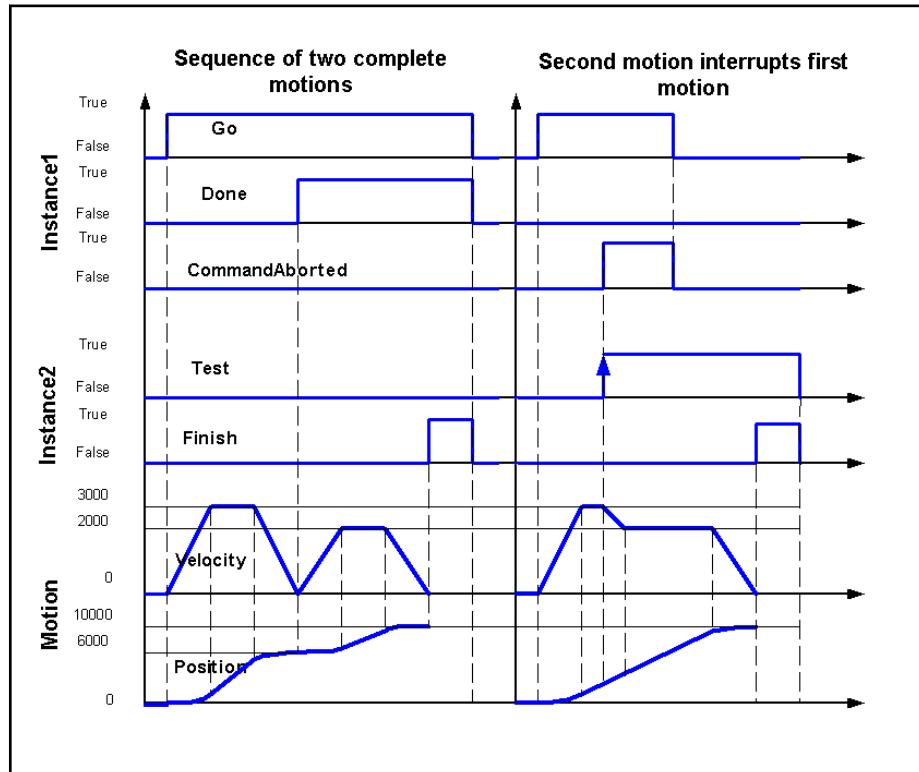


Fig. 7-25: Time diagram: Two successive motions of "absolute" and "additive positioning" modes

Relative positioning

This operation mode enables the time-optimum positioning of a single axis. A distance is specified in the "relative positioning" mode. The distance is added to the current **actual position** and transferred to the interpolator as new target position. The interpolator calculates a position command value sequence for the position controller considering the given positioning data (velocity, acceleration and jerk).

Typical use case:

- Clocked feed

The following example shows the combination of two successive motions with "relative positioning" using the MC_MoveRelative function block:

1. The left part of the time diagram shows a case in which Instance2 is called after Instance1 was processed. After Instance1 has reached the distance 6,000 (velocity 0), its "Done" output uses Instance2 to cause a further motion by 4,000 to reach the total distance of 10,000.
2. The right side shows how Instance2 is already activated by the "Test" signal while Instance1 is still running. The first motion is aborted during the constant velocity of Instance1. Instance1 adds its distance of 4000 to the current position (3250). The axis approaches the resulting position of 7,250.

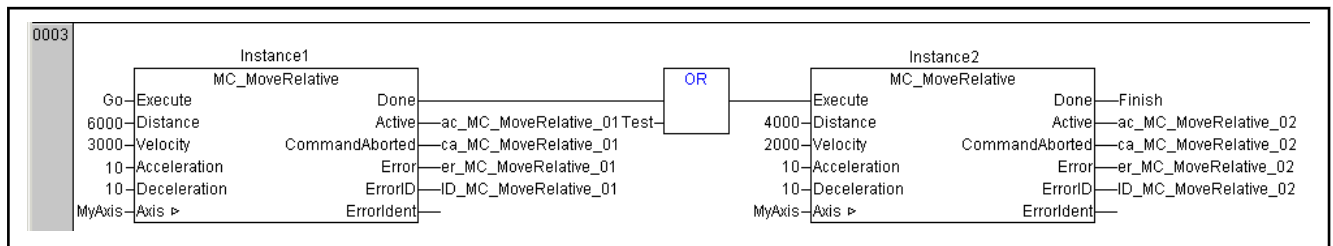


Fig. 7-26: Two instances of MC_MoveRelative

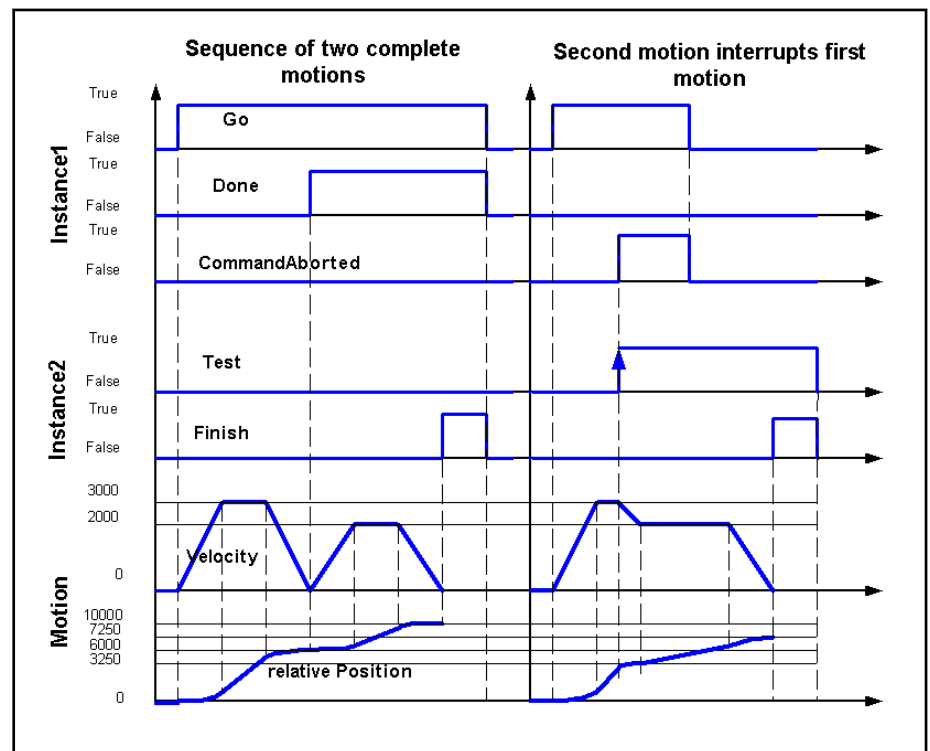


Fig. 7-27: Time diagram: Two successive motions of the "relative positioning" mode

Velocity control

In the "velocity control" mode, a velocity command value for an "endless" motion to the next motion command is defined for the axis.

Typical use cases:

- Control of the virtual master axis speed
- Continued execution of paint application or paste rolling at machine standstill
- Continuous product feed...

For real axis in the "SercosDrive" mode, the subordinate drive mode "velocity control" is not available. It is not available since the determination on the Sercos application profile PackProfile does not intend a velocity control as secondary operation mode. The function block MC_MoveVelocity or the "velocity control" mode is represented in the drive via a "position control" by a control. The velocity command values are integrated into a position command value by the control and the function block "MC_MoveVelocity" is also available for this axis type.

Remark:

Using the position control leads to a following distance (that might build up) normally corrected by the position controller. This is not the case for a "real" closed-loop velocity control. Whether this missing slippage is relevant, has to be determined application-specifically.

This restriction does not apply to real axes operated in the IndraDrive profile. A "real" velocity control takes place in the drive controller. The interpolation of the velocity command values is executed in the control or in the drive depending on the axis mode (central/decentral) used.



Up to 11VRS, a position control has also been used for the IndraDrive with interpolation in the control. When applying old projects, observe whether the change in the closed-loop control method has effects on the machine processing. Compatibility to the 11VRS behavior can be achieved by changing the axis type to a SercosDrive.

The following figure shows two examples of two combined instances of the MC_MoveVelocity function block:

1. The left part of the time diagram shows a case in which the second instance is called after the job of the first instance is complete. Once the first function reached the required velocity of 3,000, the "Instance1.InVelocity" output **AND** the "Next" signal cause the second function block to continue the motion at a velocity of 2,000.
2. The right side of the time diagram shows a case where the first function block has not yet reached the velocity when the second function block is started. The following is shown: The first motion is restarted by "Go" at the "Instance1.Execute" input. While the first function block is still accelerating to reach a velocity of 3,000, it is interrupted by the "Test" signal which starts the second function block. The second function block is now running and decelerates to a velocity of 2,000.

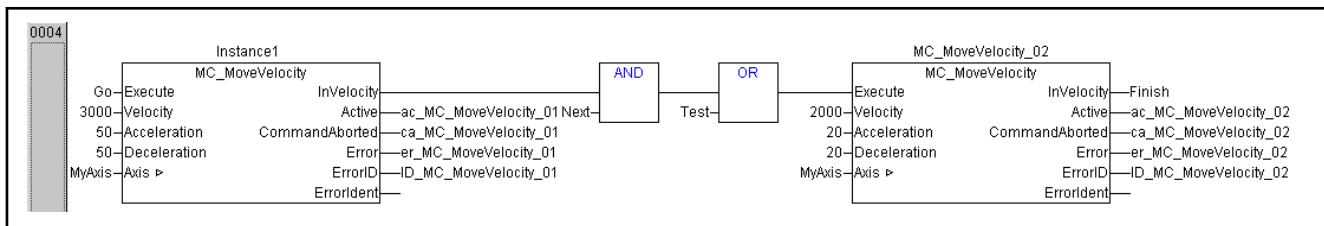


Fig. 7-28: Two instances of MC_MoveVelocity

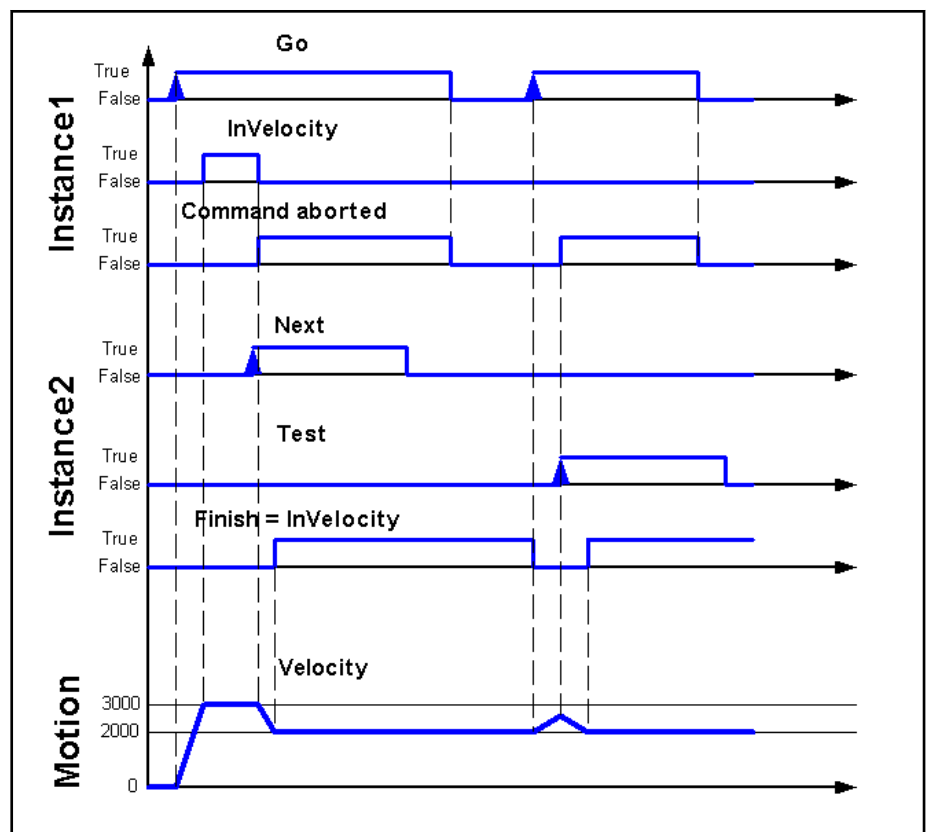


Fig. 7-29: Time diagram: Two successive motions of the "velocity control" mode

Torque/force control

In the "torque/force control" mode, a torque/force command value is specified for the drive.

Typical use cases:

- Torque coupling for mechanically coupled ("switched in parallel") axes
- Hydraulic applications

The torque/force control support can also be disabled for a real axis with interpolation in the control. This is performed via the A-parameter A-0-0007 of the respective axis. As a consequence, the operation mode and the respective S-/P-parameters are not parameterized by the control anymore. The parameters and the operation mode are thus not reserved by the control and can be linked drive-internally for special functions such as coupling the torque command value to an analog input.

The "torque/force control" mode is only provided for real axes operated in the IndraDrive profile. For real axes in the SercosDrive profile, no torque/force control can be used by the control.

The figure below shows two examples of two combined instances of the MC TorqueControl function block:

1. The left part of the time diagram shows a case in which the second instance is called after the job of the first instance is complete. Once the first function block reached the requested torque of 30, the "Instance1.InTorque" output **AND** the "Next" signal cause the second function block to be reduced to a torque of "20".
2. The right part of the time diagram shows a case where the first function block has not yet reached the torque when the second function block is

started. The following is shown: The first motion is restarted by "Go" at the "Instance1.Execute" input. While the first function block is still operating to reach a torque of 30, it is interrupted by the "Test" signal which starts the second function block. Now, the second function block reduces the torque to 20.

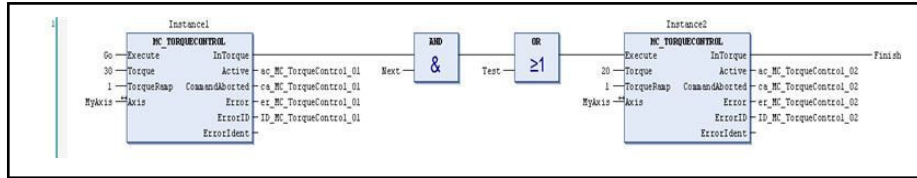


Fig. 7-30: Two instances of MC_TorqueControl

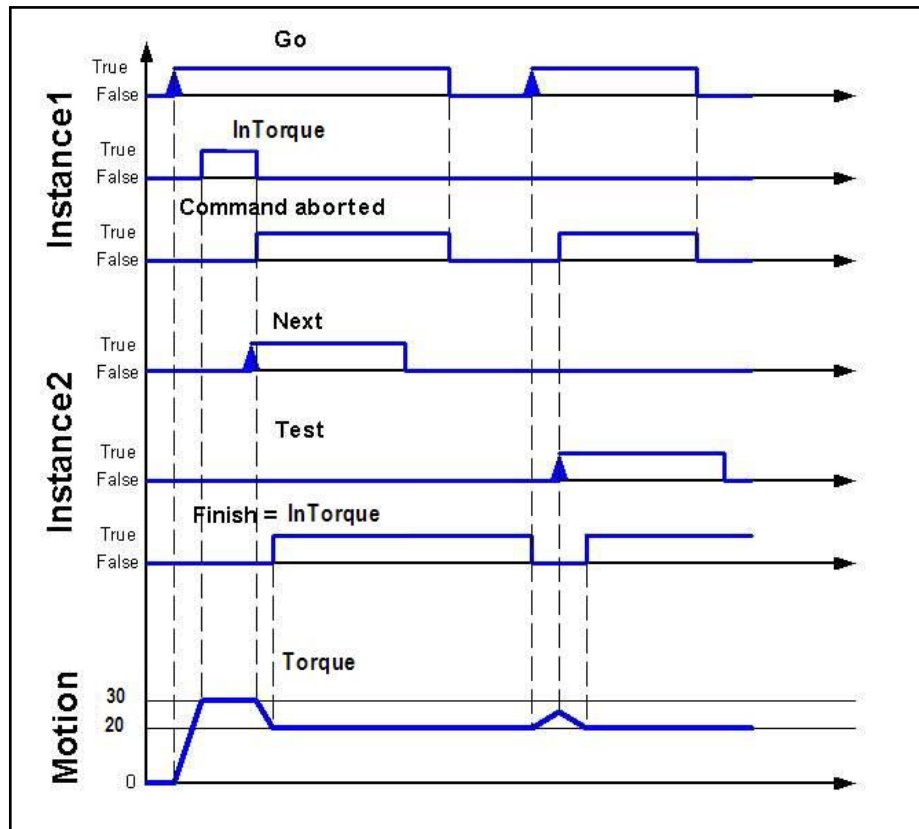


Fig. 7-31: Time diagram: Two successive motions of the "torque/force control" mode

7.9 Operation modes for synchronous motions with electronic gear function

Velocity synchronization

In the "velocity synchronization" mode, the axis velocity-synchronously follows a specified master axis velocity. The master axis velocity can be specified by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is a velocity-synchronous (drift-free) run between the master axis and the selected slave axis.

Typical use cases:

- Simple transport axes
- Draw rollers in winder applications

- Cooling rolls
- Impression cylinders
- Paint application rollers
- Film/paper drawing...

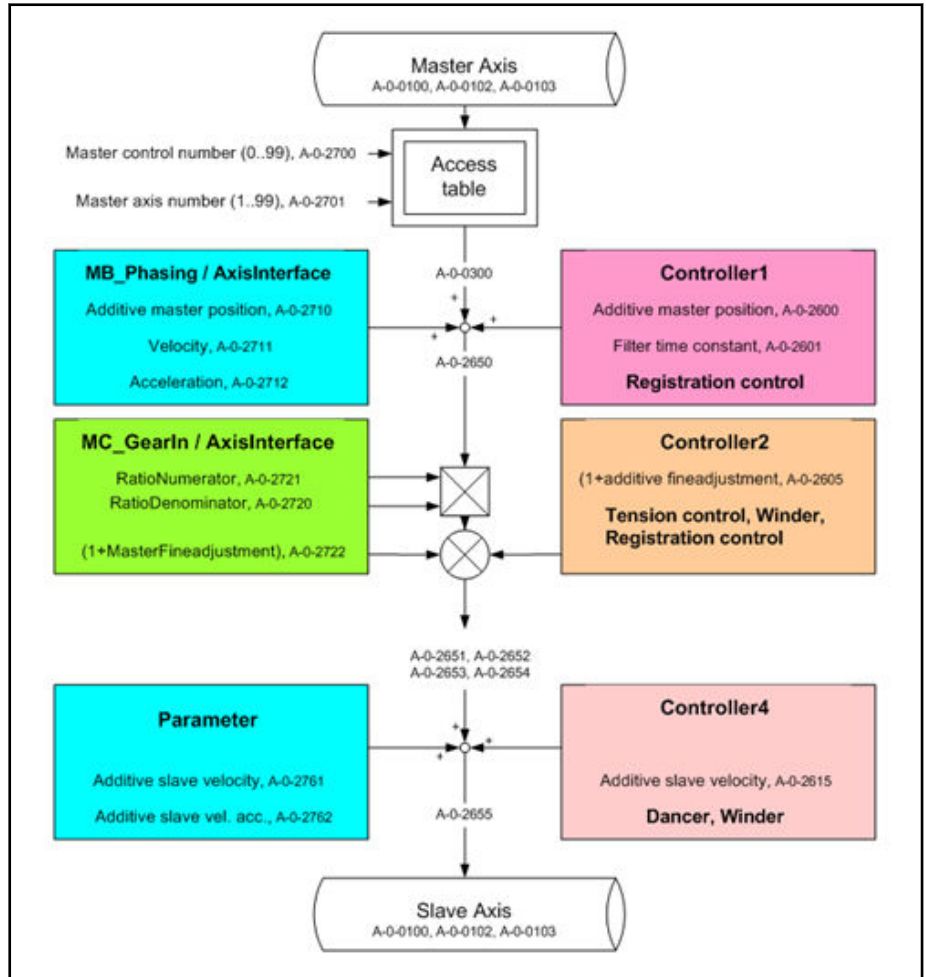


Fig. 7-32: MotionControl functional chain velocity synchronization

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, ELS, phasing, additive position command value" can be defined via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, ELS, master axis gear, output revolutions" and "A-0-2720, ELS, master axis gear, input revolutions" and the "A-0-2722, ELS, gear ratio fine adjust". The fine adjustment value is specified in percent and calculated as $(1 + \text{fine adjustment})$.

These values are specified via "MC_GearIn" or the AxisInterface

- The additive command velocity of the slave axis defined by "A-0-2761, ELS, PhasingSlaveVel, additive command velocity"

For real axis in the "SercosDrive" mode, the subordinate drive modes "velocity control" or "velocity synchronization" are not available. It is not available since the determination on the Sercos application profile PackProfile does not intend a velocity control/synchronization as secondary operation mode. In this case, the function block MC_GearIn or the "velocity synchronization"

mode are represented in the drive via a "position control" by a control. The velocity command values of the slave axis are integrated into a position command value by the control and the function block MC_GearIn is also available for this axis type.

Remark:

Using the position control leads to a following distance (that might build up) normally corrected by the position controller. This is not the case for a "real" velocity control/synchronization. Whether this missing slippage is relevant, has to be determined application-specifically.

This restriction does not apply to real axes operated in the IndraDrive profile. A "real" velocity control takes place in the drive controller.

- At interpolation in the drive, it is synchronized via the "velocity synchronization" mode. The master axis velocity is transferred to the drive. The drive device calculates the synchronous velocity
- In the mode with interpolation in the control, the "velocity synchronization" mode is not required in the drive. The control applies the calculation of the resulting synchronous velocity command values of the slave axis and transfers this value as cyclic velocity command value to the drive

Axis mode	SercosDrive	IndraDrive (interpolation in the control)	IndraDrive (interpolation in the drive)
Drive type used	Position control	Velocity control	Velocity synchronization

Tab. 7-3: Drive type used in different axis modes

Phase synchronization

In the "phase synchronization" mode, the axis follows a specified master axis position either absolutely or relatively phase-synchronous. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is a phase-synchronous and velocity-synchronous (drift-free) run between the master axis and the selected slave axis.

Typical use cases:

- Machining units for stamping, embossing, perforating...
- Printing cylinders
- Materials transportation,...

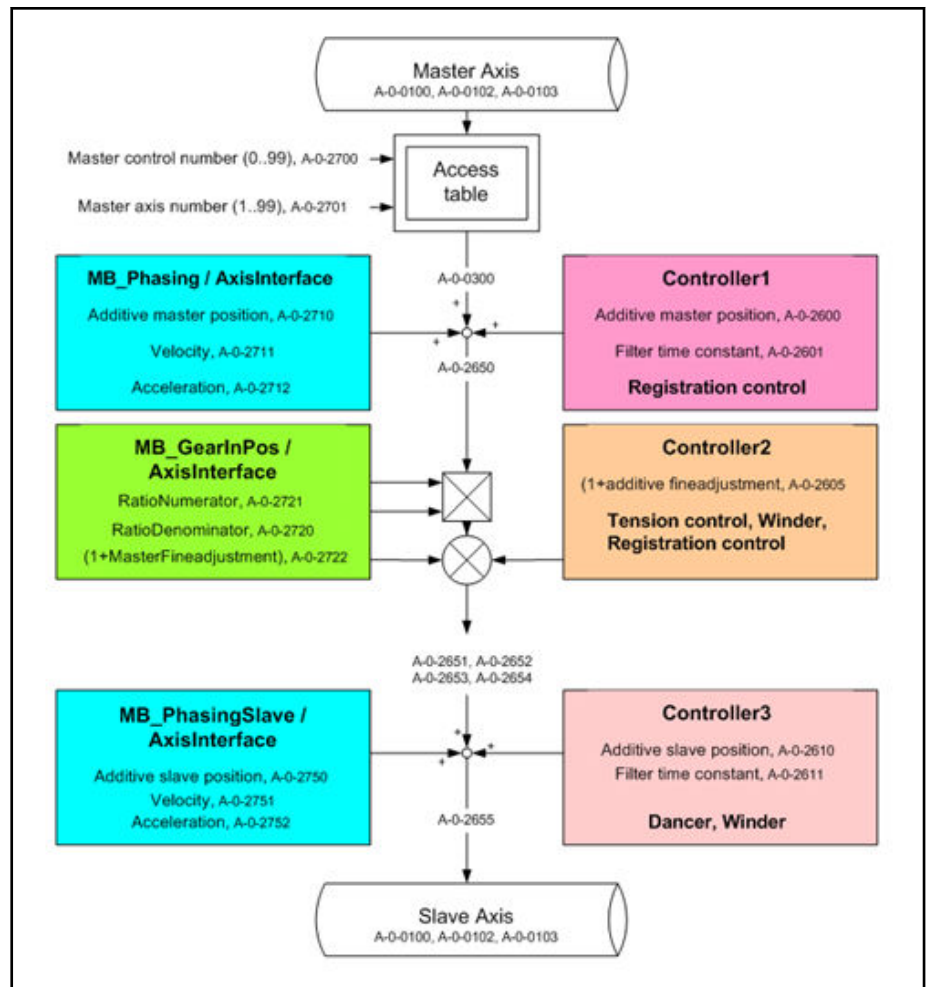


Fig. 7-33: MotionControl functional chain: Phase synchronization

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, ELS, phasing, additive position command value" can be defined via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, ELS, master axis gear, output revolutions" and "A-0-2720, ELS, master axis gear, input revolutions" and the "A-0-2722, ELS, gear ratio fine adjust". The fine adjustment value is specified in percent and calculated as $(1 + \text{fine adjustment})$.

These values are specified via MB_GearInPos or the AxisInterface

- The additive slave axis position defined by "A-0-2750, ELS, PhasingSlave, additive position command value" can be defined via MB_PhasingSlave or the AxisInterface

Electronic cam

In the "electronic cam" mode, the axis follows a specified master axis position defined by a fixed relationship between the master axis position and the slave axis. This relationship is defined in a cam table by points. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is to implement the dependency between the master axis and the selected slave axis. This dependency is stored in the cam table.

Typical use cases:

- CrossCutter
- FlyingShear
- Cycle-synchronous lock-on and lock-off...

The cam tables can be generated and loaded using the "CamBuilder" integrated in IndraWorks. Moreover, PLC function blocks are provided by IndraWorks to generate cam tables for specific applications such as cross cutting and cross sealing.



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

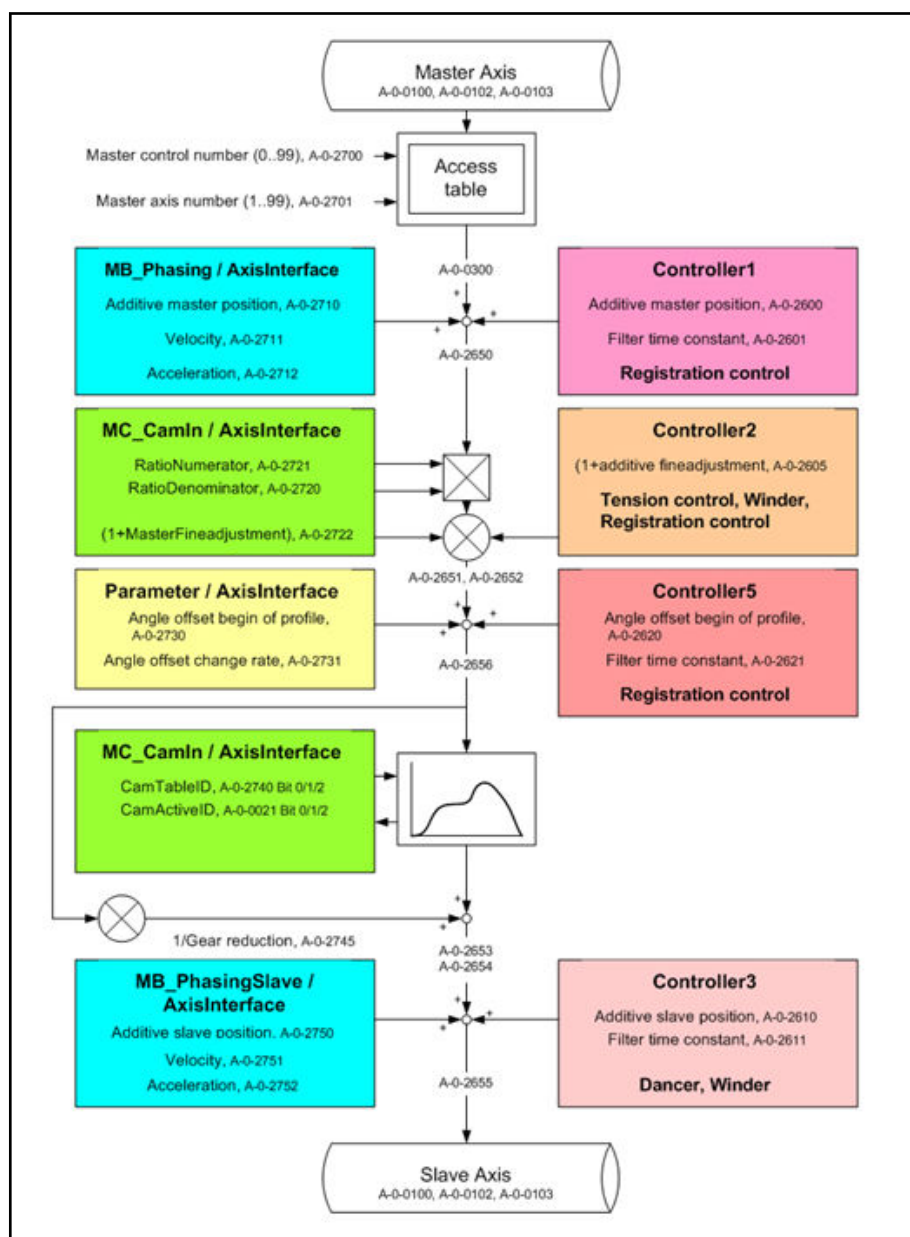


Fig. 7-34: MotionControl functional chain: Electronic cam

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, ELS, phasing, additive position command value" can be defined via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, ELS, master axis gear, output revolutions" and "A-0-2720, ELS, master axis gear, input revolutions" and the "A-0-2722, ELS, gear ratio fine adjust". The fine adjustment value is specified in percent and calculated as $(1 + \text{fine adjustment})$

The selection of the two possible cam tables to be previously stored in the drive: "A-0-2740, ELS, CamIn, cam table preselection".

These values are specified via MC_CamIn or the AxisInterface

- The additive slave axis position defined by "A-0-2750, ELS, PhasingSlave, additive position command value" can be defined via MB_PhasingSlave or the AxisInterface

Electronic FlexProfile MotionProfile

In the "FlexProfile" mode, the axis follows a specified master axis position defined as analytic functions by mathematical motion laws. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is to implement a dependency between the master axis and the selected slave axis. This dependency is stored in the FlexProfile.

Typical use cases:

- Time-controlled profiles for thermoforming machines
- Sealing axis with bagging machines
- FlyingShear/bottle fillers,...

FlexProfiles can be generated and loaded with the "CamBuilder" integrated in IndraWorks.



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

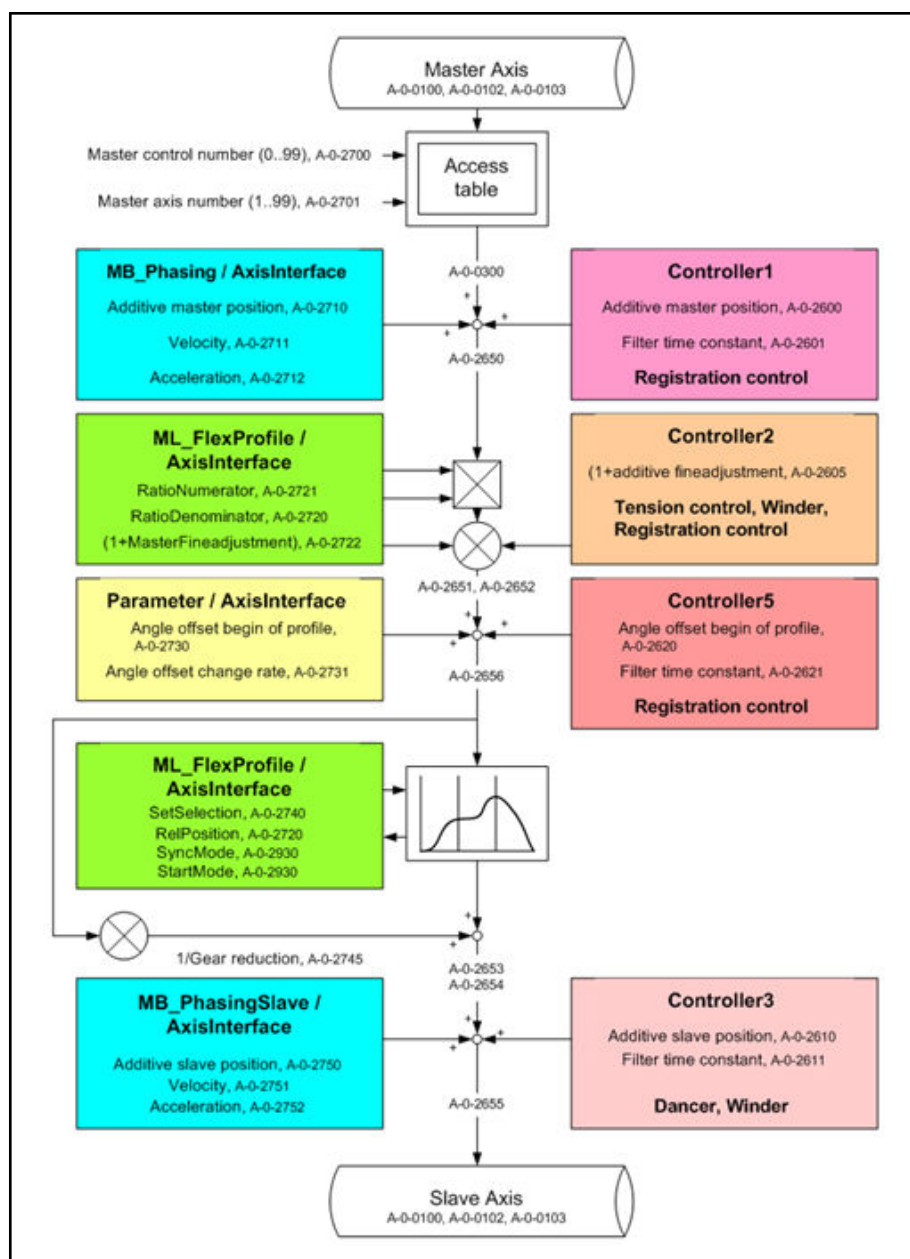


Fig. 7-35: Electronic MotionProfile FlexProfile MotionControl functional chain

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, ELS, phasing, additive position command value" can be defined via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, ELS, master axis gear, output revolutions" and "A-0-2720, ELS, master axis gear, input revolutions" and the "A-0-2722, ELS, gear ratio fine adjust". The fine adjustment value is specified in percent and calculated as (1 + fine adjustment).

The selection of one of the four possible FlexProfiles previously saved in the PLC:

These values are specified via ML_Flexprofile or the AxisInterface

- The additive slave axis position defined by "A-0-2750, ELS, PhasingSlave, additive position command value" can be defined via MB_PhasingSlave or the AxisInterface

The configuration of the "FlexProfile" mode is comprehensive and described in the documentation on the "ML_FlexProfile" function block (refer to the documentation "IndraLogic XLC IndraMotion MLC 14VRS PLCopen Libraries").

7.10 Boundary conditions for an axis velocity specification in the PLCopen state "Synchronized Motion"

The following condition applies to an axis calculated in the control (axis with interpolation in the control, virtual axis, encoder axis, controller axis, link axis) and generating a velocity command value for a coupled axis (in PLCopen state "Synchronized Motion"):

The velocity specification must not exceed the following maximum value $n_{\max}$ (Shannon sampling theorem):

$$n_{\max} = 0.5 * \text{modulo value} / T_{\text{cyc}}$$

- with T_{cyc} Motion cycle time "C-0-0410, Motion, cycle time (T_{cyc}), actual value" in ms

- modulo value of the axis (A-0-0045, Modulo value)

The following applies to a module value of 360 degrees:

$$n_{\max} = (1000 \text{ rpm} * 0.5 * 60 \text{ ms}) / T_{\text{cyc}}$$

The following theoretical velocities result from certain cycle times:

Cycle time in ms	Velocity in rpm
1	30000
2	15000
4	7500
8	3750
16	1875

To ensure a safety distance to these theoretical values, a safety factor is taken into consideration.

The following values result for factor 0.95:

- for 1 ms: 28,500 rpm
- for 2 ms: 14,250 rpm
- for 4 ms: 7,125 rpm
- for 8 ms: 3,563 rpm
- for 16 ms: 1,781 rpm

The maximum velocity can also be achieved by specifying the command value to the master axis or by using gear and offset parameters between master axis/axes and slave axis/axes.

Example:

Two coupled virtual axes and one real coupled axis:

For T_{cyc} 4 ms, a command value of 80 rpm to a virtual master axis VA_1 and an electronic gear calculated on the control (parameter A-0-2720, ELS, master axis gear, input revolutions, A-0-2721, ELS, master axis gear, output

revolutions, for an axis calculated on the control) on the virtual axis VA2 of 100 (-> command value 8,000 rpm for the coupled real axis), this condition is not complied with!

For MLC 13V12 and higher, the error "F5113002, Velocity too high for cycletime" is generated when the velocity is exceeded!

All axes are decelerated!

Possible remedy when reaching this boundary condition:

- Specify a lower command value or adjust the command value specification to the Motion cycle time
- Reducing the Motion cycle time
- Move the gears calculated in the control to the drive (for an axis with interpolation in the drive) if required

7.11 Axis commissioning

7.11.1 Overview

Use the "Axis Commissioning" dialog in the context menu of the "Motion" node to move axes without writing a PLC program. This is especially useful during commissioning if the PLC program is not complete or if an axis is to be moved differently as intended in the PLC program for test purposes.

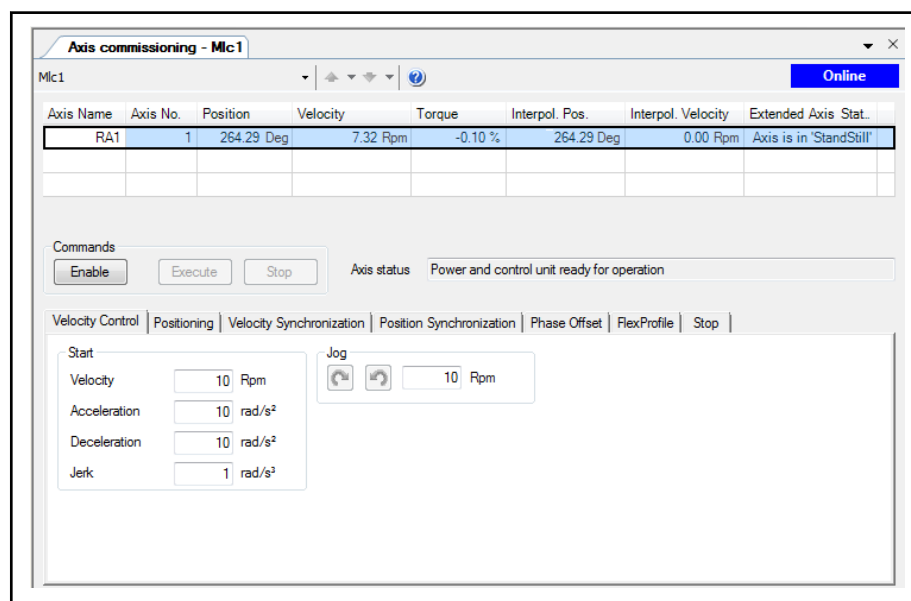


Fig. 7-36: "Axis Commissioning" dialog

The dialog is divided into an overview and a details section. The most important axis data can be displayed in the overview section. Axes to be moved can also be selected in this dialog. In the details section, motion commands can be sent to the currently selected axis. These motion commands orient at the state diagram of the PLCopen (refer to the manual "MLC 14VRS PLCopen Libraries", chapter "State Diagram of a Real Axis") and are the same as those commands created by the respective function blocks.

All axis types can be displayed in the overview section of the dialog, but motion commands can only be sent to real, virtual and controller axes (only MLC). All other axis types are only displayed due to reasons of clarity.

Overview section

In this section, select the axes to be displayed and moved. Thus, click on a field in the "Axis Name" column and select the axis. To remove an axis from the overview section, select the empty entry or press <Del> after selecting a line.

The most important information on each axis is displayed in the table. More information is displayed in the tooltip when moving the mouse pointer over the corresponding axis.

Details section

All commands as well as the axis status in the details section refer to the axis selected in the overview section. Select the motion type and the corresponding command values via the tabs. All fields of a tab are only input fields and not automatically updated. If an invalid value is entered (entry is no digit for example), the input field and its tab are colored in red and an error message is displayed in the tooltip of the entry field. No motion command can be sent to the axis (corresponding buttons are disabled).

7.11.2 Safety functions

Before the actual commissioning dialog is displayed, confirm that the required measures for a safe axis operation were performed.

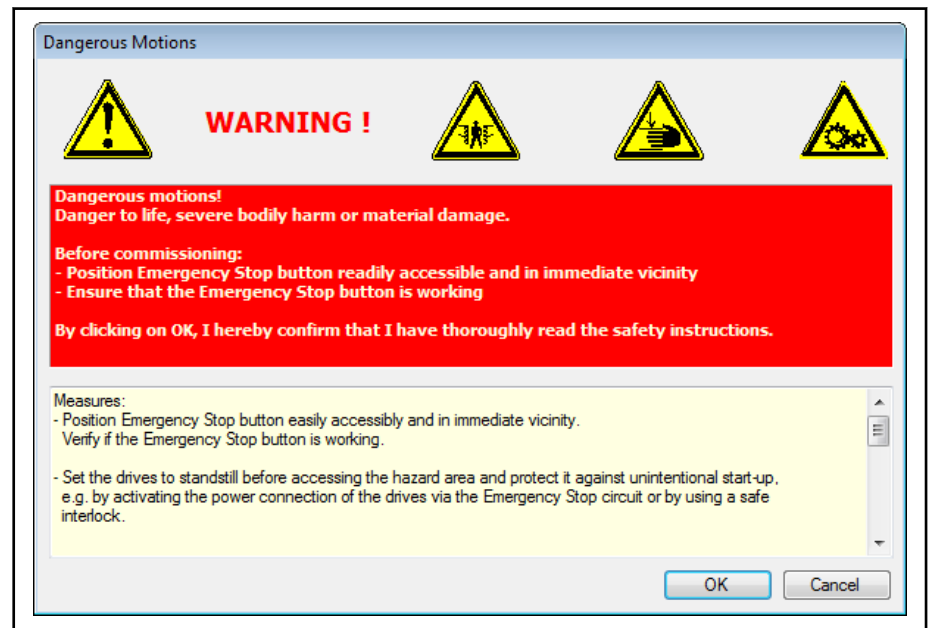


Fig. 7-37: Warning when opening the commissioning dialog

While the dialog is open, click on the "Stop" window to stop all axes.

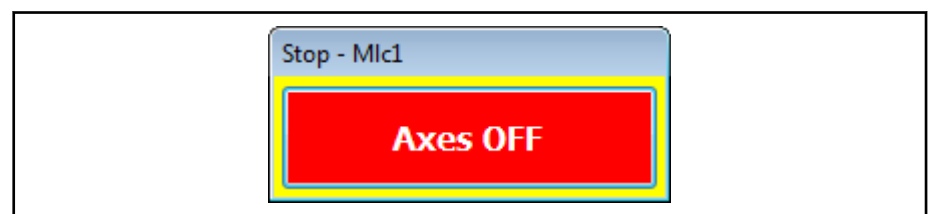


Fig. 7-38: Stopping axes



Real axes with interpolation in the drive cannot be stopped if the axes are already in the "Stopping" state. In this case, the axis is stopped with its originally set deceleration values ("stopping" the axis with changing deceleration values) is not possible.

Ensure that real axes with interpolation in the drive are not stopped with deceleration values that are too low.

Axes may only be moved as long as axes are displayed in the dialog. Thus, all axes are stopped when the dialog is closed. Furthermore, a running axis cannot be deleted or changed in the overview section.

To avoid conflicts with the PLC program, axes can only be moved if one of the following conditions apply:

- All PLC user applications are stopped
- All running PLC user application contain the variable "AllowAxisCommissioning". Its value is TRUE in the "UserVarGlobal" or "UserVarAppGlobal" if a device application is used. To move axes at a running PLC, create a Boolean variable named "AllowAxisCommissioning" in the node "UserVarGlobal" or "UserVarAppGlobal". Apply this variable to the symbol configuration of the PLC and set its value to TRUE. Thus, the PLC program can control whether and when moving axes via the dialog is permitted

If axes are moved via the commissioning dialog and if the previously mentioned conditions are not fulfilled anymore, all axes are immediately stopped and further motion commands are inhibited.



When closing the dialog, a stop command is sent to all running axes and it is waited for their standstill. If an axis requires more than two seconds up to the standstill, the dialog is still closed and a warning is issued in the IndraWorks status bar. In this case, the axis is still stopped, but remains in the "Stopping" state. To finally stop an axis ("Standstill" state), open the dialog at any time and issue the "Stop" command again to the axis. Alternatively, the axis can also be stopped via the PLC.



Response when connection is interrupted between the IndraWorks interface and the control

If the connection between PC and control is interrupted (e.g. network cable defective or removed), the control outputs the error "F536000E MLPI: Watchdog error". This stops all commanding axes automatically.

7.11.3 Enabling an axis

To move a real or a controller axis (only MLC), the axis must be enabled. The enabling functionality corresponds to the one of the "MC_Power" function block (refer to the documentation "MLC 14VRS PLCOpen Library"). An enabled axis is always highlighted in green in the overview and details section. If the button is pressed again, enabling is canceled.

To enable an axis, the following prerequisites have to be met:

- Sercos bus is in P4 (operating mode)
- Axis is not in P2 (parameterization mode)
- Control and power section are ready for operation (bit 14 is set in the parameter A-0-0021)

- No error is present at the axis

If one of the mentioned prerequisites is not met, the **Enable** button is disabled and the missing prerequisites are shown as tooltip next to the **Enable** button.

Virtual axes are automatically enabled and thus do not have to be enabled explicitly by the user (they can receive a Motion command immediately).

7.11.4 Velocity control

An enabled axis can be moved at a constant velocity in the "Velocity Control" tab. Enter velocity, acceleration and jerk values into the corresponding fields and press **Execute**. If the button is pressed again, the command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the one of the "MC_MoveVelocity" function block (refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
Start/Velocity	Velocity
Start/Acceleration	Acceleration
Start/Deceleration	Deceleration
Start/Jerk	Corresponds to the content of the parameter A-0-0216 when starting the command

Tab. 7-4: Input fields in the dialog on the inputs of the MC_MoveVelocity function block

The "Jog" section can be used to move the axis only when the corresponding button is pressed. The velocity command value from the "Jog" section is used. The acceleration and jerk values originate from the "Start" section.

7.11.5 Positioning

An enabled axis can be moved to a position in the "Positioning" tab. Enter position, velocity, acceleration and jerk values into the corresponding fields and press **Execute**. If the button is pressed again, the command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the one of the "MC_MoveAbsolute" function block (refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
Start/Position	Position
Start/Velocity	Velocity
Start/Acceleration	Acceleration
Start/Deceleration	Deceleration
Start/Jerk	Corresponds to the content of the parameter A-0-0216 when starting the command

Tab. 7-5: Input fields in the dialog on the inputs of the MC_MoveAbsolute function block

Alternatively, use the "Jog" section to move the axis along a relative position. This function corresponds to the function of the function block "MC_MoveRelative" (refer to the documentation "MLC 14VRS PLCopen Library"). The incre-

mental position command value from the "Jog" section is used. The acceleration, velocity and jerk values originate from the "Start" section.

The button **Position data reference** is used to determine the zero point of real axes. The Sercos bus has to be in phase 4, the axis may not be connected to power and no error may be present for the axis.

7.11.6 Velocity synchronization

In the "Velocity Synchronization" tab can be specified whether the velocity of an enabled axis is synchronized to the velocity of another axis. Enter master axis and gear settings into the input fields and press **Execute**. If the button is pressed again, the command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the one of the "MC_GearIn" function block (refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
"Master axis" range	Master
Gear/Input revolutions	RatioDenominator
Gear/Output revolutions	RatioNumerator
Gear/Fine adjustment	MasterFineadjust

Tab. 7-6: Input fields in the dialog on the inputs of the MC_GearIn function block

7.11.7 Position synchronization

In the "Position Synchronization" tab can be specified whether the position of an enabled axis is synchronized to the position of another axis. Enter master axis, gear and synchronization settings into the corresponding fields and press **Execute**. If the button is pressed again, the command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the one of the "MC_GearInPos" function block (refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
"Master axis" range	Master
Gear/Input revolutions	RatioDenominator
Gear/Output revolutions	RatioNumerator
Gear/Fine adjustment	MasterFineadjust
Synchronization/direction	SyncMode
Synchronization/starting mode	StartMode

Tab. 7-7: Input fields in the dialog on the inputs of the MB_GearInPos function block

7.11.8 Phase offset

An additional phase offset between two synchronized axes can be set in the "Phase Offset" tab. Enter phase, velocity and acceleration values into the corresponding fields and press **Execute**. If the button is pressed again, the

command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the functionality of the function blocks "MB_Phasing" and ("MB_PhasingSlave" refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
Start/Phase offset	Position
Start/Velocity	Velocity
Start/Acceleration	Acceleration
Start/Deceleration	Deceleration
Effect on the position of master axis/ slave axis	Function analog to the function blocks MB_Phasing/MB_PhasingSlave

Tab. 7-8: Input fields in the dialog on the inputs of the function blocks MB_Phasing and MB_PhasingSlave

7.11.9 FlexProfile

An enabled axis can be synchronized to another axis via a cam in the "Flex-Profile" tab. Enter the command values into the input fields and press **Execute**. If the button is pressed again, the command values are again transferred to the axis. The axis does not have to be stopped.

The functionality corresponds to the one of the "MC_FlexProfile" function block (refer to the documentation "MLC 14VRS PLCopen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
FlexProfile/Number	SetSelection
"Master axis" range	Master
Starting mode and offset/Master axis	ProfileEntry and MasterOffset
Starting mode and offset/Slave axis	ProfileEntry and SlaveOffset
Gear/Input revolutions	RatioDenominator
Gear/Output revolutions	RatioNumerator
Gear/Fine adjustment	MasterFineadjust
Starting options/Processing type	ExecutionMode
Starting options/Switching position	UseSwitchingPosition and SwitchingPosition
Synchronization	SyncType
Synchronization/Velocity	SyncVelocity
Synchronization/Acceleration	SyncAcceleration

Tab. 7-9: Input fields in the dialog on the inputs of the ML_FlexProfile function block

7.11.10 Stop

An enabled axis can be stopped in the "Stop" tab. Enter deceleration and jerk values into the input fields and press **Execute**.

The command values in this tab are also used when pressing the **Stop** button. Which tab is selected is of no importance.



A changed deceleration value for the stop is not applied to real axes with interpolation in the drive if the stop was already commanded with a different value.

A new value can only be commanded after reaching the standstill message of the axis.

If the axis has to be stopped immediately with a changed deceleration value at active stop, stop the axis using E-Stop.

The functionality corresponds to the one of the "MC_Stop" function block (refer to the documentation "MLC 14VRS PLCOpen Library"). The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block
Stop/Deceleration	Deceleration
Stop/Jerk	Corresponds to the content of the parameter A-0-0216 when starting the command

Tab. 7-10: Input fields in the dialog on the inputs of the "MC_Stop" function block

7.12 Validating Motion configuration

7.12.1 Overview

In the Motion configuration download or when switching online, IndraWorks checks the entered Motion configuration automatically on project planning errors. The validation result is displayed in the task list as error and warning messages. It is validated in several steps: First, it is validated offline. An error in this validation aborts the complete action. Otherwise, it is switched to online mode and then validated online.

The offline validation checks the data projected on the PC and includes the following checks:

- Name checks for controls, axes, kinematics, etc.
- Consistency checks for axis and kinematic numbers as well as Sercos addresses
- Check for maximum number of axes, kinematics, function modules, etc. allowed.
- Consistency checks for function modules

The online validation checks the data consistency in the control and includes the following checks:

- Check for the function packages of the connected drives
- Check for cross communication configuration of the control
- Check for axis parameter consistency

Validation can be started manually at any time via the context menu of the control. The extent of validation depends on the connection state. The offline validation is always performed. If the control is switched to online, there is an online validation.

Outputting warnings while "validating" can be enabled or disabled via the XLC/MLC "Options" dialog under **Tools ▶ Options... ▶ XLC / MLC** "Switch on-

line/offline" under "Message visibility" (see [fig. 7-14 "IndraWorks menu item Tools → Options → XLC/MLC → Switch Online/Offline" on page 531](#)).

For a better identification, a unique name is assigned to each error and warning message in the task list. Use this name to search for the message in the online help for example. The name format is:

MLs-<Type><Digit><Class><Number>.

The meanings of the individual fields is as follows:

- <Type>: Message type
 - E: It is an error message (Error)
 - W: It is a warning message
- <Digit>: This field is reserved and always contains the value 0
- <Class>: This field indicates the type of object affected. The following values are defined:
 - A: The message refers to an axis
 - C: The message refers to a control (controller)
 - F: The message refers to a function module
 - L: The message refers to the cross communication (link configuration)
 - P: The message refers to the complete project
 - K: The message refers to a kinematics
 - S: The message refers to a Sercos device
 - X: The message has no special object reference
 - Y: The message refers to an object with safety engineering
- <Number>: A four-digit number.

Example:

The message MLs-E0A0001 is an error message for an axis. The message MLs-W0S0013 is a warning for a Sercos device.



Messages for controller axes, kinematics, Sercos function modules and cross communication are only relevant for the IndraMotion MLC.

7.12.2 Error messages

General information

Error messages refer to fatal input errors. Thus, the current Motion configuration cannot be used to switch online.

An example of a fatal error is the use of an axis name that is not IEC-compliant, since the axis can then not be accessed in the PLC program. An IEC-compliant name may only comprise letters, digits and the underscore. The first character may not be a digit. Additionally, two underscores may not directly follow each other and the last character may not be an underscore.

Examples of IEC-compliant names: ABCD, _ABCD, ABCD1, A_B_C_D, ABCD_1

Examples of non-IEC-compliant names: 1ABCD, __ABCD, AB__CD, ABCD_

Another example of a fatal error are names that do not comply with the RCL naming convention, but used in a kinematics. An RCL-compliant name may

only comprise letters, digits and the underscore and the first character may not be a letter. Additionally, the maximum length of such a name is limited to twelve characters. The name of an axis used in a kinematics has thus to comply with the RCL naming conventions as well.

Axis error messages

MLs-E0A0001: The axis name '<Name>' is not IEC-compliant

Cause The axis name specified does not comply with the naming conventions of the IEC-61131 standard. To reference an axis in a PLC program, IndraWorks automatically creates a global variable with the axis name. Thus, the axis name has to be IEC-compliant.

Solution

- Change the axis name to an IEC-compliant name

MLs-E0A0002: The axis name <Name> below the control is not unique

Cause The same name was specified for two (or more) axes below one control. To uniquely identify an axis, its name may only be specified once in one control.

Solution

- Rename one of the two axes
- Delete one of the two axes

MLs-E0A0004: The axis <Name> and a kinematics have the same name

Cause The same name was specified for an axis and a kinematics (only IndraMotion MLC). Since axes and kinematics are declared as global variables in the PLC program, their names have to differ.

Solution

- Rename the axis
- Rename the kinematics
- Delete the axis
- Delete the kinematics

MLs-E0A0005: The axis <Name> and a drive have the same name

Cause The same name was specified for an axis and a multiple-axis drive. Since this might cause misunderstandings, the names have to differ.

Solution

- Rename the axis
- Rename the drive
- Delete the axis
- Delete the drive

MLs-E0A0010: The number of projected axes (<Digit1>) is higher than the maximum number of axes allowed (<Digit2>)

Cause The number of projected axes exceeds the number the control is able to process. The maximum number of supported axes is written in <Digit2>.

Solution

- Delete the surplus axes
- Convert the control into a control type of higher performance

MLs-E0A0012: The axis number <Digit> is invalid

Cause An axis was specified with a number higher than supported by the control.

Solution

- Delete the axis
- Convert the control into a control type of higher performance

MLs-E0A0013: The axis number <Digit> below the control is not unique

Cause The same number was specified for two (or more) axes below one control. To uniquely identify an axis, its number may only be assigned once in one control.

Solution

- Change the axis number of an axis to a unique number in the "Properties" dialog
- Delete one of the two axes

MLs-E0A0014: The axis name <Name> is longer than permitted (maximum <Digit> characters)

Cause The specified axis name is too long. The maximum length is written in <Digit>.

Solution

- Enter a shorter name for the axis

MLs-E0A0015: The axis identification <Unique ID> below the control is not unique

Cause The unique ID of an axis exists multiple times below a control. This indicates a corrupt project.

Solution

- Export all respective axes. Delete the axes and import them again. When switching online the next time, the parameters of the axes can also be backed up

MLs-E0A0020: The encoder axis <Name1> is assigned to the real axis <Name2> This axis does not support any encoder axes.

Cause The encoder axis <Name1> was assigned to the real axis <Name2>, but these axes do not support any encoder axes.

Solution

- Assign a real axis supporting encoder axes to the encoder axis
- Delete the encoder axis

MLs-E0A0021: The encoder axis <Name> is not assigned to a real axis

Cause The encoder axis was not assigned to a real axis or the assigned real axis was deleted.

Solution

- Assign a real axis to the encoder axis
- Delete the encoder axis

MLs-E0A0022: The axis <Name> does not match the projected Sercos protocol

Cause A drive was projected, but it does not match the set Sercos protocol, e.g. an EcoDrive was configured for Sercos III even though it requires a Sercos II master communication (only IndraMotion MLC). The Sercos protocol is indirectly set via the function module configuration, e.g. via the configuration of the Sercos II function module.

Solution

- Adjust the function module configuration for the master communication
- Delete the drive

MLs-E0A0024: The firmware <Name1> of the axis <Name2> is invalid

Cause A drive was projected. The drive firmware is not supported by the control, as an old project was converted or drives were imported from an old import file for example.

- Solution**
- Open the properties of the axis and change the firmware of the drive to a supported version
 - Delete the axis and add a drive of the "SercosDrive" type instead

MLs-E0A0030: For this axis, the control only supports the basic package "Closed Loop"

- Cause** The "Open Loop" basic package was configured for a real axis, but the control firmware does not support this basic package. In some cases, the cause can also be that the basic package is not supported by the drive.

- Solution**
- Upgrade to a control firmware supporting the "Open Loop" basic package
 - Replace the drive with a drive supporting the "Open Loop" basic package
 - Replace the drive with a drive with the basic package "Closed Loop"

MLs-E0A0100: A conversion error was determined causing missing internal axis data

- Cause** This project was transferred from an earlier IndraWorks (08VRS, 09VRS), but errors occurred during the conversion.

- Solution**
- Open the properties of the respective control and click **OK**. This corrects the internal data of all axes. Note that all parameters of the respective axes are reset to their default values upon next Motion configuration load to the control

MLs-E0A0500: The axis number <Digit1> is invalid for <Controller-Type>. The axis number has to be in the range from 1 to <Digit2>

- Cause** A hydraulic controller axis (only IndraMotion MLC) was specified with a number higher than supported by the control. In contrast to other axes, there are partially more restrictions for hydraulic controller axes with regard to their axis number. These restrictions depend not only on the control type, but also on the controller type.

Valid axis numbers for the controller type are specified in the validation message.

- Solution**
- Change the axis number
 - Delete the axis
 - Convert the control into a control type of higher performance

MLs-E0A0501: The maximum number of <Digit> controller axes of the type <ControllerType> was exceeded

- Cause** More hydraulic controller axes (only IndraMotion MLC) of the specified controller type than the control can process were projected. The maximum number of supported axes is written in <Digit>. In contrast to other axes, there are partially more restrictions for hydraulic controller axes with regard to their number. These restrictions depend not only on the control type but also on the controller type.

Valid axis numbers for the controller type are specified in the validation message.

- Solution**
- Delete the axes of the specified controller type
 - Convert the control into a control type of higher performance

MLs-E0A0502: The task configuration required for the controller axes is incorrect

Cause The tasks required to control hydraulic controller axes (only IndraMotion MLC) ("HCBackgroundTask", "HCCmdTask" and "HCSercosSyncTask") are deleted, renamed or modified. Apart from the direct manipulation of the tasks, this error can also occur after importing controller axes from a different project without importing the tasks.

Solution

- Open the "Properties" dialog of one of the controller axes the error was reported for and exit the dialog via **OK**. This creates all required tasks again

MLs-E0A0504: The hardware connection <Name> selected in the controller axis is not supported in this version!

Cause After changing the project version, the currently selected hardware connection becomes invalid.

Solution

- Open the properties dialog of the controller axis and check or correct the settings on the tab pages "Signals, general" and "Signal assignment". After the adjustment, press **OK** to close the dialog

MLs-E0A0505: The controller type '<Name>' is not supported by controls of type '<DeviceType>'

Cause A controller axis was created that is not supported by the projected device type of the control.

Solution

- Change the projected device type in the "Properties" dialog of the control
- Delete the controller axis

MLs-E0A0511: The program implementation of the controller axes is incorrect: <DetailedMessage>

Cause The automatically generated program implementation of the hydraulic controller axes (only IndraMotion MLC) in the "HydrControl" directory was manually modified. This is invalid. The program implementation may only be opened and viewed for diagnostic purposes.

Solution

- Open the "Properties" dialog for each controller axis the error was reported for and exit the dialog via **OK**. This creates a directory and the program implementation required for this axis is generated in the directory. The programming implementations of all controller axes can be created at once by executing the function **Create ► Clear**

MLs-E0A0520: The input or output assignment determined in the controller axis is incorrect

Cause I/O devices assigned to hydraulic controller axes (only IndraMotion MLC) or their variable assignment were changed. This interrupted the logic connection between the I/O device and the program implementation.

Solution

- Open the "Properties" dialog of each controller axis the error was reported for and check the settings in the "Signal Assignment" tab. Make changes if required and exit the dialog with **OK**. This creates all required variable definitions again

MLs-E0A0521: The axis configuration of the project changed

Cause Axes assigned to a hydraulic controller axis (only IndraMotion MLC), e.g. synchronization controllers were renamed or deleted. This interrupted the logic connection to the controller axis.

- Solution**
- Open the "Properties" dialog of the controller the error was reported for and adjust the axis assignment

MLs-E0A0590: No controller application is specified for the controller axis.

- Cause** There is one controller axis and multiple applications below the "Device" application. None of these applications contains the code for the controller axis.

- Solution**
- Open the "Properties" dialog of the controller axis the error was reported for and select a controller application.

MLs-E0A0591: There are several controller applications (<App1>, <App2>).

- Cause** There are multiple applications containing the code to compute the controller axes. In the runtime, the computation of controller axes is limited to one application.

- Solution**
- Open the "Properties" dialog of the controller axis the error was reported for and select a controller application. Then, all controller axes are computed in this application.

Control error messages

MLs-E0C0001: The control name <Name> is not IEC-compliant

- Cause** The control name specified does not comply with the naming conventions of the IEC-61131 standard.

- Solution**
- Change the control name to an IEC-compliant name

MLs-E0C0002: The control name <Name> in the project is not unique

- Cause** The same name was specified for two (or more) controls in the project. To uniquely identify a control, its name may only be specified once in the project.

- Solution**
- Rename one of the two controls
 - Delete one of the two controls

MLs-E0C0003: The hardware "VEP" is not supported as control by IndraWorks

- Cause** An older project was opened. This project contains a control of the type "IndraMotion MLP VEP" or "IndraLogic XLC VEP". These controls are not supported by IndraWorks anymore for 12VRS or higher.

- Solution**
- Convert the control into a supported control type
 - Delete the control

MLs-E0C0004: A control firmware of the version {VersionNumber} is not supported by this IndraWorks version

- Cause** An older project was opened, in which a firmware - not supported anymore by the IndraWorks version - is entered for the control.

- Solution**
- Change the firmware in the "Properties" dialog of the control to a supported version and load the firmware to the control
 - Open the project with a firmware suitable for the IndraWorks version

MLs-E0C0005: The device <Hardware> (<Version>) is not installed

- Cause** The project contains a control for which no device description is installed. This indicates that either the project was opened with a wrong IndraWorks version or the IndraWorks installation is faulty.

- Solution**
- Open the project with a suitable IndraWorks version or

- Repair the IndraWorks installation

MLs-E0C0006: The firmware release <Firmware> is not supported

Cause The project contains a control whose firmware release is not supported. This can be the case if the control was created with an IndraWorks test version and is now edited with an officially released IndraWorks version.

Solution

- Change the firmware release to a supported release in the "Properties" dialog of the control. Remember to update the firmware in the control (firmware download)

MLs-E0C0007: The projected firmware of the control (<Firmware>) does not match the compiler version <Version>

Cause The PLC compiler version of the project is set to a ≥ 3.5 , but the firmware version of the control is <14VRS. Starting from the PLC compiler version 3.5, the compiler checks the variable declaration of the type `VAR_IN_OUT`. A symbol transferred to an FB instance has to be a variable and may thus not be a constant. This intensified check causes incompatibilities with the Motion function blocks provided up to the firmware version 13VRS to which a constant of type `AXIS_REF` - defined in the automatically created declaration "MlcVarGlobal" - can be connected. In 14VRS and higher, the variable declarations of the Motion function blocks were changed to the type `VAR_IN_OUT CONSTANT`. These function blocks now fully match the new PLC compiler version.

Solution

- Set the PLC compiler version to a value <3.5 (menu item "Project/PLC Compiler Version...")
- Convert the control into a firmware version ≥ 14 VRS ("Properties" dialog of the control)

MLs-E0C0008: The configured control (<Firmware>) supports a maximum of n application(s)

Cause Too many applications created below the device application of the control. To log in, the specified number of applications must not be exceeded.

Solution Reduce the number of applications or use a control with a higher performance.

MLs-E0C0010: The IP address <IP address> of the control is not unique in the project

Cause The same IP address was assigned to two (or more) controls in the project. This can cause access conflicts while establishing a connection (logging in or switching online). Thus, one IP address may only be specified once in a project.

Solution

- Change the IP address of one of the two controls
- Delete one of the two controls

MLs-E0C0014: The control name <Name> is longer than permitted (maximum <Digit> characters)

Cause The specified control name is too long. The maximum length is written in <Digit>.

Solution

- Enter a shorter name for the control

MLs-E0C0101: Without the selected "Motion" function package, the external event of the "GATMotionSyncTask" task has to be of type "EVENT_OP_MODE_SERCOS_CYCLIC"

Cause A control with GAT central/GAT decentral application and "Motion" function package was converted into a control without "Motion" function package.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Change the type of the external event of the "GATMotionSyncTask" task to "EVENT_OP_MODE_SERCOS_CYCLIC"
 - Convert the control into a control with "Motion" function package

MLs-E0C0102: With the selected "Motion" function package, the external event of the "GATMotionSyncTask" task has to be of the type "EVENT_OP_MODE_MOTION_CYCLIC"

Cause A control with "GAT central / GAT decentral application" and without "Motion" function package was converted into a control with "Motion" function package.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Change the type of the external event of the "GATMotionSyncTask" task to "EVENT_OP_MODE_MOTION_CYCLIC"
 - Convert the control into a control without "Motion" function package

MLs-E0C0103: For the TECHTEMPLATE library lower than 14VRS, the initializations of the units have to be adapted

Cause An existing control with GAT decentral application was converted on the control firmware 13VRS.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Add the "pfbAxis" input to the VAR_INPUT declaration of the FB_Init method of all units
 Insert the assignment with the input "pfbAxis := ADR(fbAxis);" into the Global Variable List of all units.
 Delete the following state code "arpAxis_gb[uiLoopIndex]:= ADR(fbAxis[uiLoopIndex]);" in the FB_Init method of the "TE_MachineControl" function block
 - Change the control firmware version to 14VRS

MLs-E0C0104: For the TECHTEMPLATE library higher than 13VRS, the initializations of the units have to be adapted

Cause An existing control with GAT decentral application was converted on the control firmware 14VRS.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Delete the "pfbAxis" input in the VAR_INPUT declaration of the FB_Init method of all units
 Delete the assignment with the input "pfbAxis" in the Global Variable List of all units.
 Insert the following state code "arpAxis_gb[uiLoopIndex]:= ADR(fbAxis[uiLoopIndex]);" after the line "fbAxis[uiLoopIndex].mInitExtension(ui-

LoopIndex);" into the FB_Init method of the "TE_MachineControl" function block

- Change the control firmware version to 13VRS

MLs-E0C0105: The global axis <Name> assigned to the GAT axis <Name> does not exist

Cause There is a GAT axis in the project. Its assignments to a global axis is not defined.

- Solution**
- Double-click on the error message line to open the "Properties" dialog of the GAT axis and select a valid global variable
 - Create a global axis '<Name>'

MLs-E0C0106: For the TECHINTERFACE library lower than 14V06, the implementation has to be adapted

Cause An existing control with an AxisInterface application was converted on the control firmware lower than 14V06.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Open the action "actPhaseShift" of the "TE_AxisInterface" function block and replace the existing code "UDINT_TO_DWORD (AdminStatusExt._OpModeAck)" by "UINT_TO_WORD (AdminStatusExt._OpModeAck)"
 - Change the control firmware version to higher than 14V04

MLs-E0C0108: The global kinematics '<Name>' assigned to the GAT kinematics '<Name>' does not exist.

Cause There is a GAT kinematics in the project. Its assignments to a global kinematics is not defined.

- Solution**
- Double-click on the error message line to open the "Properties" dialog of the GAT kinematics and select a valid global kinematics
 - Create a global kinematics '<Name>'

MLs-E0C0110: The initializations of the axes have to be adapted for the SEQPROG library lower than 14V08.

Cause An existing control with a sequential program was converted to a control firmware lower than 14V08.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Open the "mOneTimeInit" method of the "TE_MachineControl" function block and replace the existing code ".Axis := MlcVarGlobal." in the wizard area "SEQUENTIAL AXES INITIALIZATION" with ".Axis REF= MlcVarGlobal."
 - Change the control firmware version equal to or higher than 14VRS

MLs-E0C0111: The initializations of the axes have to be adapted for the SEQPROG library higher than or equal to 14V08.

Cause An existing control with a sequential program was converted to a control firmware higher than or equal to 14V08.

- Solution**
- Double-click on the line of the error message to automatically perform the changes

- Open the "mOneTimeInit" method of the "TE_MachineControl" function block and replace the existing code ".Axis REF= MlcVarGlobal." in the wizard area "SEQUENTIAL AXES INITIALIZATION" with ".Axis := MlcVarGlobal."
- Change the control firmware version lower than 14V08

MLs-E0C0112: The implementation of the HydraulicBasic plugin has to be adapted for the SEQPROG library lower than 14VRS.

Cause An existing control with a HydraulicBasic plugin was converted to a control firmware lower than 14VRS.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Open the declaration part of the "MH_AxisInterfaceTypeHydraulic" function block and replace the existing code
 - "//TorqueModeCtrl: REFERENCE" with "TorqueModeCtrl: REFERENCE"
 - "//rOldTorque:" with "rOldTorque:"
 - "//rOldTorqueRamp:" with "rOldTorqueRamp:"
 - "//fbAxisTorqueControl:" with "fbAxisTorqueControl:"
 - Open the "mInitExtension" method of the "MH_AxisInterfaceTypeHydraulic" function block and replace the existing code in the implementation part
 - "//TorqueModeCtrl" with "TorqueModeCtrl"
 - Open the "mCheckReferences" method of the "MH_AxisInterfaceTypeHydraulic" function block and replace the existing code in the implementation part
 - "///(ADR(TorqueModeCtrl) = 0) OR" with "(ADR(TorqueModeCtrl) = 0) OR"
 - Change the control firmware version lower than 14V08

MLs-E0C0113: The implementation of the HydraulicBasic plugin has to be adapted for the SEQPROG library higher than or equal to 14VRS.

Cause An existing control with a HydraulicBasic plugin was converted to a control firmware higher than or equal to 14VRS.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Open the declaration part of the "MH_AxisInterfaceTypeHydraulic" function block and replace the existing code
 - "TorqueModeCtrl: REFERENCE" with "//TorqueModeCtrl: REFERENCE"
 - "rOldTorque:" with "//rOldTorque:"
 - "rOldTorqueRamp:" with "//rOldTorqueRamp:"
 - "fbAxisTorqueControl:" with "//fbAxisTorqueControl:"
 - Open the "mInitExtension" method of the "MH_AxisInterfaceTypeHydraulic" function block and replace the existing code in the implementation part
 - "TorqueModeCtrl" with "//TorqueModeCtrl"

- Open the "mCheckReferences" method of the "MH_AxisInterfaceType-Hydraulic" function block and replace the existing code in the implementation part
 - "(ADR(TorqueModeCtrl) = 0) OR" with "///(ADR(TorqueModeCtrl) = 0) OR"
- Change the control firmware version lower than 14VRS

Function module error messages

MLs-E0F0010: The number of projected function modules (<Digit1>) is greater than the maximum permissible number of function modules (<Digit2>)

Cause The number of projected function modules exceeds the number the control is able to process. The maximum number of supported function modules is written in <Digit2>.

- Solution**
- Delete the surplus function modules
 - Convert the control into a control type of higher performance

MLs-E0F0011: More than the valid number (<Digit>) of function modules of type <Name> were projected

Cause More function modules of type "name" were projected than allowed for the current control type. The maximum number allowed is written in <Digit>.

- Solution**
- Delete the surplus function modules
 - Convert the control to a control type supporting more function modules of this type

MLs-E0F0012: The slot <Digit> is not valid for the function module <Name>

Cause A invalid slot was assigned to a function value.

- Solution**
- Move the function module to a valid slot. For more detailed information on the special features, refer to the description of the function module

MLs-E0F0013: The function module <Name> on the slot <Digit> has to be plugged in as last function module

Cause More function modules were projected after plugging in the function module to be plugged in last. This is physically not possible, since no further function module can be plugged in at the left side of the function module. For more detailed information on the special features, refer to the description of the function module

- Solution**
- Move the function module to the last slot
 - Delete the following function modules

MLs-E0F0020: The function module <Name> is not valid for the current control type

Cause A function module not supporting by the current control type was projected.

- Solution**
- Delete the function module
 - Convert the control to a control type supported by the function module

MLs-E0F0021: The device description file for the device <Name> is not installed

Cause A function module "<Name>" was projected. Its device description is not installed.

- Solution**
- Install the device description for the function module
 - Delete the function module

Extension module error messages

MLs-E0E002: The slot (<Digit1>) of the extension module below the control is not unique.

Cause Two (or more) plug-in cards were projected with the same slot number.

- Solution**
- Adjust the slot numbers in the "Properties" dialog or on "Parameters" site of the extension modules.
 - Delete the extension modules with double slot number

MLs-E0E0010: The number of projected extension modules (<Digit1>) is higher than the maximum number of extension modules permitted (<Digit2>)

Cause More plug-in cards were projected than available in the control. The maximum number of supported plug-in cards is written in <Digit2>.

- Solution**
- Delete the surplus extension modules

MLs-E0E0011: More extension modules of the type <Name> were projected than permitted (<Digit>)

Cause More plug-in cards of the type <Name> were projected than permitted for the current control type. The maximum number allowed is written in <Digit>.

- Solution**
- Delete the surplus extension modules

MLs-E0E0020: The extension module <Name> is not permitted for the current control type

Cause A plug-in card - that is not supported by the current control type - was projected.

- Solution**
- Delete the extension module
 - Convert the control into a control type supporting the extension module

MLs-E0E0021: The device description file for the device <Name> is not installed

Cause An extension module "<Name>" was projected. Its device description is not installed.

- Solution**
- Install the device description for the extension module
 - Delete the extension module

Kinematic error messages (only IndraMotion MLC)

MLs-E0K0001: The kinematic name <Name> is not IEC-compliant

Cause The kinematic name specified does not comply with the naming conventions of the IEC-61131 standard. To reference an axis in a PLC program, IndraWorks automatically creates a global variable with the name of the kinematics. Thus, the kinematic name has to be IEC-compliant.

- Solution**
- Change the kinematic name to an IEC-compliant name

MLs-E0K0002: The kinematic name <Name> below the control is not unique

Cause The same name was specified for two (or more) kinematics below one control. To uniquely identify a kinematics, its name may only be specified once in one control.

- Solution**
- Rename one of the two kinematics
 - Delete one of the two kinematics

MLs-E0K0005: The RCL program name <Name> below the control is not unique

Cause The same name was specified for two (or more) RCL programs below one control. To uniquely identify an RCL program, its name may only be specified once in one control.

- Solution**
- Rename one of the two RCL programs
 - Delete one of the two RCL programs

MLs-E0K0006: The axis name <Name> does not comply with the RCL naming conventions

Cause An axis not complying with the RCL naming conventions is referenced in one kinematics. Thus, the axis cannot be used by the kinematics.

- Solution**
- Rename the axis
 - Use another axis in the kinematics

MLs-E0K0010: The number of projected kinematics (<Digit1>) is greater than the maximum permissible number of kinematics (<digit2>).

Cause The projected number of kinematics exceeds the number the control can process. The maximum number of supported kinematics is written in <Digit2>.

- Solution**
- Delete the surplus kinematics
 - Convert the control into a control type of higher performance

MLs-E0K0012: The kinematic number <Digit> is invalid

Cause A kinematics was specified with a number higher than supported by the control.

- Solution**
- Delete the kinematics
 - Convert the control into a control type of higher performance

MLs-E0K0013: The kinematic number <Digit> below the control is not unique

Cause The same number was specified for two (or more) kinematics below one control. To uniquely identify a kinematics, its number may only be specified once in one control.

- Solution**
- Delete one of the two kinematics

MLs-E0K0020: The axis assignment to position <Digit> is missing under the properties of the kinematics

Cause An axis that does not exist, since it has already been deleted for example, is referenced in a kinematics. <Number> indicates the respective line in the axis assignment of the kinematics.

- Solution**
- Correct the axis reference in the kinematics
 - Delete the kinematics

MLs-E0K0021: The first axis has to be configured as positioning axis

Cause The first axis of the kinematics was not configured as positioning axis.

- Solution**
- Configure the first axis of the kinematics as positioning axis

- Delete the kinematics

MLs-E0K0022: No kinematics was configured with the number <Digit>

Cause The kinematic numbers are not ascending consecutively. There are gaps in between. It is for example not permitted to project only the kinematic numbers 1 and 4, since the numbers 2 and 3 are then missing.

- Solution**
- Add a new kinematics with the missing number
 - Delete all kinematics with a higher number if these kinematics are not required

MLs-E0K0023: The axis <Name> is not unique in the kinematics

Cause The same address is referenced several times in the axis assignment of the kinematics. This is invalid.

- Solution**
- Modify the axis references in the kinematics until they are unique
 - Delete all ambiguous axis references

MLs-E0K0024: Belt axes <Digit1> were configured. Only a maximum of <Digit2> belt axes is permitted.

Cause More belt axes than allowed were configured in the kinematics.

- Solution**
- Delete the surplus belt axes or

MLs-E0K0025: Only <Digit1> positioning axes were configured. At least <Digit2> positioning axes are required for the kinematics

Cause Less positioning axes than required for this kinematic type were configured in one kinematics.

- Solution**
- Configure at least the number of positioning axes specified in <Digit2>
 - Change the kinematic type

MLs-E0K0027: The axis on position <Digit> cannot be configured after an empty axis

Cause A further axis was configured after an empty axis (axis type stands on "---") in a kinematics. This is invalid. <Digits> indicates the respective line in the axis assignment of the kinematics.

- Solution**
- Ensure that there are no empty elements between the individual axis references in the axis assignment of the kinematics

MLs-E0K0028: The positioning axis on position <Digit> cannot be configured after an orientation axis.

Cause A positioning axis was configured after an orientation axis in the axis assignment of the kinematics. This is invalid. <Digits> indicates the respective line in the axis assignment of the kinematics.

- Solution**
- Ensure that all orientation axes are configured after the positioning axes

MLs-E0K0029: The axis on position <Digit> is no belt axis and can thus not be configured after a belt axis.

Cause In the axis assignment of the kinematics, another axis, which is no belt axis, was configured after the first belt axis. This is invalid. <Digits> indicates the respective line in the axis assignment of the kinematics.

- Solution**
- Move the axis in front of the belt axes
 - Change the axis type to "belt axis"

MLs-E0K0030: 0 has to be entered as control number for the axis on position <Digit>, as it is no belt axis.

Cause In the axis assignments of the kinematics, a control number not equal to 0 was entered while assigning an axis, even though this axis was not a belt axis. Axis assignments with a control number not equal to 0 refer to an axis in the cross link and are only allowed for belt axes. <Digits> indicates the respective line in the axis assignment of the kinematics.

Solution

- Change the axis type to "belt axis"
- Enter 0 as control number and select the configured axis

MLs-E0K0031: The axis <Name> is impermissibly used in several kinematics (<kinematic list>)

Cause The same axis is referenced in several kinematics. This is only allowed for belt axes.

Solution

- Ensure that the axis is only referenced in one kinematics

MLs-E0K0032: The axis <Name> is already used as belt axis in the kinematics (<KinematicList>)

Cause In the axis assignment of the kinematics, an axis was referenced that is also referenced as belt axis by other kinematics. This is invalid. An axis referenced as belt axis by a kinematics may only be referenced as belt axis by other kinematics as well.

Solution

- Change the axis reference to an axis that has not been used yet
- Change the type of axis assignment to "belt axis"

MLs-E0K0033: The number of coordinates does not match the number of axes

Cause A number of axes was configured in the kinematics, but not the same number of coordinates. To reasonably operate a kinematics, the number of coordinates and the number of axes have to be equal.

Solution

- Adjust the number of coordinates to the number of axes
- Adjust the number of axes and coordinates

MLs-E0K0034: The coordinate name <Name> below the control is not unique

Cause The same name was specified for several coordinates in one kinematics. This is invalid.

Solution

- Specify unique names for the coordinates
- Delete all ambiguous coordinates

MLs-E0K0035: The coordinate name <Name> does not comply with the RCL naming conventions

Cause A name was specified for the coordinate of a kinematics. This name does not comply with the RCL naming conventions. Thus, the coordinate cannot be used by the kinematics.

Solution

- Rename the coordinate
- Delete the coordinate

MLs-E0K0037: The coordinate name <Name> is identical to an RCL keyword

Cause A name was specified for the coordinate of a kinematics. This name corresponds to an RCL keyword (e.g. "BEGIN"). Thus, the coordinate cannot be used by the kinematics.

Solution

- Rename the coordinate
- Delete the coordinate

MLs-E0K0038: No axis type was configured for the axis on position <Digit>

Cause An axis has been referenced in the axis assignment of the kinematics, but no axis type was entered.

Solution

- Enter the axis type
- Delete the axis assignment

MLs-E0K0039: The kinematic name <Name> does not comply with the RCL naming conventions

Cause A name was specified for a kinematics. This name does not comply with the RCL naming conventions. Thus, this kinematics cannot be used.

Solution

- Rename the kinematics
- Delete the kinematics

MLs-E0K0040: The kinematic name <Name> is identical to an RCL keyword

Cause A name was specified for a kinematics. This name corresponds to an RCL keyword (e.g. "BEGIN"). Thus, this kinematics cannot be used.

Solution

- Rename the kinematics
- Delete the kinematics

MLs-E0K0041: The axis name <Name> is identical to an RCL keyword

Cause An axis is referenced in a kinematics. The axis name corresponds to an RCL keyword (e.g. "BEGIN"). Thus, the axis cannot be used by the kinematics.

Solution

- Rename the axis
- Use another axis in the kinematics

MLs-E0K0042: The transformation number <Digit1> is smaller than the maximum valid value <Digit2>

Cause The value specified for the transformation number of a user-defined kinematics is too low. This causes a conflict between the internally used transformation numbers. Thus, the kinematics cannot be used.

Solution

- Specify a value higher than or equal to <Digit2> for the transformation number
- Delete the kinematics

MLs-E0K0047: The kinematic version <Version> is not supported by the control

Cause A kinematics was configured whose version is not supported from the projected control, e.g. no kinematic version "Robot Control V2" can be loaded to a control with a firmware version lower than 13V06.

Solution

- Increase the projected control version

- Delete the kinematics

MLs-E0K0048: The axis type <Type2> is invalid for the axis on the position <Number> (kinematic axis type <Type1>)

Cause An axis - whose type does not fit to the kinematic axis type - is referenced in a kinematics. Thus, it is not reasonable to use an encoder axis as positioning axis, since an encoder axis cannot be directly traversed.

- Solution**
- Change the kinematic axis type so that it matches the referenced axis
 - Reference an axis whose type fits with the kinematic axis type
 - Delete the axis assignment

MLs-E0K0049: The kinematics <Name> with the version "Robot Control V2" has a lower number (<Digit>) than at least one other kinematics with the version "Robot Control V1"

Cause The version of the kinematics is "Robot Control V2", but its kinematic number is lower than of a least one other kinematics with the version "Robot Control V1". This is not permitted. The numbers of the kinematics with the version "Robot Control V1" have to start with one and then increase consecutively. Only then, numbers of kinematics with the "Robot Control V2" version may follow.

- Solution**
- Assign the kinematics to the version "Robot Control V1"
 - Delete all kinematics with the version "Robot Control V1" whose kinematic number is higher than the number of the kinematics specified

MLs-E0K0050: Only <Digit1> orientation axes were configured. At least <Digit2> orientation axes are required for the kinematics

Cause Less orientation axes than required for this kinematic type were configured in one kinematics.

- Solution**
- Configure at least the number of orientation axes specified in <Digit2>
 - Change the kinematic type

MLs-E0K0053: The transformation scheme <Digit> of the kinematics is not supported by the control

Cause A transformation scheme, which is not supported by the control, was specified in a kinematics. This can be the case if the kinematics were imported from a different project not suitable for the control.

- Solution**
- Change the transformation scheme to "User-defined" for example
 - Delete the kinematics

MLs-E0K0054: The transformation scheme <Digit> of the kinematics is only supported from a control firmware version <Version>

Cause A transformation scheme, which is not supported by the current control firmware, was specified in a kinematics.

- Solution**
- Change the transformation scheme
 - Increase the firmware version of the control and its "Properties" dialog
 - Delete the kinematics

MLs-E0K0055: The transformation scheme <Digit> of the kinematics is only supported from a control firmware version <Version> or lower

Cause A transformation scheme, which is not supported anymore by the current control firmware, was specified in a kinematics. This can be the case if kinematics of an old project were applied.

- Solution**
- Change the transformation scheme
 - Reduce the firmware version of the control and its "Properties" dialog
 - Delete the kinematics

Cross communication error messages (only IndraMotion MLC)

MLs-E0L0012: The CrossComm Sercos III control address <digit> is invalid

- Cause** A control address has been entered in the Sercos III C2C configuration that are not within the valid range.
- Solution**
- Change the control address in the Sercos III C2C configuration

MLs-E0L0020: The control does not simultaneously support a Sercos II and a Sercos III cross communication

- Cause** A function module "CrossComm Sercos II" and a function module "CrossComm Sercos III" were projected for one control. Such a configuration is technically impossible.
- Solution**
- Delete the function module that is not required

MLs-E0L0021: A Sercos III cross communication is only possible if the master communication also takes place via Sercos III

- Cause** A function module "CrossComm Sercos III" was projected for a control, even though the cross communication takes place via Sercos II. Such a configuration is technically impossible.
- Solution**
- Delete the function module "CrossComm Sercos III"
 - Change the master communication to Sercos III by deleting the Sercos II function module

MLs-E0L0022: A Sercos III cross communication is only possible with the "Motion" function package

- Cause** A function module "CrossComm Sercos III" was projected for a control without "Motion" function package. Such a configuration is technically impossible.
- Solution**
- Delete the function module "CrossComm Sercos III"
 - Enable the "Motion" function package of the control
 - Convert the control into a control with "Motion" function package

MLs-E0L0023: A Sercos III cross communication is only possible with an activated Sercos master

- Cause** A function module "CrossComm Sercos III" was projected for a control without activated Sercos master. Such a configuration is technically impossible.
- Solution**
- Delete the function module "CrossComm Sercos III"
 - Enable the Sercos master
 - Convert the control into a control with Sercos master

Sercos device error messages

MLs-E0S0010: The number of projected Sercos devices (<Digit1>) is greater than the maximum permissible number of Sercos devices (<Digit2>)

- Cause** An invalid high number of Sercos devices was projected. The maximum number of Sercos devices is written in <Digit2>.
- Solution**
- Delete the surplus Sercos devices

MLs-E0S0012: The Sercos address <Digit> is invalid

- Cause** An invalid high Sercos address was projected for a Sercos device.
- Solution**
- If it is a Sercos III I/O device, change the Sercos address in the "Configuration Sercos devices" dialog
 - If it is a drive, change the Sercos address in the "Configuration of Sercos devices" dialog or in the "Properties" dialog of the corresponding axis
 - Delete the Sercos device

MLs-E0S0013: The Sercos address <Digit> below the control is not unique

- Cause** The same address <Digit> was assigned to several Sercos devices. Thus, the Sercos bus cannot be switched to BB.
- Solution**
- If it is a Sercos III I/O device, change the Sercos addresses in the participating devices in the "Configuration Sercos devices" dialog
 - If it is a drive, change the Sercos addresses of the participating devices in the "Configuration of Sercos devices" dialog or in the "Properties" dialog of the corresponding axis
 - Delete the surplus Sercos devices

MLs-E0S0014: The logic address <Digit> in the PLC devices of the control is not unique

- Cause** The same logic address <Digit> was assigned to several PLC devices. Thus, these devices cannot be uniquely identified anymore for the parameter communication.
- Solution**
- Open the editors of all affected PLC devices (double-click or via the context menu item "Open") and enter a unique logic address. Recommendation: If the logic address does not overlap with an axis number, enter the value specified in the "Sercos address" field for the logic address

MLs-E0S0015: The axis number <Digit1> overlaps with the logic address of the PLC device <Name> with the Sercos address <Digit2>

- Cause** An axis number overlapping with the logic address of a PLC device was specified for an axis. Thus, the axis and the PLC device cannot be uniquely identified anymore for the parameter communication.
- Solution**
- Open the "Properties" dialog of the corresponding axis and enter a unique axis number into this dialog
 - Open the editor of the affected PLC device (double-click or via the context menu item "Open") and enter a unique logic address. Recommendation: If the logic address does not overlap with an axis number, enter the value specified in the "Sercos address" field for the logic address

MLs-E0S0022: The I/O device <Name> does not match the projected Sercos protocol

- Cause** A Sercos III I/O device was projected, even though the master communication is set to Sercos II.
- Solution**
- Delete the I/O device
 - Delete the Sercos II function module if a Sercos III master communication is to be set

MLs-E0S0023: The logic address <Digit> is invalid

- Cause** A logic address <Digit> that is not supported by the control was assigned to a PLC device.
- Solution**
- Open the editor of the affected PLC device (double-click or via the context menu item "Open") and enter a valid logic address. Recommendation: If the logic address does not overlap with an axis number, enter the value specified in the "Sercos address" field for the logic address

Safety error messages**MLs-E0Y0010: The number of gateways "SLC-3-GS3S" (<Digit1>) is greater than the maximum permissible number (<Digit1>)**

- Cause** The control cannot process the number of gateways of type "SLC-3-GS3S" that were projected. The maximum number of supported gateways is written in <Digit2>.
- Solution**
- Delete the surplus gateways of type "SLC-3-GS3S"

MLs-E0Y0011: The number of "CIP Safety on Sercos" targets (<Digit1>) is greater than the maximum permissible number of "CIP Safety on Sercos" targets (<Digit2>)

- Cause** More "CIP Safety on Sercos" targets - than the gateways are able to process - were projected for a gateway of type "SLC-3-GS3S". The maximum number of supported "CIP Safety on Sercos" targets is written in <Digit2>. This can be the case if axes from different project were imported into one project.
- Solution**
- Delete the surplus "CIP Safety on Sercos" targets via the context menu of the gateway for example

MLs-E0Y0012: The target number <Digit1> is outside the valid range (1..<Digit2>)

- Cause** "CIP Safety on Sercos" was projected for a real axis with a target number outside the valid value range. The maximum target number allowed is written in <Digit2>. This can only be the case if an axis - whose import files was manually modified before - is imported.
- Solution**
- Change the target number via the context menu of the axis for example

MLs-E0Y0013: The target number <Digit> was specified multiple times

- Cause** The same target number was projected for the gateway of type "SLC-3-GS3S". This is invalid. The target number has to be unique in a gateway. This can be the case if axes from different project were imported into one project.
- Solution**
- Assign a unique target number (e.g. via the context menu of the gateway) to all "CIP Safety on Sercos" targets
 - Delete the "CIP Safety on Sercos" targets whose target number is not unique

MLs-E0Y0014: "CIP Safety on Sercos" was projected for the axis, even though it is not supported by the axis

- Cause** "CIP Safety on Sercos" was projected for this axis, even though it does not support safety engineering. This can be the case if an old project - in which the axis still supports the safety engineering - is applied.
- Solution**
- Change the firmware of the axis supporting the safety engineering
 - Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

MLs-E0Y0015: The axis is assigned to the gateway "SLC-3-GS3S" which does not exist anymore. The gateway name was <Name>, the Sercos address was <Digit>

Cause An axis was assigned to a gateway of type "SLC-3-GS3S" which does not exist anymore, since the gateway was deleted in the meantime for example. The old name and the Sercos address of the deleted gateway are specified in <Name> and <Digit> and are only used for a better understanding of the original project planning.

Solution

- Assign an existing gateway of type "SLC-3-GS3S" to the axis
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

MLs-E0Y0100: "CIP Safety on Sercos with SafeLogic" was projected for the axis, but the required function module "Safety CPU" is missing

Cause "CIP Safety on Sercos with SafeLogic" was projected for an axis, but no "Safety CPU" function module is present below the control. However, the axis cannot use the selected safety function without this function module.

Solution

- Add a "Safety CPU" function module to the control
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

MLs-E0Y0101: "CIP Safety on Sercos with SafeLogic" was projected for the axis, but no Safety profile was selected

Cause "CIP Safety on Sercos with SafeLogic" was projected for an axis, but no Safety profile is selected.

Solution

- Select a Safety profile for the axis
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

MLs-E0Y0102: The Safety profile <Name> selected for the axis is invalid

Cause "CIP Safety on Sercos with SafeLogic" was projected for an axis, but its Safety profile is invalid. This can be the case if a new device description file was installed for the corresponding drive and this device description does not contain the earlier selected Safety profile anymore.

Solution

- Select a Safety profile again for the axis
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

MLs-E0Y0103: The device description file for the device <Name> is not installed

Cause "CIP Safety on Sercos with SafeLogic" was projected for an axis, but the device description of the assigned drive is not installed.

Solution

- Install the device description for the drive assigned to the axis
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

EtherCAT error messages

MLs-E0T0001: An EtherCAT master is only possible with the "ECAT"function package.

Cause You planned an "EtherCAT master" for a control without "ECAT"function package. Such a configuration is not allowed.

- Solution**
- Enable the "ECAT" function package of the control
 - Remove the "EtherCAT master"

7.12.3 Information messages

General information

Information messages provide notes on the validation. Information messages are used to point on special states or options and not on an error condition.

Non-object-related information messages

MLs-I0X0001: The following error <Identification> is temporarily only considered as warning.

- Cause** After contacting the support, a special setting was made in IndraWorks. Due to that setting, the following error is only considered as warning. This setting is only permitted to continue operating (e.g. switching online) if the validation incorrectly detected an error. This setting is to be undone if it is upgraded to a higher IndraWorks release.

- Solution**
- Upgrade to a higher IndraWorks release and undo the special setting

MLs-I0X0002: An internal error was detected during validation. Double-click to display details

- Cause** An internal error occurred during validation impeding some checks to be performed. This information indicates a potential problem with unknown effects. Report error details to the Bosch Rexroth Service.

- Solution**
- Report the error details to the Bosch Rexroth Service

7.12.4 Warning messages

General information

Warning messages indicate a potential problem in the Motion configuration. However, it can still be switched online or the Motion configuration can be loaded to the control.

Axis warning messages

MLs-W0A0020: The configured function package of the axis <Name> is not enabled in the corresponding drive

- Cause** An axis was configured so that a certain function package is required in the drive. This function package is not in the drive. The most frequent cause for this error is that the interpolation method "Drive" was selected for this axis or the encoder axis was projected, but the function package "SNC Synchronization" is not enabled in the drive. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Enable the required function package in the drive
 - Change the interpolation type of the axis in the "Properties" dialog or delete the possibly projected encoder axes

MLs-W0A0021: The projected axis name <Name1> does not match the axis name in the control <Name2>

- Cause** The axis name (parameter A-0-0002) set in the control does not correspond to the axis name projected in IndraWorks. Possible reasons for this difference are:
- The corresponding parameter in the drive (S-0-0142) is password-protected

- The parameter A-0-0002 was changed manually or by the PLC program after loading the Motion configuration to the control

Normally, the axis name is updated in the control when loading the Motion configuration to the control. To avoid comprehension problems, do not change the name in the control.

- Solution**
- Delete the drive password or allow write access on its parameter
 - Rename the axis so that its name differs from the one of the control
 - Ensure that the parameter A-0-0002 is not changed anymore

MLs-W0A0022: An encoder is configured in the drive <Name>, even though the function package "Open Loop" is set

- Cause** The "Open Loop" function package was set for an axis, but the corresponding drive configured an encoder. Thus, it is not possible to switch the Sercos bus to phase 4.

- Solution**
- Parameterize the drive to ensure that the encoder is not used anymore
 - Replace the drive with a drive with the basic package "Closed Loop"

MLs-W0A0200: The projected axis is a axis different than the axis configured in the control (name: <Name>, axis number: <Digit>)

- Cause** It was logged in to the PLC, but the axis configured in the control does not match the axis projected in IndraWorks. Thus, the PLC program could move different axes as actually intended. This can be the case if it is logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to update the Motion configuration of the control

MLs-W0A0201: The projected axis is not available in the control

- Cause** It was logged in to the PLC and the axis projected in IndraWorks could not be found in the control. Thus, the PLC program could move different axes as actually intended. This can be the case if it is logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to update the Motion configuration of the control

MLs-W0A0202: An axis <Name> (axis number <Digit>) is in the control that is not in the project

- Cause** It was logged in to the PLC and the axis configured in the control is not projected in IndraWorks. Thus, the PLC program could move different axes as actually intended. This can be the case if it is logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to update the Motion configuration of the control

MLs-W0A0203: The axis of the drive projected in the control with the Sercos addresses <Digit1> and <Digit2> are assigned to multiple connected drives

- Cause** A drive with multiple axes and its corresponding Sercos addresses were projected. When comparing with the actually connected drives, the specified Sercos addresses belonged to axes of different drives. This can cause unexpected addressing errors for some functions (e.g. firmware download).

- Solution**
- Change the Sercos addresses of the axes of the connected drives via the "Sercos Configuration" dialog to match the addresses of the projected axes

- Change the Sercos addresses in the project to match the addresses of the connected drives

MLs-W0A0501: The maximum number of <Digit> controller axes of the type <ControllerType> was exceeded

Cause More hydraulic controller axes (only IndraMotion MLC) of the specified controller type than the control can process were projected. The maximum number of supported axes is written in <Digit>. In contrast to other axes, there are partially more restrictions for hydraulic controller axes with regard to their number. These restrictions depend not only on the control type but also on the controller type.

Valid axis numbers for the controller type are specified in the validation message.

- Solution**
- Delete the axes of the specified controller type
 - Convert the control into a control type of higher performance

MLs-W0A0502: The task configuration required for the controller axes is incorrect

Cause The tasks required to control hydraulic controller axes (only IndraMotion MLC) ("HCBackgroundTask", "HCCmdTask" and "HCSercosSyncTask") are deleted, renamed or modified. Apart from the direct manipulation of the tasks, this error can also occur after importing controller axes from a different project without importing the tasks.

- Solution**
- Open the "Properties" dialog of one of the controller axes the error was reported for and exit the dialog via **OK**. This creates all required tasks again

MLs-W0A0503: The library configuration required for the controller axes is incorrect

Cause The libraries required to control hydraulic controller axes (only IndraMotion MLC) ("MH_HydrControl", "MH_TechHydrBase" and "MH_SynchControl") are deleted, renamed or modified.

- Solution**
- Open the "Properties" dialog of one of the controller axes the error was reported for and exit the dialog via **OK**. This creates all required libraries again

MLs-W0A0504: The hardware connection <Name> selected in the controller axis is not supported in this version!

Cause After changing the project version, the currently selected hardware connection becomes invalid.

- Solution**
- Open the properties dialog of the controller axis and check or correct the settings on the tab pages "Signals, general" and "Signal assignment". After the adjustment, press **OK** to close the dialog

MLs-W0A0510: The "HydrControl" directory for the program implementation of the controller axes is not present

Cause The "HydrControl" directory required to control hydraulic controller axes (only IndraMotion MLC) which has to be located below the "Application" node was deleted or renamed.

- Solution**
- If the directory was renamed by accident, rename it again in "HydrControl"
 - Open the "Properties" dialog for each controller axis the error was reported for and exit the dialog via **OK**. This creates a directory and the program implementation required for this axis is generated in the directory

MLs-W0A0511: The program implementation of the controller axes is incorrect: <DetailedMessage>

- Cause** The automatically generated program implementation of the hydraulic controller axes (only IndraMotion MLC) in the "HydrControl" directory was manually modified. This is invalid. The program implementation may only be opened and viewed for diagnostic purposes.
- Solution**
- Open the "Properties" dialog for each controller axis the error was reported for and exit the dialog via **OK**. This creates a directory and the program implementation required for this axis is generated in the directory. The programming implementations of all controller axes can be created at once by executing the function **Create ► Clear**

MLs-W0A0520: The input or output assignment determined in the controller axis is incorrect

- Cause** I/O devices assigned to hydraulic controller axes (only IndraMotion MLC) or their variable assignment were changed. This interrupted the logic connection between the I/O device and the program implementation.
- Solution**
- Open the "Properties" dialog of each controller axis the error was reported for and check the settings in the "Signal Assignment" tab. Make changes if required and exit the dialog with **OK**. This creates all required variable definitions again

MLs-W0A0521: The axis configuration of the project changed

- Cause** Axes assigned to a hydraulic controller axis (only IndraMotion MLC), e.g. synchronization controllers were renamed or deleted. This interrupted the logic connection to the controller axis.
- Solution**
- Open the "Properties" dialog of the controller the error was reported for and adjust the axis assignment

MLs-W0A0522: In the input/output assignment, no signals are assigned to the controller axis

- Cause** "With signal assignment" is selected in the controller axis properties, but no signals are assigned in the "Input/output assignment". This can for example result when copying an axis, as the input/output assignment of the original axis is not applied.
- Solution**
- Open the properties dialog of the controller axis the error occurred in and check or correct the settings on the tab pages "Signals, general" and "Signal assignment". After the adjustment, press **OK** to close the dialog

MLs-W0A1000: The controller type '<Name>' (ID:<Digit>) could not be loaded

- Cause** A project was opened containing a controller axis (only IndraMotion MLC), but whose type is not installed in IndraWorks. This can be the case if an IndraWorks project created on another computer is open.
- Solution**
- Install the controller axis type
 - Delete the controller axis

MLs-W0A1001: The controller type '<Name>' is not supported by the control firmware '<Firmware>'

- Cause** A controller axis was projected. This controller axis is not supported by the control, as the firmware release is too low for example.

- Solution**
- Change the projected firmware version or the firmware release in the "Properties" dialog of the control
 - Delete the controller axis

Control warning messages

MLs-W0C0020: A higher device version (<Version>) is available for the control

- Cause** A project was opened that was created with an older, unofficial IndraWorks release and the device version of the control changed in the meantime. Thus, some new functions of the control cannot be used.

- Solution**
- Update the device in the properties of the control

MLs-W0C0021: The connected control has a lower firmware release (<Firmware>) than projected (<Firmware>)

- Cause** Connected to a control obtaining a lower firmware release than projected in the properties of the control. Undesired effects can be caused during the operation, since it is possible that the control does not support all IndraWorks functions.

- Solution**
- Update the device in the properties of the control
 - Load a newer firmware to the control

MLs-W0C0022: Not all IndraWorks online functions are available, as the configuration of the IndraWorks project differs from the control configuration

- Cause** It is connected to a control whose Motion configuration differs from the configuration saved in the IndraWorks project. There are multiple possible reasons. An axis might have been added to the PC or the IndraWorks project is not suitable for the control. In this case, IndraWorks allows only the following operations:

- Phase switching via the toolbar and the context menu of the Sercos node
- Start of the parameter editor of the control
- Start of the control oscilloscope
- Start of the parameter import and export of the control
- View of the communication settings, advanced properties, invalid parameters and tasks of the control
- Setting the language of the control and the connected drives.

- Solution**
- Load the Motion configuration from the PC to the control
 - Load the Motion configuration from the control to the PC
 - Adapt the Motion configuration in the IndraWorks project to the configuration of the control. A detailed list of differences can be seen under "Synchronize" context menu of the control
 - Perform the online operations required and switch offline again

MLs-W0C0023: The hardware version <Value> of the connected control is syntactically incorrect

- Cause** The connected control has a hardware version, i.e. the value of the parameter "C-0-0010, Version number, hardware", with an invalid value. Thus, the configuration of the control cannot be correctly compared to the configuration in IndraWorks and it is only possible to switch partially synchronized to online mode.

- Solution**
- Contact the Bosch Rexroth Service for a corrected hardware version of the control.

MLs-W0C0024: The scope of the project parameters is not up-to-date and should be adjusted

- Cause** The selected firmware release is too old. Format and scope of the included project parameters are not up-to-date.

- Solution**
- Select a newer firmware release in the "Properties" dialog of the control

MLs-W0C0109: To eliminate some compiler warnings, adjustments have to be made in the PLC applications.

- Cause** An existing control with "GAT central application" was converted on the control firmware 14VRS.

- Solution**
- Double-click on the line of the error message to automatically perform the changes
 - Change the enumeration type "TE_OPMODES" to UINT.
Insert ") UINT;" instead of ");"
 - Change the enumeration type "TE_STATES" to UINT.
Insert ") UINT;" instead of ");"
 - Change the data type of the variable "uiSTATE_USER_INITIAL_gb" to UINT.
Insert "uiSTATE_USER_INITIAL_gb: UINT:=" instead of "uiSTATE_USER_INITIAL_gb: INT:="
 - Add the line "{warning disable C0327}" to the actions of the individual states of the operation mode function blocks
 - Change the control firmware version to 13VRS

MLs-W0C0114: The present GAT template is only supported by "IndraMotion MLC" controls

- Cause** An existing MLC control with GAT template has been converted into an XLC control. The XLC control does not support this template.

- Solution**
- Convert the control into an MLC again
 - Remove the template code from the PLC application.

MLs-W0C0200: The Motion project in the control (<Name>) does not match the Motion project in IndraWorks

- Cause** It is logged in to the PLC with a project, but the Motion project was not loaded to the control. A Motion project is required for example to operate I/O devices on the Sercos bus or to see the control parameters.

- Solution**
- Load the Motion configuration to the control. This function can be started either via the toolbar or the "Synchronize" menu item in the context menu of the control

Function module warning messages

MLs-W0F0020: An SRAM function module was projected, even though the control is provided with an already integrated SRAM

- Cause** An SRAM function module (only IndraMotion MLC) was projected, even though the control is already provided with an integrated SRAM. Since always the internal SRAM is used in this case, this function module is not required.

- Solution**
- Delete the SRAM function module

- Use a control without integrated SRAM

MLs-W0F0021: If the control is switched off, kinematic data is lost as no SRAM function module is projected

Cause The kinematic data (RCL programs, workpiece coordinates, etc.), but no SRAM module were projected. Thus, the control is not able to save this data permanently. If the control is switched off and switched on again, the kinematic data is lost and has to be reloaded again to the control.

- Solution**
- Insert an SRAM function module
 - Delete all kinematic data if not required anymore

MLs-W0F0022: An SRAM function module was projected, but no kinematic data

Cause An SRAM function module was projected, but no kinematic data (RCL programs, workpiece coordinates, etc.). Since this function module is only used for the permanent storage of this data, it is not required.

- Solution**
- Delete the SRAM function module if it is not required
 - Add kinematic data (RCL programs or workpiece coordinates) to the project

Kinematic warning messages (only IndraMotion MLC)

MLs-W0K0001: The axis <Name> is also used in user-defined kinematics (<KinematicList>)

Cause In the axis assignment of the kinematics, an axis has been referenced that is also referenced in one or several user-defined kinematics. This can cause problems.

- Solution**
- Change the axis reference to an axis that has not been used yet
 - Delete the axis reference

MLs-W0K0002: Global kinematic data is configured, but no corresponding kinematics of the version "Robot Control V1"

Cause Global data was projected for the kinematics (workpiece coordinates, tool management or library files), but there is no kinematics of the version "Robot Control V1". The global data can thus not be used, as only data of the kinematics of the "Robot Control V1" version can be used.

- Solution**
- Create at least one kinematics of the version "Robot Control V1"
 - Delete the global kinematic data

MLs-W0K0003: The "Global data" node is not supported by the set control version

Cause A project from an older IndraWorks version was applied. This version had the "Global data" node. This node is not supported anymore and can cause incorrect results when comparing the project with the control content.

- Solution**
- Delete the "Global data" node via its context menu

Cross communication warning messages (only IndraMotion MLC)

MLs-W0L0020: The produced axis with the number <Digit> is not projected

Cause A number of a produced axis has been entered in the Sercos III CrossComm configuration. This axis is not configured. This message is only for information purposes. Phase switching the cross link and the master communication are still possible.



This check is only made by the offline validation if the control is configured as CrossComm master.

- Solution**
- Project the missing axis in IndraWorks
 - Delete the axis number from the list of the produced axes

MLs-W0L0022: The produced axis with the number <Digit> is not in the control

Cause A number of a produced axis has been entered in the Sercos III CrossComm configuration. This axis is not configured. This message is only for information purposes. Phase switching the cross link and the master communication are still possible.



This check is always made by the online validation irrespective of the control configuration as CrossComm master or slave.

- Solution**
- Project the missing axis in IndraWorks
 - Delete the axis number from the list of the produced axes

MLs-W0L0023: The Motion cycle time (<Digit1> ms), the Sercos cycle time (<Digit2> ms) and the cross link cycle time (<Digit3> ms) differ

Cause A cross link was configured, but the cycle times for the Motion task, master communication and cross link differ. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Set the same value for all cycle times. It can either be set via the parameter editor or the respective IndraWorks dialog
 - The cycle times for the Motion task (parameter "C-0-0400, Motion, cycle time, command value") and the Sercos bus (parameter "C-0-0503, sercos master, cycle time") can be set in the "Cycle time" that can be opened via the context menu of the "Motion" node
 - The cycle time of the cross link (parameter "C-0-0700, C2C, cycle time (Tcyc), command value") can be found in the configuration dialog of the respective function module

MLs-W0L0024: The link axis with the number <Digit> is not in the control

Cause A non-existent link axis was entered into the Sercos II CrossComm configuration. This link axis is supposed to provide its axis position in the cross link. This message is only for information purposes. Phase switching the cross link and the master communication are still possible.

- Solution**
- Correct the axis specification in the settings of the function module CrossComm Sercos II

MLs-W0L0026: The control address in the link (<Digit1>) is greater than the maximum permissible control address (<Digit2>).

Cause An invalid high control address was specified in the Sercos II CrossComm configuration. The maximum valid control address <Digit2> depends on the desired cycle time of the cross link and is:

- 16 if cycle time ≤ 2 ms
- 32 if cycle time > 2 ms and cycle time ≤ 4 ms
- 64 if cycle time > 4 ms

- Solution**
- Correct the control address in the settings of the function module CrossComm Sercos II
 - Reduce the cycle time of the cross link

MLs-W0L0027: Link axes were configured for the control. However, no function module of type "CrossComm Sercos II" was configured

- Cause** Link axes were projected, but no function module "CrossComm Sercos II". Thus, the link axes cannot be accessed.

- Solution**
- Add a "CrossComm Sercos II" function module to the control
 - Delete link axes if they are not required anymore

Sercos device warning messages

MLs-W0S0013: Several devices with the Sercos address <Digit> are connected to the control

- Cause** Several devices were found at the Sercos bus. These devices are provided with the same Sercos address. It cannot be switched to BB with this configuration.

Note: This warning refers to the actually connected devices and **not** to the devices projected in IndraWorks.

- Solution**
- Set unique Sercos addresses for the devices. For drives, the Sercos address can be set directly at the device. For I/O devices, the address has to be set in the "Configuration Sercos Devices" dialog

MLs-W0S0020: The device with the Sercos address <Digit> is disabled, even though it is connected to the control

- Cause** A Sercos III device is disabled in the control, even though it is actually connected to the control. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Enable the device
 - Remove the device from the control

MLs-W0S0021: The device with the Sercos address <Digit> is connected to the control, but not configured in the control

- Cause** A device is connected to the Sercos bus, but not configured in the control. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Project the device in IndraWorks and load the Motion configuration to the control
 - Remove the device from the control

MLs-W0S0023: The Motion cycle time (<Digit1> ms) is no multiple of the Sercos cycle time (<Digit2> ms)

- Cause** The cycle time for the Motion task is set, but no multiple of the Sercos cycle time. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Correct the values for the cycle time of the Motion tasks (parameter "C-0-0400, Motion, cycle time, command value") and the Sercos bus (parameter "C-0-0503, sercos master, cycle time") so that they fit. That means that the Motion cycle time is an integer multiple of the Sercos cycle time. This can be performed via the parameter editor or the "Cycle time" dialog, which can be opened via the context menu of the "Motion" node

MLs-W0S0024: The device with the Sercos address <Digit> is configured in the control, but not connected

Cause A Sercos device is configured as active in the control, but not connected to the Sercos bus. Thus, the Sercos bus cannot be switched to BB.

- Solution**
- Disable the device in IndraWorks and load the Motion configuration to the control
 - Connect the device to the control

MLs-W0S0200: For the I/O device (Sercos address <Digit>), the device identification in the project (<Name1>) does not match the device identification (<Name2>) configured in the control

Cause It is logged in to the PLC, but the device identification of the I/O device (parameter "C-0-0478, sercos motion configuration") configured in the control does not match the device configuration of the I/O device projected in IndraWorks. Thus, the PLC program cannot access this I/O device. This can be the case if I/O devices are changed below the "Sercos" node and logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to apply the changed I/O configuration to the control

MLs-W0S0201: The projected I/O device (Sercos address <Digit>) is not configured in the control

Cause It is logged in to the PLC, but the specified I/O device is not configured in the control (parameter "C-0-0478, sercos motion configuration"). Thus, the PLC program cannot access this I/O device. This can be the case if I/O devices are added below the "Sercos" node and logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to apply the changed I/O configuration to the control

MLs-W0S0202: In the control, an I/O device (device identification <Name>) is configured to the Sercos address <Digit>, but it is not in the project

Cause It is logged in to the PLC, but the I/O device configured in the control (parameter "C-0-0478, sercos motion configuration") is not configured in IndraWorks. Thus, the PLC program cannot access this I/O device. This can be the case if I/O devices are deleted below the "Sercos" node and logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to apply the changed I/O configuration to the control

MLs-W0S0203: For the I/O device (Sercos address <Digit>), the activation in the project does not match the activation in the control

Cause It is logged in to the PLC, but the activation of the I/O device (parameter "C-0-0478, sercos motion configuration") configured in the control does not match the activation of the I/O device projected in IndraWorks. Thus, under certain circumstances, the PLC program cannot access this I/O device. This can be the case if the activation of an I/O device is changed below the "Sercos" node and logged in to the PLC without loading the Motion configuration to the control before.

- Solution**
- Load the Motion configuration to the control to apply the changed I/O configuration to the control

Safety warning messages

W0Y0010: "CIP Safety on Sercos" was projected for the axis, but the actually connected drive does not support this functionality

Cause "CIP Safety on Sercos" was projected for an axis, but the control section of the assigned drive does not contain a corresponding component. Thus, the safety functions cannot be used.

Solution

- Connect the drive whose control section contains the corresponding safety component
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

W0Y0011: No "CIP Safety on Sercos" target was assigned to the gateway "SLC-3-GS3S"

Cause An "SLC-3-GS3S" gateway was projected, but no "CIP Safety on Sercos" target was assigned to this gateway. Thus, the safety functions of the gateway cannot be used.

Solution

- Assign at least one "CIP Safety on Sercos" target to the gateway (e.g. via the context menu of the gateway)
- Delete the gateway if it is not required

W0Y0012: The configured drive type <Type1> does not match the connected drive <Type2>

Cause "CIP Safety on Sercos with SafeLogic" was projected for one axis, but the configured drive type does not match the type of the connected drive. Thus, it is not possible to switch the Sercos bus to phase 4.

Solution

- Close the drive, whose type matches the projected drive type
- Adapt the projected drive type to the actually connected drive, load the Motion configuration to the control and log in again
- Delete the selection "CIP Safety on Sercos" for the axis (e.g. via its context menu)

7.13 Electronic cams

7.13.1 General information

Cams are used wherever complex, nonlinear motion takes place or where rotary and translatory slave motion sequences have to be generated depending on a given master axis.

In its basic functions, a cam gear generates the reference between a master axis and a slave axis using a freely designable transfer function. The reference signal is usually an angle of rotation " φ ". Using a cam, this angle of rotation is compiled into a new slave axis motion with the angle of rotation " ψ ". The figure below shows a simplified representation.

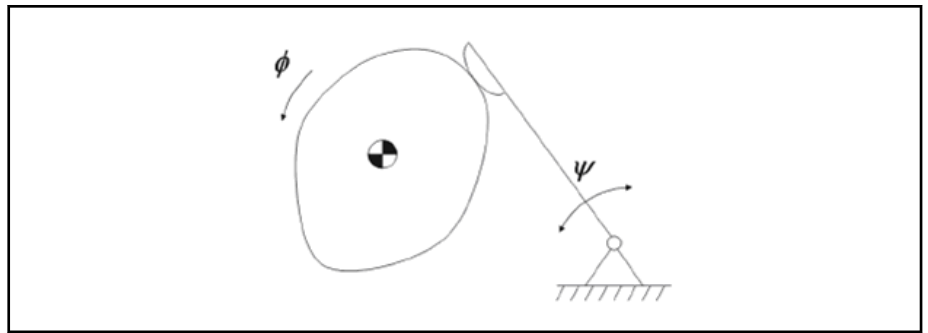


Fig. 7-39: Block diagram of a general cam

In general, two cam solutions can be defined. These are the mechanical and the electronic cam solution. The purely mechanical cams are not discussed in detail. An electronic cam can be constructed either as cam table or analytically as polynomial profiles (FlexProfile, MotionProfile).

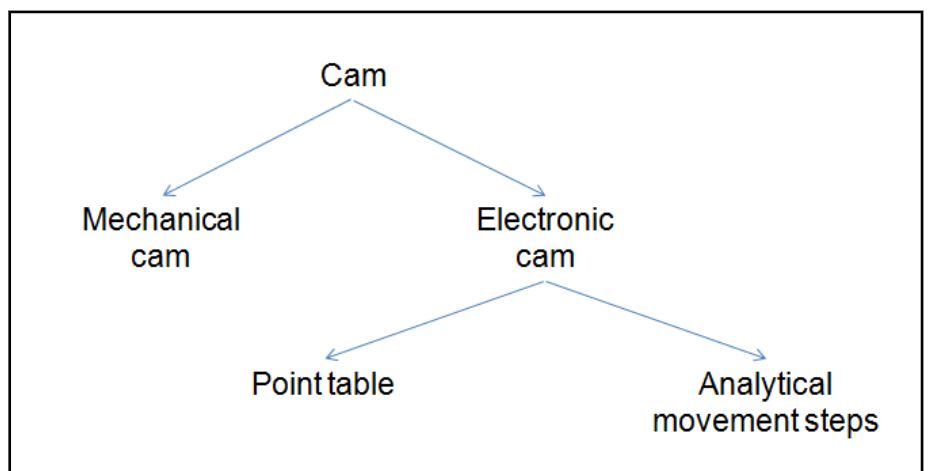


Fig. 7-40: Basic cam solutions

The FlexProfile parameterization is executed via the dialog of the respective axis (see e.g. [chapter 6.8.22 "FlexProfile" on page 478](#)).

An exemplary use case for the FlexProfile is described in "IndraMotion MLC 14VRS First Steps" and "IndraLogic XLC 14VRS First Steps" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

7.13.2 Cam solutions

If existing electronic cam solutions are studied in terms of their functions, two basic implementation types can be distinguished:

Cam table In its simplest form, the curve profile which represents the coupling of master axis and slave axis typical for cams exists as curve profile defined by data points. The slave axis position is determined by an interpolation between the corresponding data points of the current interval. The slave axis position is defined by the master axis position. Various interpolation procedures can be used depending on the application.

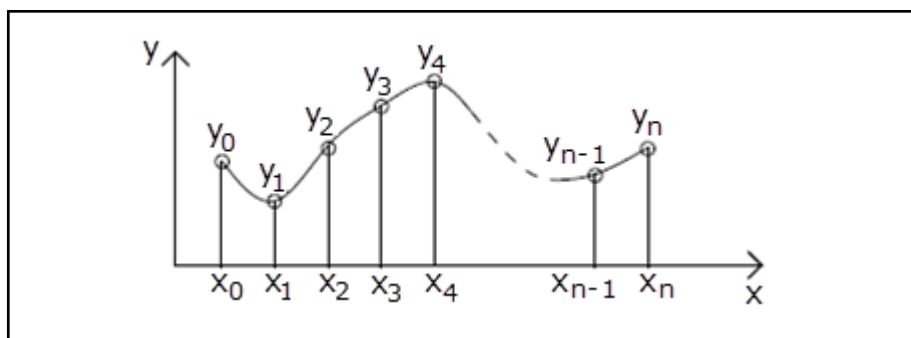


Fig. 7-41: Cam table with cubic compensation spline

Apart from the simple linear interpolation, spline functions are often used. If precise data points are available that should be traversed later, interpolating polynomial splines have to be used. The figure above shows an example of how to use a cubic spline to interpolate between the given data points. To dynamically generate better curves, Hermite spline functions can be used while the cubic interpolation splines mentioned above are based on polynomials of 5th order. These splines execute a curve approximation resulting in a smoother curve. Irrespective of the interpolation procedure, cams are very often described like this with regard to the processing in a servo controller.

The cam tables are provided with the following characteristics:

- Simple and easy mode of operation
- Low computing effort
 - All the coefficients required for spline interpolation are determined in a calculation made before the time of execution
- The slave axis position can be determined very easily at runtime
- Suitable for motions whose shape is not changed online
- All polynomial coefficients have to be calculated again after a data point was changed
- Large data volume

The cam tables can be configured either via the PLC function block **MB_ChangeCamData** or the IndraWorks interface.

When using or creating cam tables used in the control, note the following:

The control firmware scans the cam table in each motion cycle. The motion distance from scanning to scanning point is computed using the shortest distance.

If the cam table is provided with a motion of $> \text{Modulo}/2$ from scanning to scanning point (corresponds to $> 50\%$ in the cam table), the motion is $< \text{Modulo}/2$ (with regard to the shortest distance).

the command values derived from the cam table do not perform motions higher than $\text{Modulo}/2$ even if the table points between the data points contain a longer motion distance.

The axis performs a motion different than expected according to the cam table.

NOTICE**Limiting the maximum master axis velocity**

The user has to ensure that such a case with a corresponding safety area is excluded (the maximum master axis velocity may not cause a velocity of the "cam axis" higher than Modulo/2 per analysis cycle of the cam).

The analysis cycle corresponds to the motion cycle time, control parameter C-0-0400, Motion, cycle time, command value.

Analytical motion laws

Apart from describing the cam exclusively with a cam table, it is possible to describe it using mathematical transfer functions. Here, these are called motion laws. Motion laws describe the relative motion of two gear members as analytical functions (in this case the output motion depending on the input motion). The entire cam profile is described in steps using various motion laws. Each step with the respective motion sequence, is called a "motion step". The figure below shows a cam profile that consists of three motion steps.

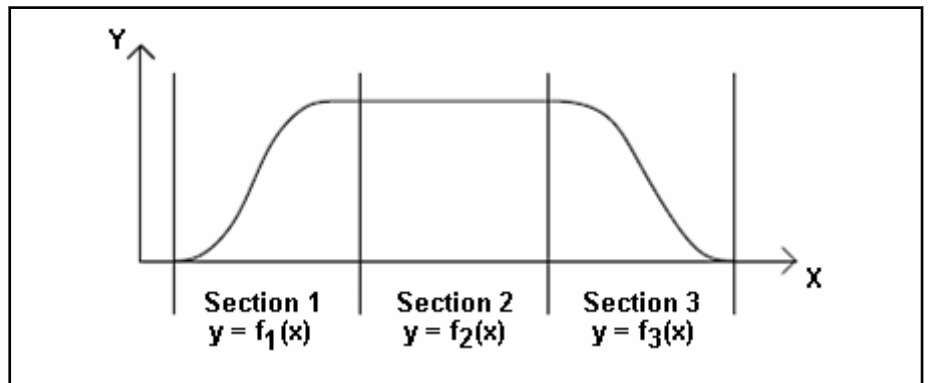


Fig. 7-42: Cam profile consisting of three motion steps

Mainly polynomial functions of the 5th order or higher are used since these polynomial functions provide the corresponding degrees of freedom to specify velocity, acceleration and (if necessary) jerk at the start/end of the motion step. The individual motion steps can be put into sequence without impact or jerks by selecting identical limit values. Trigonometric motion laws such as different sine curves can be used as motion laws. Several of such motion laws are defined in the VDI 2143 standard. This solution has the following advantages:

- The cam profiles are described with little data volume. The required information is limited to the specification of the boundary values of the individual motion steps
- Individual motion steps can be changed more easily and irrespective of the other motion steps. However, increased calculations at runtime are caused. The corresponding motion law has to be calculated for every point in time for which the slave axis position is to be determined

The analytical MotionProfiles can be configured either using the PLC function blocks **MB_ChangeProfileSet** (for MotionProfile), **MB_ChangeFlexProfileSet** (for FlexProfile) or the IndraWorks interface.

7.13.3 Electronic cam

In the control, the typical coupling between the master and slave axis also results for an electronic cam (see figure below). In this context, often named master axis or slave axis or master and slave only. However, as opposed to mechanical cams, the coupling is not permanent. Each axis whose current

actual position can be added to the cam table can be used as cam profile. It can also be virtual master axes. This is an axis calculated on the control without physical counterpart. Its position can for example be used as a reference signal for a cam table and thus indirectly control the motion of a slave axis.

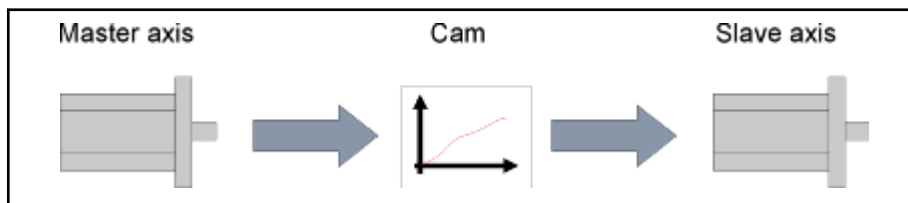


Fig. 7-43: Signal flow and cam localization

7.13.4 Use cases

Typical use cases of electronic cams include:

- Transforming a rotary motion into straight-line translational motions with a controllable course
- Transforming a rotary motion into an oscillating rotary or translational motion with a controllable course
- Generating master motions or mechanically synchronized relative motions of components or tools and controlling the resulting acceleration and velocity characteristics
- Linearization of physical or mechanical relationships or transformations

However, it cannot generally be specified to what degree gears that translate unequally represent a solution for a given application problem. As early as the planning stage of the application, this requires a close examination of the task as well as the necessary knowledge and mechatronic know-how of the designer. Due to its flexible ease of design and potential for optimization, the electronic cam represents a tool for a number of motion tasks

7.13.5 Centralized and decentralized cam concept

The cam processing and the resulting command value generation can take place either centrally in a superordinate control or decentrally in the drives. Bosch Rexroth drive units allow the storage of several cam table profiles in the memory and the direct processing from a superordinate control or a PLC after the command was issued.

Apart from this decentral execution of the cam table operation in the IndraDrive family, the IndraLogic XLC/IndraMotion MLC system also provide the option to execute the calculation/interpolation of the cam profile in the control and commanding the drives cyclically using a position command value interface.

7.13.6 FlexProfile – Basic functionalities

General information

FlexProfile belongs to the group of "electronic motion laws". The FlexProfile is described by mathematical motion laws as analytical functions. In addition to the functions described in [chapter 7.13.4 "Use cases" on page 596](#), the following properties can be selected in the FlexProfile:

- Time control
- Event control
- Wide selection of motion laws, etc.

Basic structure of synchronous operating states "FlexProfile"

In the "FlexProfile" operating state, there is a firm relationship between the defined master axis position and the slave axis. The main procedural chain of this synchronization type also contains the gear and the FlexProfile that influence the relationship between the master axis and the slave axis. All axis types can be used as the master axis. In addition, there are several methods to affect the signal flow.

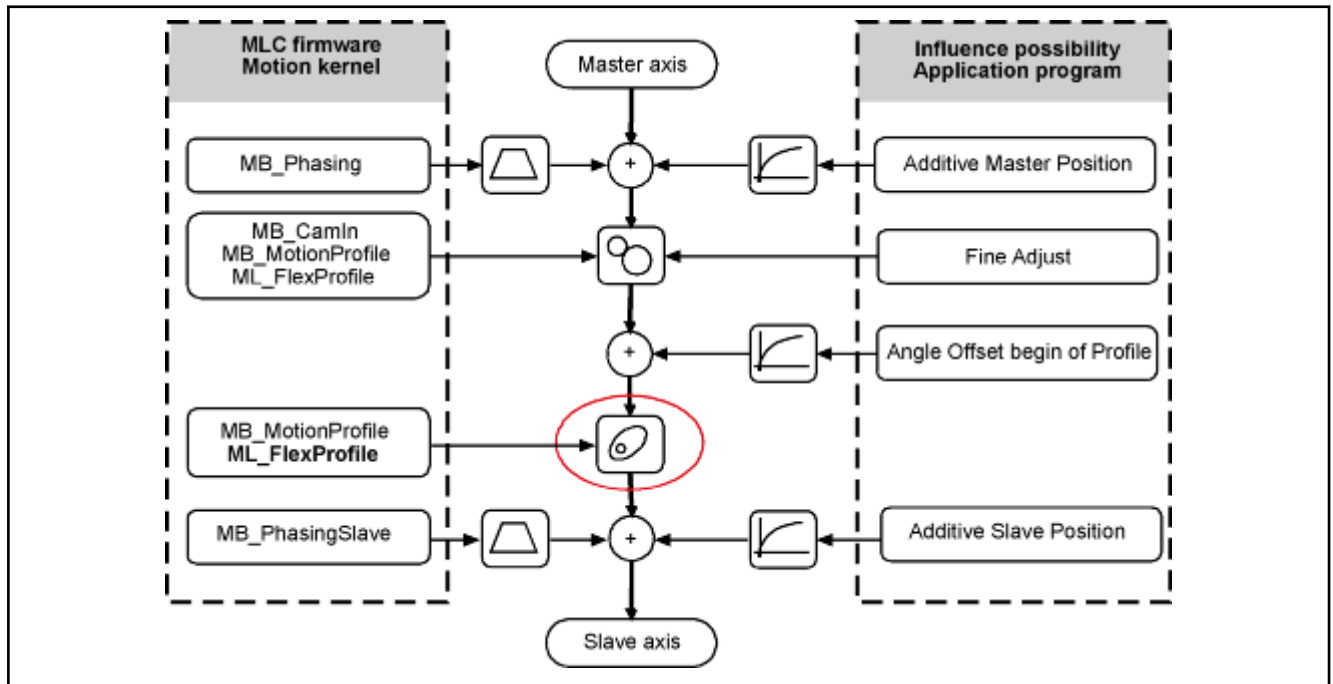


Fig. 7-44: Synchronous operating states ML_FlexProfile

The FlexProfile can be started using the PLC function block **ML_FlexProfile**.

Profile configuration

When creating a FlexProfile, note that the individual motion steps are defined using a relative master axis range and a relative distance (see the figure below). The motion sections defined in this manner are arranged in sequence. A profile created using this method has no absolute reference anymore. This absolute reference can be established again using a FlexStep.

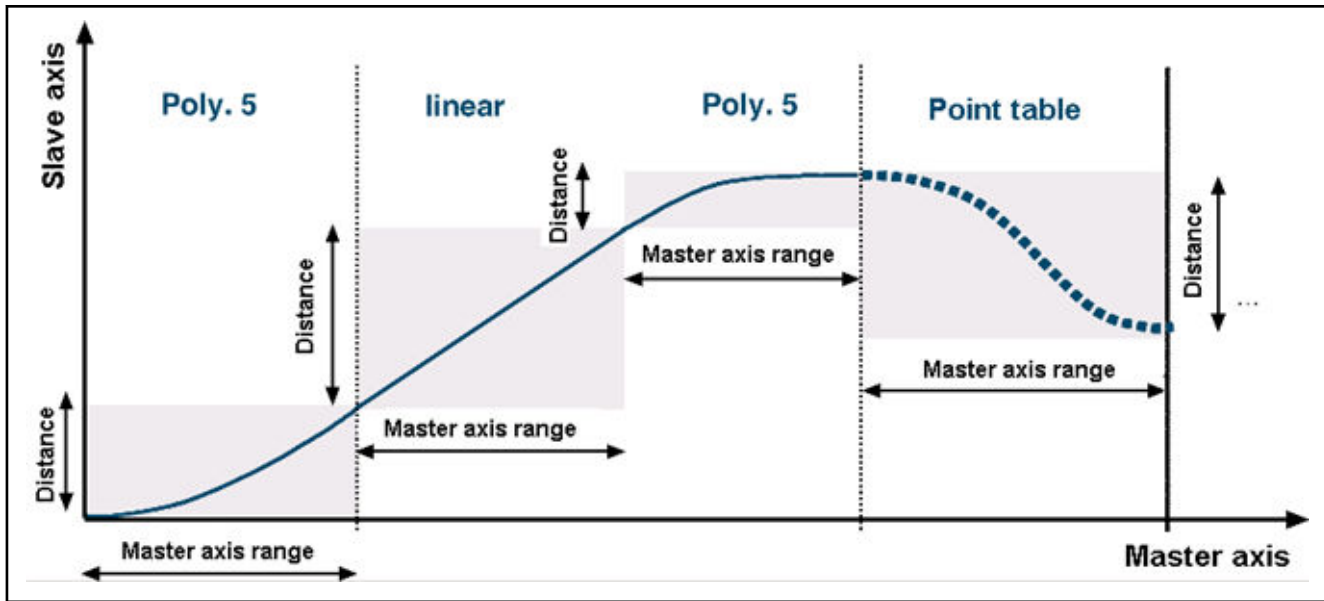


Fig. 7-45: Configuring and creating the FlexProfile

The master axis range can be either axis or time (time control). The duration for processing a motion step or an entire profile can be entered directly. The scaling of the master axis and slave axis can be freely selected.

Time master

In order to allow time-controlled sequences in a MotionProfile, this section shows how different "master sources" can be assigned to the individual motion steps of a MotionProfile. Now, not only one single master axis exists for all the motion steps of a cam profile, but a separate master source can already be specified during the generation of the MotionProfile/motion plan. If time as such is seen as a master source, time-controlled motions can also be implemented in this manner. For steps with such a time reference signal, the duration of the execution does not depend on the master axis velocity.

A FlexStep (see [chapter 7.13.6 "FlexProfile – Basic functionalities" on page 596](#)) must be used to restore an absolute master axis range or to synchronize different master axis encoders.

Motion laws

Default motion laws

The relationship between the master axis motion and the slave axis motion in the individual motion steps is specified by motion laws based on different standardized transfer functions.

According to VDI2143, the following four motion tasks can be specified in the boundaries of a motion step, depending on the velocity and acceleration:

Motion task	Abbreviation	Velocity	Acceleration
Rest	R	$v=0$	$a=0$
Constant velocity	G	$v \neq 0$	$a=0$
Reverse	U	$v=0$	$a \neq 0$
Motion	B	$v < > 0$	$a < > 0$

Tab. 7-11: Motion tasks according to VDI 2143

Various motion laws can be classified accordingly in terms of their function courses possible boundary value adaptations. The following overview shows the most common standardized motion laws:

Rest → Rest

Standstill

Simple sine (simple sine curve)

Besthorn sine (inclined sine curve)

Acceleration-optimized inclined sine curve

Torque-optimized inclined sine curve

Gutman sinusoid

Modified sinusoid

Modified acceleration trapezoid

Polynomial 5th order

Polynomial 7th order

Velocity → Velocity

Linear interpolation

Polynomial 5th order

Polynomial 7th order

Modified sinusoid

Rest → velocity

Polynomial 5th order

Polynomial 7th order

Velocity → rest

Polynomial 5th order

Polynomial 7th order

General motion

Polynomial 5th order

Polynomial 7th order



A precise description of the motion laws can be found in the data type description of the enumeration data type MC_STEP_MODE.

Extended motion laws

Additional special motion laws (interpolation) for use in electronic MotionProfiles are now described. These special motion laws improve the adaptation of the MotionProfile to the motion problem with different degrees of freedom.

Generally, the following boundary conditions are specified and result in the master axis range (refer to the following figure):

- Distance
- Velocity
- Acceleration

- Jerk

The following extended motion laws are available:

- Acceleration-limited motion (trapezoid profile)
- Acceleration-limited sinusoid
- Jerk-limited motion
- Polynomial 5th order, limited velocity
- Overshooting-free polynomial 5th order
- Velocity-limited trapezoid



A precise description of the motion laws can be found in the data type description of the enumeration data type MC_STEP_MODE.

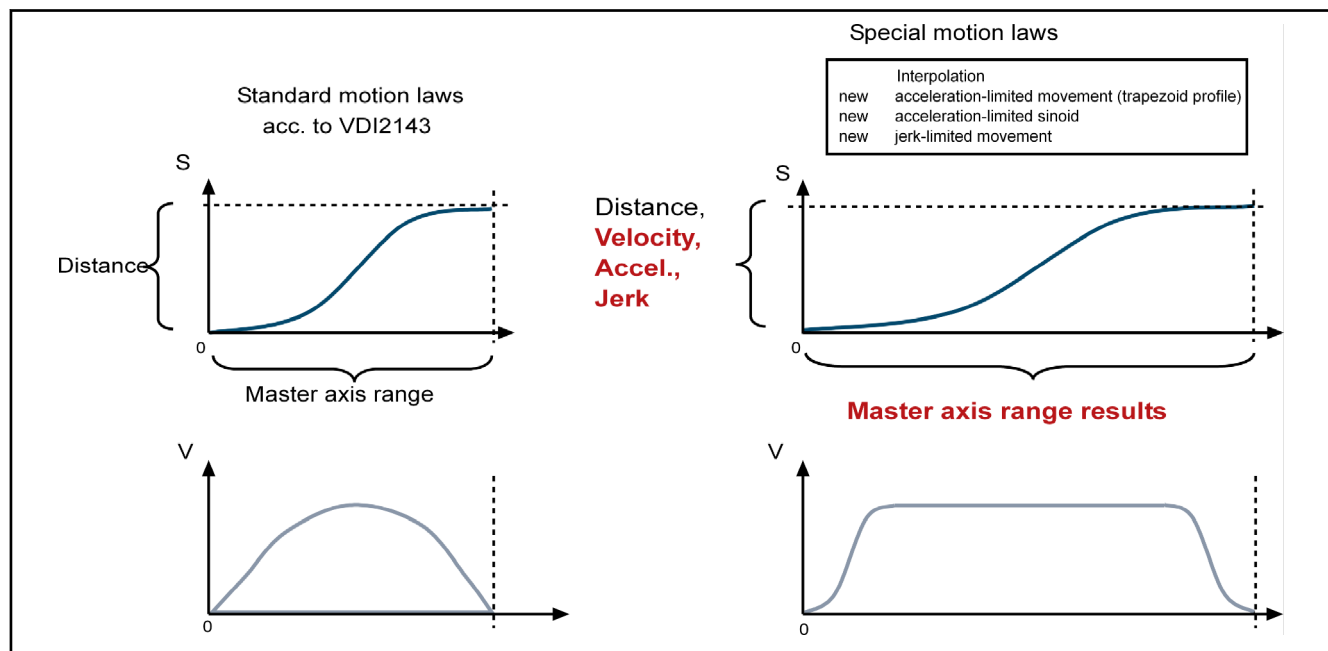


Fig. 7-46: Properties of the special motion laws

Flex step

If a motion step is marked as a FlexStep, it can be considered as active motion step. Due to the boundary values specified previously, its motion path is corrected and adapted at runtime. Flex steps are used, among other things, to synchronize motion steps with different master axes (time axis and position axis).

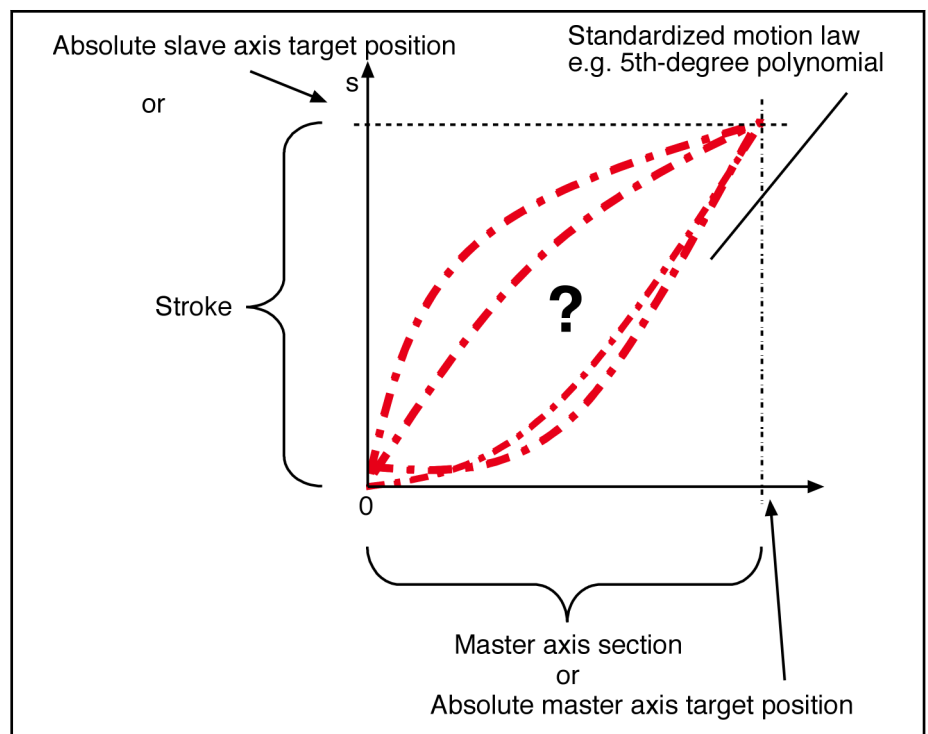


Fig. 7-47: Configuration possibilities of the FlexStep

In a FlexStep, also specify - instead of the distance - an absolute slave axis target position to be reached and - instead of the master axis section - an absolute master axis end position to be reached (the distance and the reference encoder section are calculated at runtime if necessary). The boundary values are adapted in such a way that velocity jumps are avoided.

In general, the FlexStep can be used to implement the following configurations:

- FlexStep with relative distance and relative master axis range
- FlexStep with absolute distance and relative master axis range
- FlexStep with relative distance and absolute master axis range
- FlexStep with absolute distance and absolute master axis range

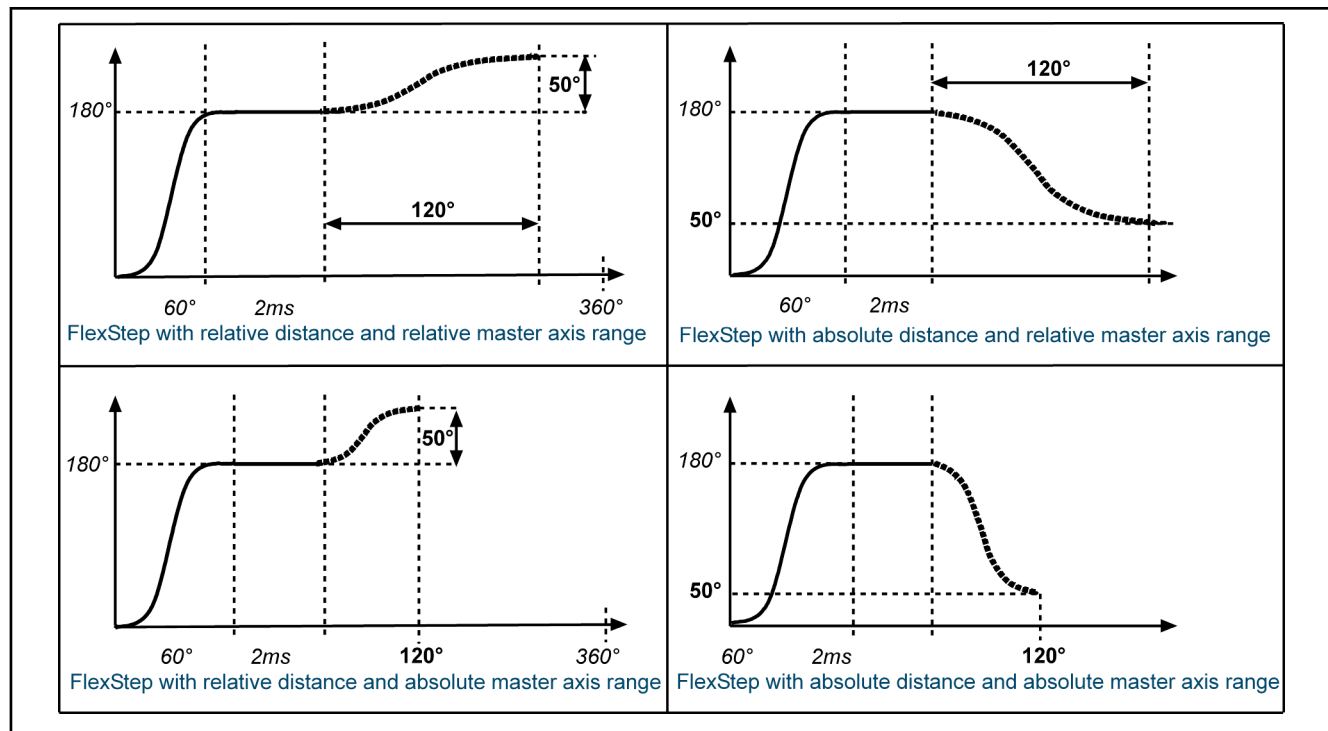


Fig. 7-48: Configuration of the FlexStep



The FlexStep can only be configured with the following motion laws:

- General motion, polynomial 5th order
- General motion, polynomial 7th order

A FlexStep has to be used after a time step.

Motion law boundary conditions

	Definition of the motion law at the input "MotionLaw" (ProfileStepAdr)		Tra-versing range		Boun-dary val-ues left			Boun-dary val-ue right			Max (not consid-ered ev-ery-where)			TPS pos-sible	Flex-Step possi-ble	Opera-tion modes
			Distance	Range	StVel	StAcc	StJerk	EndVel	EndAcc	EndJerk	MaxVel	MaxAcc	MaxJerk			
Rest-in-rest																
Standstill	REST_IN_REST_LINE-AR	2048	0	*	0	0	0	0	0	0	=	=	=	x		CT, FP
Sine curve	REST_IN_REST_SINE	2560	*	*	0	=	=	0	=	=	=	=	=	x		CT, FP
Inclined sine line	REST_IN_REST_INCLI-NEDSINE	0	*	*	0	0	=	0	0	=	=	=	=	x		CT, MP, FP
Acceleration-opti-mum inclined sinus-oid	REST_IN_REST_SI-NEACC	3072	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP

	Definition of the motion law at the input "MotionLaw" (ProfileStepAdr)		Tra-versing range		Boun-dary val-ues left			Boun-dary val-ue right			Max (not consid-ered ev-ery-where)			TPS pos-sible	Flex-Step possi-ble	Opera-tion modes
			Distance	Range	StVel	StAcc	StJerk	EndVel	EndAcc	EndJerk	MaxVel	MaxAcc	MaxJerk			
Torque-optimum in- clined sinusoid	REST_IN_REST_SINE- TORQUE	3328	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP
Gutman sinusoid	REST_IN_REST_GUT- MANSINE	2816	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP
Modified sinusoid	REST_IN_REST_MOD_ SINE	3840	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP
Modified accelera- tion trapezoid	REST_IN_REST_MOD_ TRAPEZE	3584	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP
Polynomial 5th order	REST_IN_REST_POLY 5	256	*	*	0	=	=	0	=	=	=	=	=	x		CT, FP
Polynomial 7th order	REST_IN_REST_POLY 7	2304	*	*	0	0	=	0	0	=	=	=	=	x		CT, FP
Polynomial 8th order	REST_IN_REST_POLY 8	5120	*	*	0	0	0	0	0	0	=	=	=	x		CT, MP, FP
Square parabola	REST_IN_REST_PA- RABOLA	4864	*	*	0	0	0	0	0	0	=	=	=	x		CT
Rest-in-velocity																
Polynomial 5th order	REST_IN_VELOCI- TY_POLY5	512	*	*	0	0	=	*	0	=	=	=	=			CT, MP, FP
Polynomial 7th order	REST_IN_VELOCI- TY_POLY7	768	*	*	0	0	0	*	0	0	=	=	=			CT, FP
Velocity-in-velocity																
Constant velocity	CONSTANT_VELOCI- TY	1536	*	*	=	0	0	=	0	0	=	=	=			CT, MP, FP
Polynomial 5th order	VELOCITY_IN_VELOC- ITY_POLY5	1792	*	*	*	0	=	*	0	=	=	=	=			CT, MP, FP
Polynomial 7th order	VELOCITY_IN_VELOC- ITY_POLY7	4096	*	*	*	0	0	*	0	0	=	=	=			CT, FP
Modified sinusoid	VELOCITY_IN_VELOC- ITY_MOD_SINE	4352	*	*	*	0	=	*	0	=	=	=	=			CT, FP
Velocity-in-rest																
Polynomial 5th order	VELOCI- TY_IN_REST_POLY5	1024	*	*	*	0	=	0	0	=	=	=	=			CT, MP, FP

Motion functionality

	Definition of the motion law at the input "MotionLaw" (ProfileStepAdr)		Tra-versing range		Boun-dary val-ues left			Boun-dary val-ue right			Max (not consid-ered ev-ery-where)			TPS possible	Flex-Step possible	Opera-tion modes
			Distance	Range	StVel	StAcc	StJerk	EndVel	EndAcc	EndJerk	MaxVel	MaxAcc	MaxJerk			
Polynomial 7th order	VELOCITY_IN_REST_POLY7	1280	*	*	*	0	0	0	0	0	=	=	=			CT, FP
General motion																
Polynomial 2nd order	COMMON_POLY2	16896	*	*	*	=	=	=	=	=	=	=	=			CT
Polynomial 3rd order	COMMON_POLY3	17152	*	*	*	=	=	*	=	=	=	=	=			CT
Polynomial 4th order	COMMON_POLY4	17408	*	*	*	=	=	*	=	=	=	=	=	x		CT
Polynomial 5th order	COMMON_POLY5	16384	*	*	*	*	=	*	*	=	=	=	=		x	CT, FP
Polynomial 7th order	COMMON_POLY7	16640	*	*	*	*	*	*	*	*	=	=	=		x	CT, FP
Polynomial 8th order	COMMON_POLY8	17664	*	*	*	*	*	*	*	*	=	=	=			CT
Extended motion																
- Resulting distance																
Velocity 2nd Order (starting acceleration zero)	X_VEL_STARTACC	33280	=	*	*	0	=	*	=	=	=	=	=			CT
Velocity 2nd Order (end acceleration zero)	X_VEL_ENDACC	33280	=	*	*	=	=	*	0	=	=	=	=			CT
Linear velocity	X_LINEAR_VEL	33024	=	*	*	=	=	*	=	=	=	=	=			CT
Linear acceleration	X_LINEAR_ACC	32768	=	*	*	*	=	=	*	=	=	=	=			CT
- Resulting master axis range																
Acceleration start; motion (trapezoid profile)	X_FIT_VEL_TRAPEZE ALIM	7000	*	=	*	=	=	*	=	=	*	*	=			CT, FP
Acceleration start; sine curve	X_FIT_SINE_TRAPEZE ALIM	28928	*	=	*	=	=	*	=	=	*	*	=			CT, FP
Jerk-lim. motion (trapezoid profile)	X_FIT_ACC_TRAPEZE JLIM	29184	*	=	*	=	=	*	=	=	*	*	*			CT, FP
- Other																
Acceleration start, polynomial 5th order	X_MOTION_IN_MOTION_POLY5_VLIM	24576	*	*	*	*	=	*	*	=	*	=	=			CT, FP
Overshooting-free polynomial 5th order	X_MOTION_IN_MOTION_POLY5_SLIM	24832	*	*	*	0	=	*	0	=	=	=	=			CT, FP

	Definition of the motion law at the input "MotionLaw" (ProfileStepAdr)		Traversing range		Boundary values left			Boundary value right			Max (not considered everywhere)			TPS possible	Flex-Step possible	Operation modes
			Distance	Range	StVel	StAcc	StJerk	EndVel	EndAcc	EndJerk	MaxVel	MaxAcc	MaxJerk			
Acceleration start (trapezoid profile)	X_VELOCITY_IN_VELOCITY_TRAPEZE_ALIM	20480	*	*	*	0	=	*	0	=	*	*	=			CT, FP
Point table																
Cam	CAMTABLE_1	1...99	*	*	=	=	=	=	=	=	=	=	=			CT, MP, FP

0 Explicitly 0
***** User-defined
= Calculated automatically
CT Cam table
MP MotionProfile
FP FlexProfile

Tab. 7-12: Boundary conditions of the FlexProfile motion laws

Note on distance for cam tables:

Cam tables with the same starting and end points:

The complete cam table is scaled with the specified distance.

The starting point is moved to 0 by an addition constant. This procedure allows a smooth linking of multiple steps in one profile.

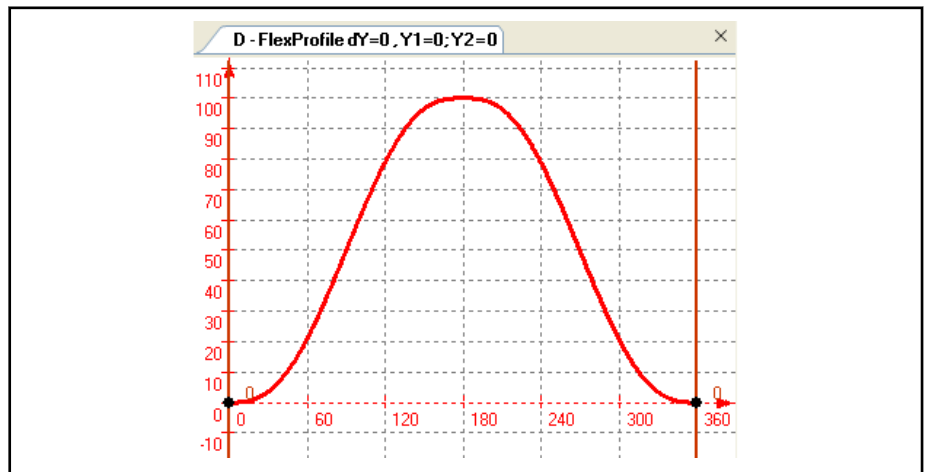


Fig. 7-49: Cam table, same starting and end point

Cam tables with different starting and end points:

The starting point is moved to 0 by an addition constant and the end point is scaled with the distance specified, thus ending at 100%.

The remaining cam table changed accordingly.

This procedure allows a smooth linking of multiple steps in one profile. Thus, only the sign of the distance indicates the direction of the distance to be traversed.

Negative cam tables are traversed in positive direction if the distance is positive.



This can cause a distortion/deformation of the cam, as the end does not have to be the point with the biggest distance.

Example: The following cam table is given (20% to 50%)

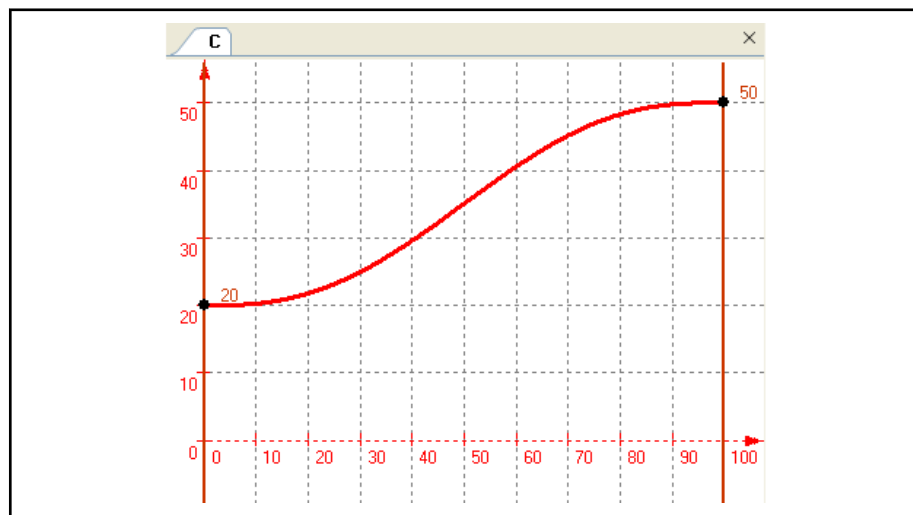


Fig. 7-50: Original cam table

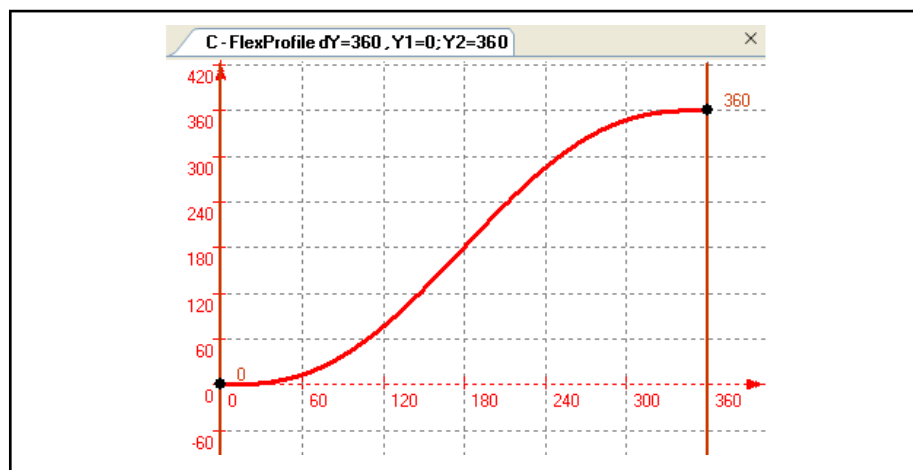


Fig. 7-51: Result if distance is 360

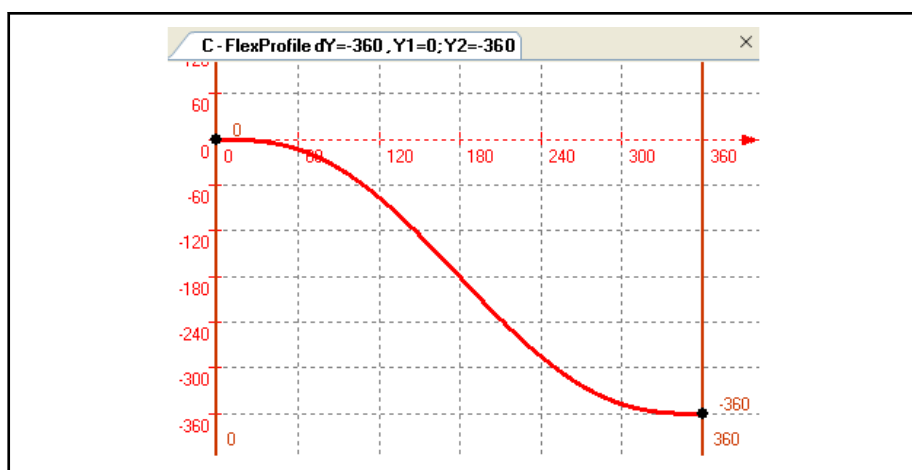


Fig. 7-52: Result if distance is -360

Switching and synchronizing FlexProfile

Selecting the coordinate system

The classification of the different profiles in the coordinate system can be relative or absolute with regard to the respective master axis and slave axis. This allows the combination of the permitted setting options (see the figure below).

The red line symbolizes the current profile and the blue line symbolizes the profile to which it should be switched.

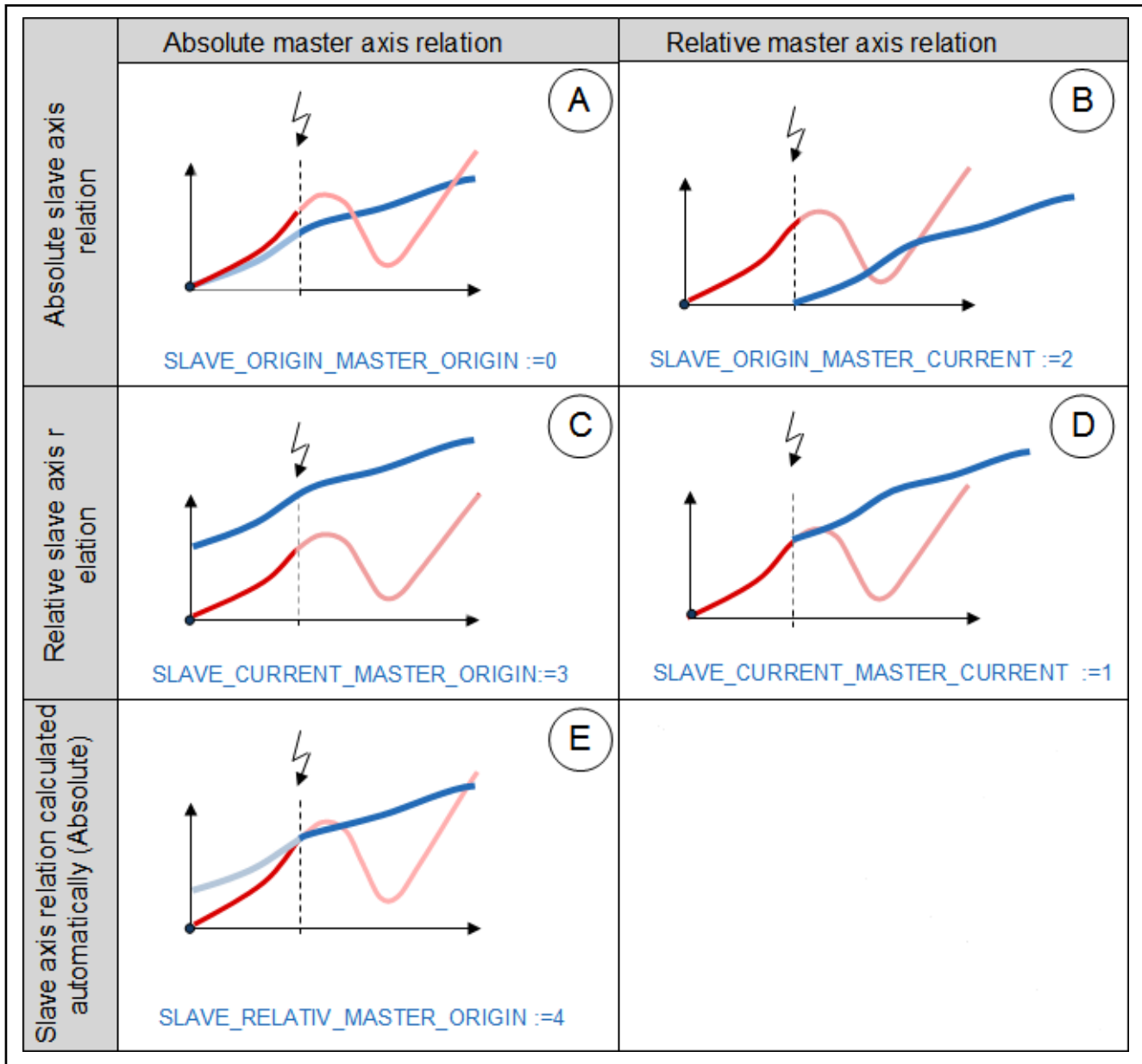


Fig. 7-53: Selecting the coordinate system

Switching and synchronizing

After the assignment of profiles has been defined, both the switching character (Switching at angle or immediately) and the synchronization type (with or without synchronization) can be selected. When switching to phase, wait after the enable signal till the specified phase is reached and at exactly this point, switching to another state is executed. In case of a decoupled state, the new profile is started instead. Immediate switching is executed simultaneously with the input of a positive edge. When using this functionality, note the congruence of the FlexProfiles. If this is ignored, command value jumps can occur in case of some configurations.

The following figures present some possible combinations for switching and synchronizing together with arbitrary coordinate systems.

The following figure shows the switching to a different MotionProfile. The origin of the first and second MotionProfile is congruent and is located in the

zero point of the coordinate system (absolute master axis position and absolute slave axis position - case A). The MotionProfiles are not moved.

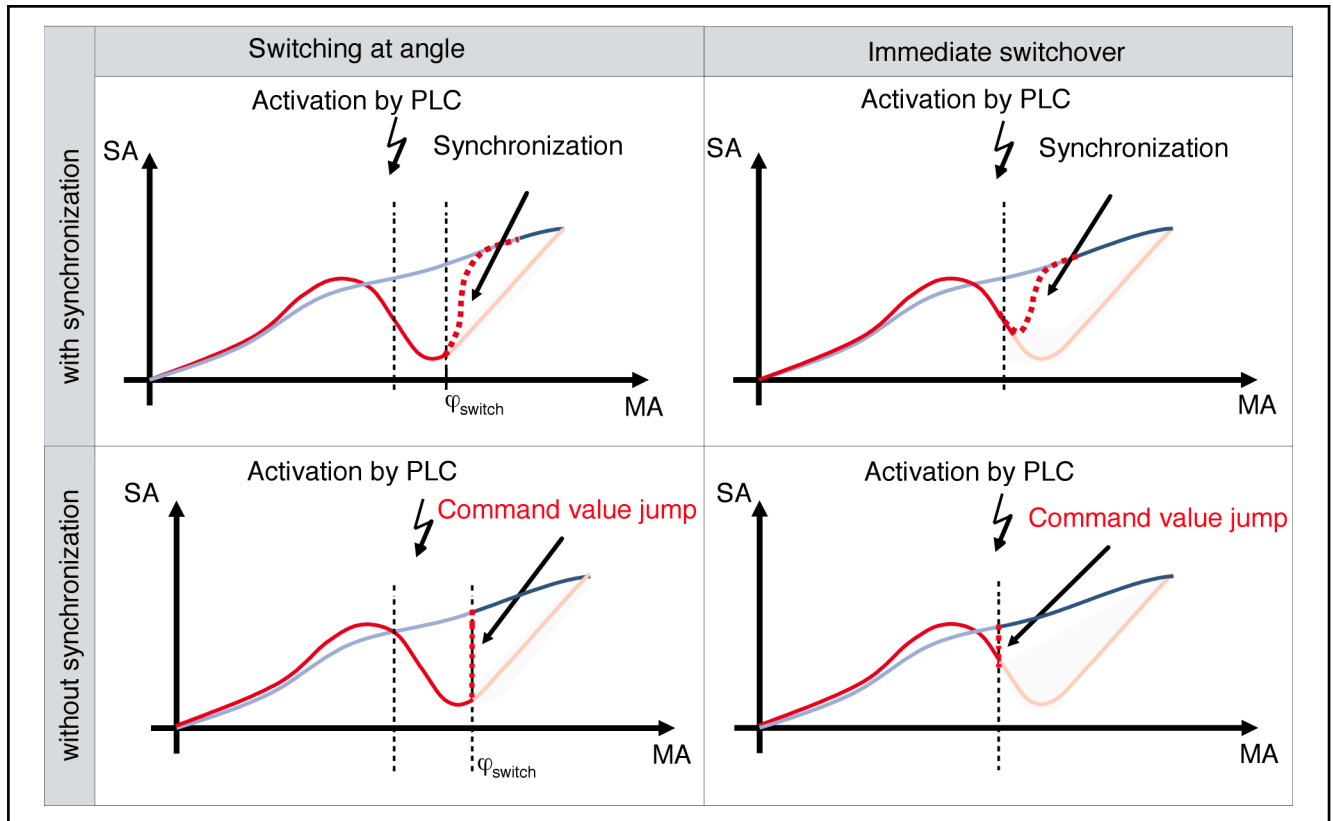


Fig. 7-54: Case A – Switching and synchronizing with absolute master axis position and absolute slave axis position

The following figure shows the switching to a different MotionProfile. The origin of the second MotionProfile is moved to the current master axis position of the first MotionProfile (relative master axis position and absolute slave axis position - case B). The MotionProfile is not moved towards the slave axis.

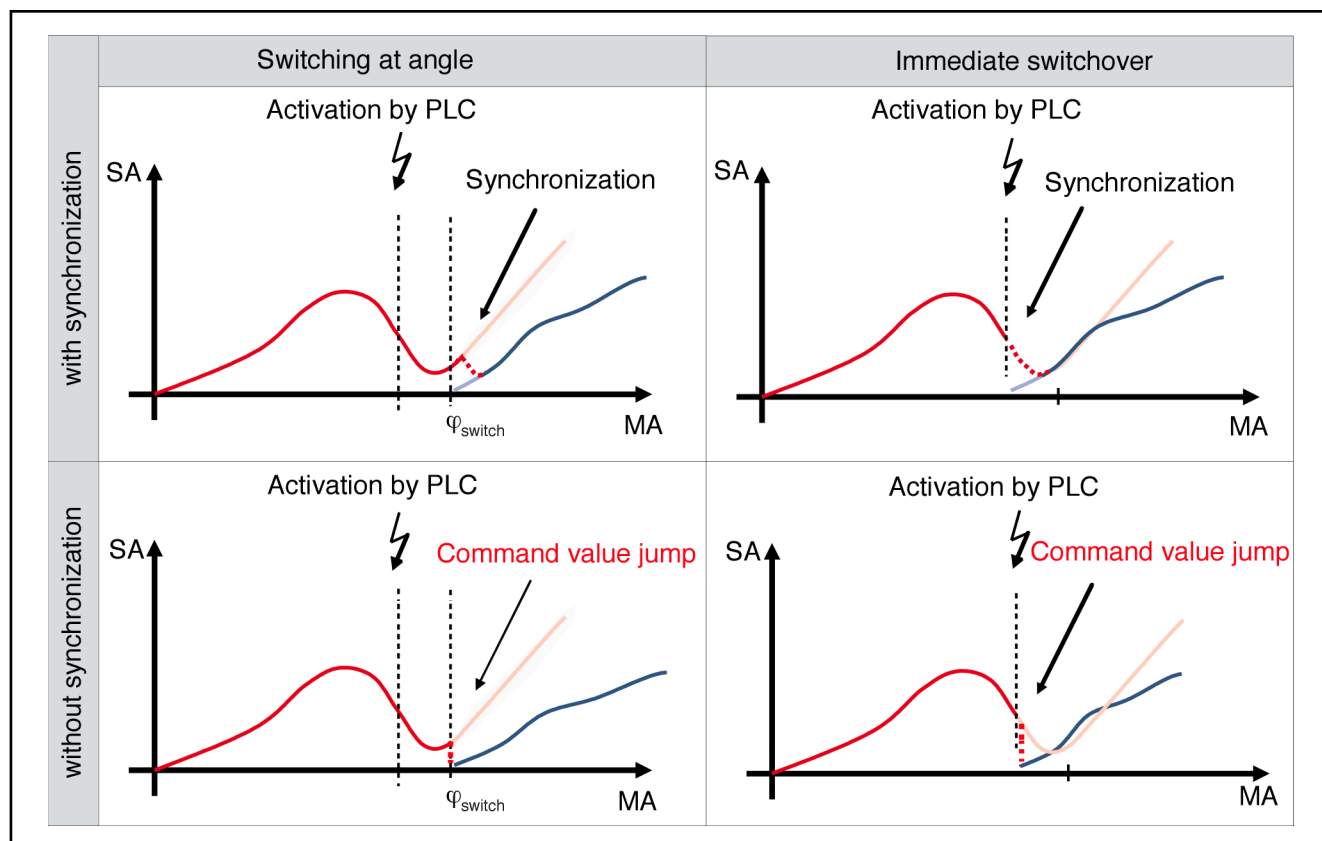


Fig. 7-55: Case B – Switching and synchronizing with relative master axis position and absolute slave axis position

The following figure shows the switching to a different MotionProfile. The origin of the second MotionProfile is moved to the current slave axis position of the first MotionProfile (absolute master axis position and relative slave axis position - case C). The MotionProfile is not moved towards the master axis.

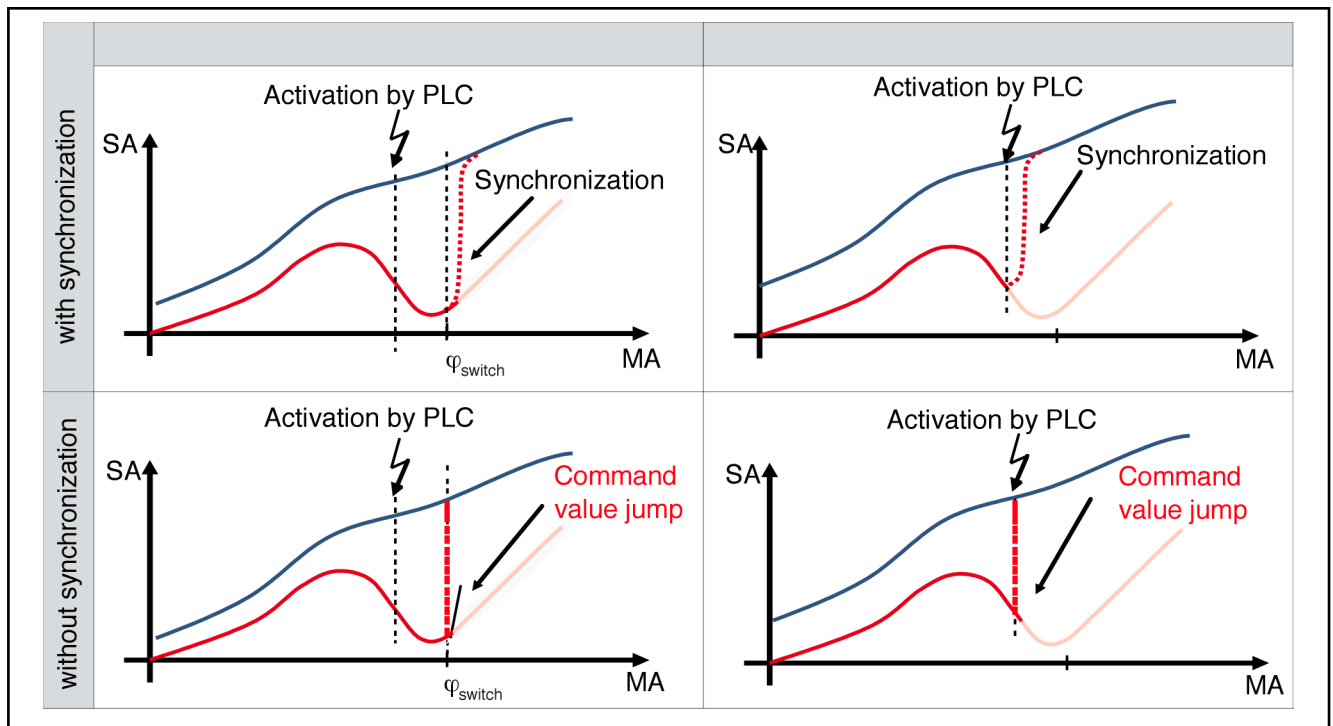


Fig. 7-56: Case C – Switching and synchronizing with absolute master axis position and relative slave axis position

The following figure shows the switching to a different MotionProfile. The origin of the second MotionProfile is moved to the current master and slave axis position of the first MotionProfile (relative master axis position and relative slave axis position - case D).

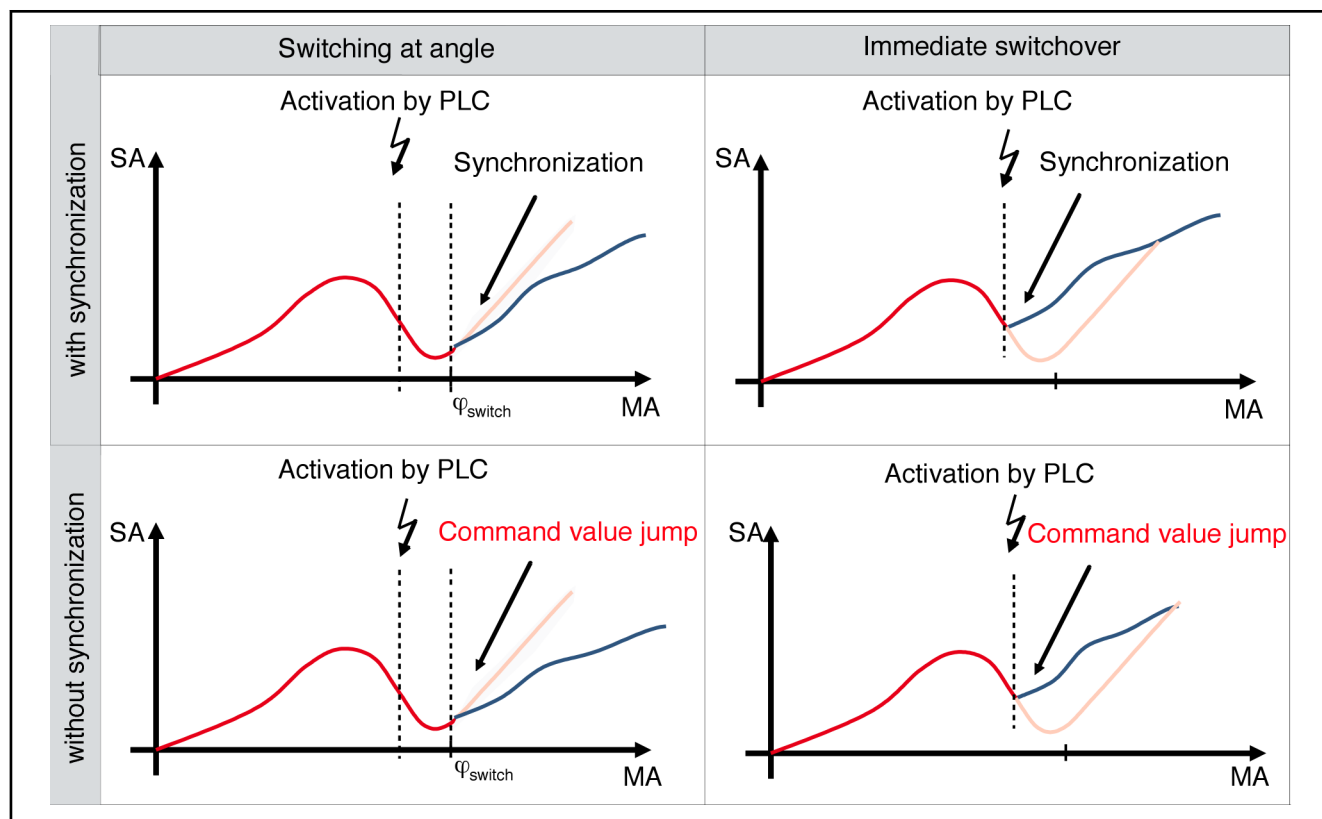


Fig. 7-57: Case D – Switching and synchronizing with relative master axis position and relative slave axis position

The following figure shows the switching to a different MotionProfile. The second MotionProfile is moved to the current slave axis position of the first MotionProfile and started (absolute master axis position and automatically determined slave axis position (relative) - case E). The MotionProfile is not moved towards the master axis.

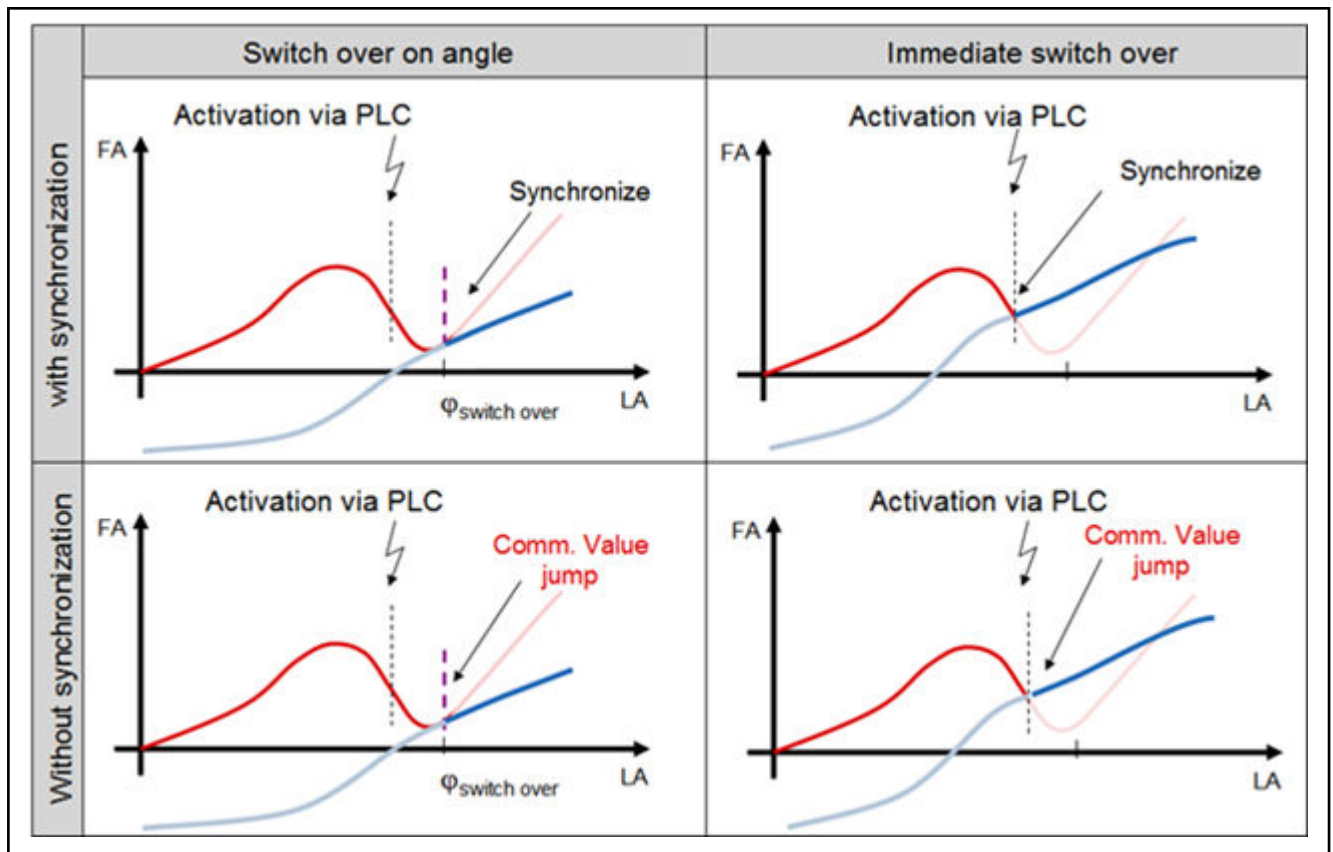


Fig. 7-58: Case E – Switching and synchronizing with absolute master axis position and automatically determined slave axis position (relative)

Processing type

There are two processing types (refer to the following figure) are distinguished:

- Continuous processing
- One-time processing (one shot)

During continuous processing, the active FlexProfile is executed cyclically. Ensure that the final profile velocity of the last motion step is identical to the initial velocity of the entire profile. If necessary, an error message is output. With the one-time processing, the selected profile is only executed once. The same profile can be started several times with a new call for the "ML_Flex-Profile" function block.

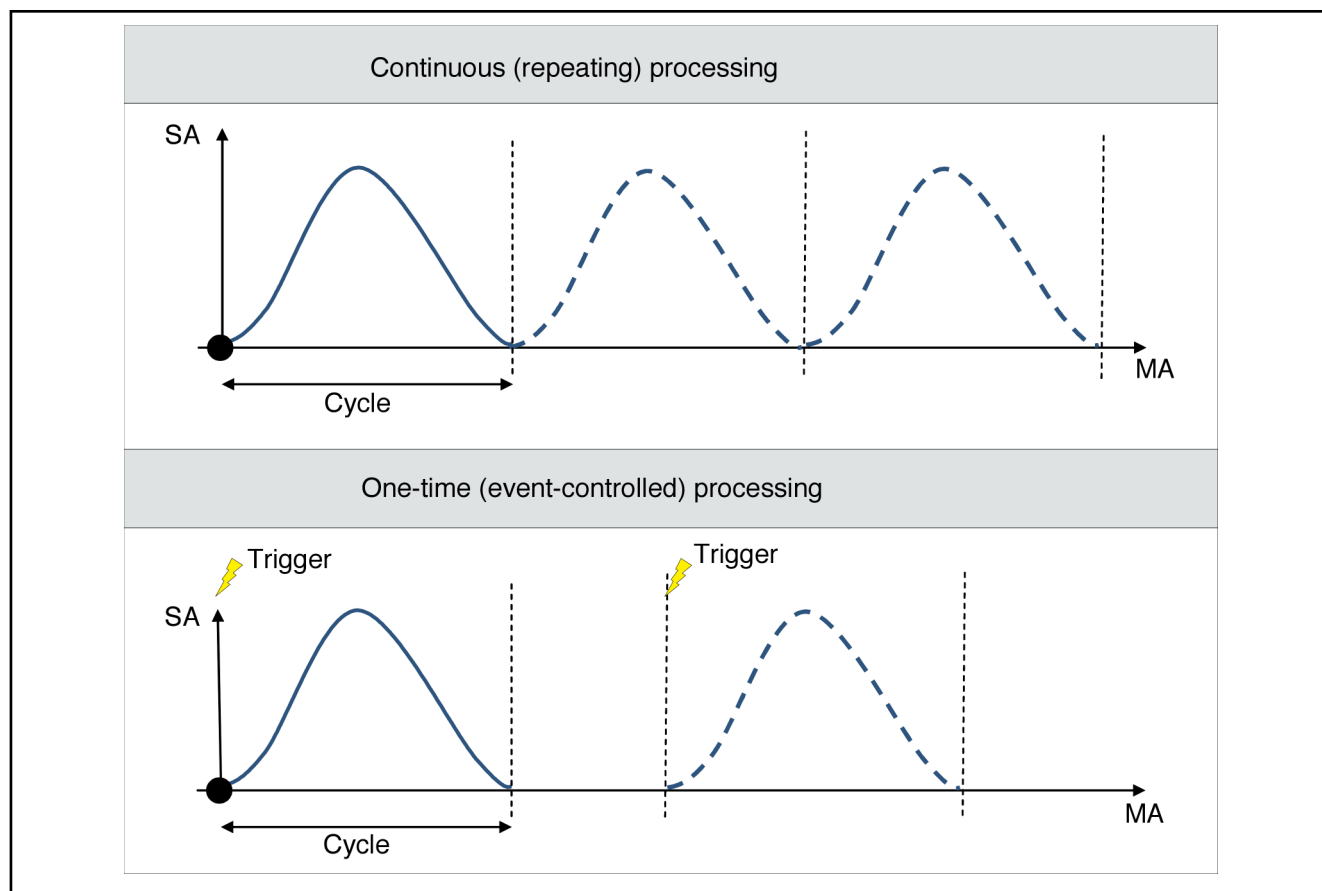


Fig. 7-59: Continuous processing and one-time processing

Event control

Characteristics of the event control

In almost all the processing machines, several axes participate in the process. The motion tasks to be carried out by the individual axes mostly depend on one another and result from the application task.

Therefore, the motion of one axis often has to start at exactly the place where another axis has reached a certain position or where another axis remained in a motion step for a certain time. This is shown in the following picture.

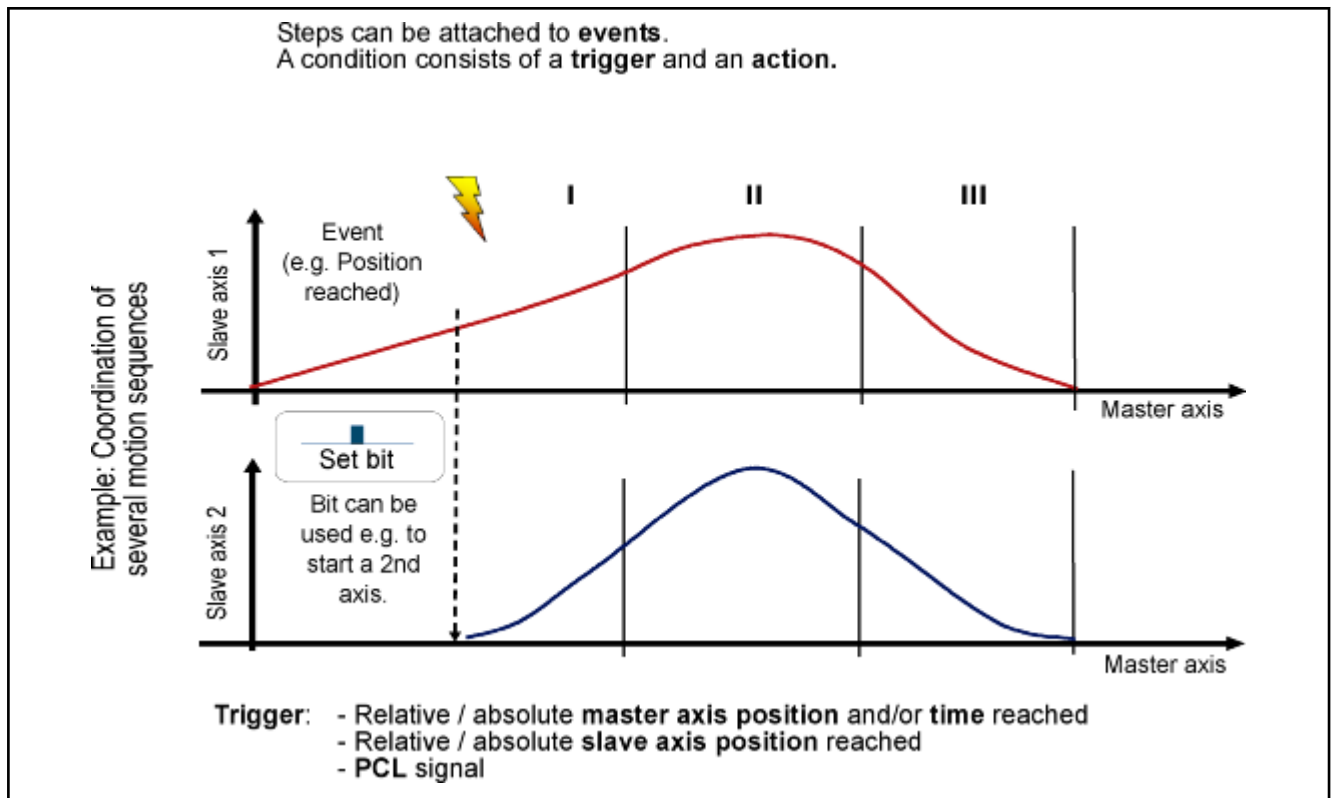


Fig. 7-60: Example of an event control

Events are very suitable to mark these points in the MotionProfile. It is very easy to respond on these points in a PLC via the AxisData structure. It is possible to start follow-up motions of other axes or to decide on the further processing. A resulting dynamic "motion chain" is realized in a PLC reflecting the machine dependencies.

Events can be attached to the motion steps. An event consists of a trigger and an action.



Events do not work if the master axis moves into negative direction (backwards).

The trigger identifies the control variable states. These states are:

- Relative/absolute master axis position reached
Describes the reaching of a relative/absolute position of the master axis. Similar to a programmable limit switch, the current position of a master source can be monitored. If the master axis crosses a specified position in the current motion step, the event occurs
- Relative/absolute slave axis position reached
Describes the reaching of a relative/absolute position of the slave axis. The same concept can also be applied to the slave axis position
- PLC signal
Actions can be triggered by a PLC. Events are reported to the PLC or directly start an action
- Time-controlled abort
The step is not time-controlled. That means that it has no time master, but a master axis to which traveling should be synchronous. Connect an event which monitors the travel time since the beginning of the motion

step with an action triggering an abort of the current motion step. The resulting MotionProfile can be used generically for different master axis velocities

- Monitoring for time steps

With regard to the time-master functionality, the events can also be used for the monitoring of different master sources. Depending on the motion task, an event can be set in such a way that the travel distance of the master axis is monitored during a motion step coupled to the time master. Thus, execute error reactions if the master axis traveled too far during this time. Different process states can be easily and comfortably buffered by the user with the help of the events. It is possible to react on this in a PLC

The action is an active element responsible for the activation of certain variables.

The following actions are possible:

- Set bit immediately

One of the available 16 bits is immediately set in the AxisData

- Set bit at the end of the motion step

One of the available 16 bits is set in the AxisData at the end of the motion step

- Set bit at the end of the profile

One of the available 16 bits is set in the AxisData at the end of the profile

- Set bit immediately and continue with the next motion step

Causes the immediate abortion of the current motion step. This motion step is not processed completely, instead, the next motion step begins directly from the ongoing motion. If this is a Flex motion step, this change can take place smooth and jerk-free.

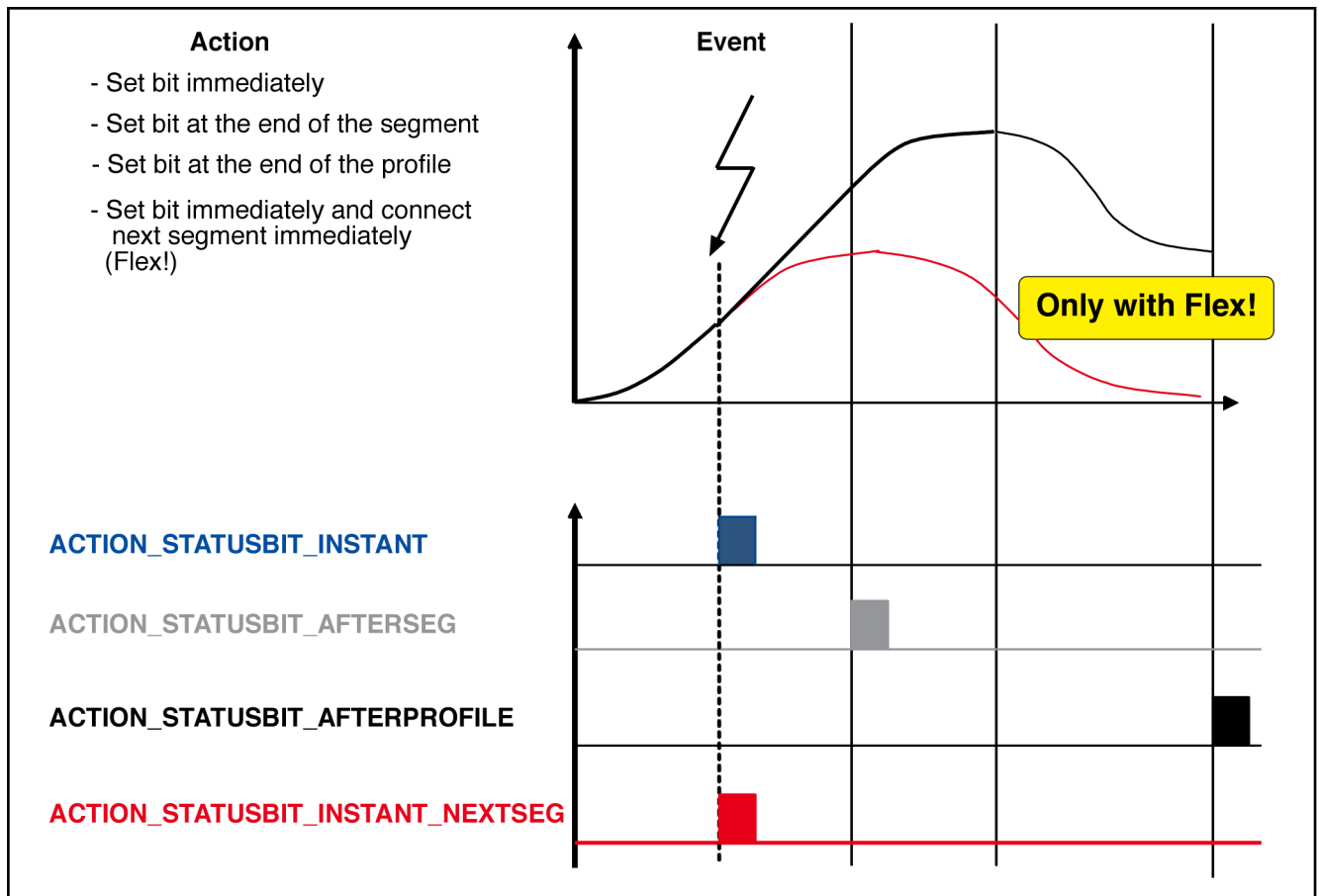


Fig. 7-61: Possible actions

The events can be configured either via the PLC function block MB_ChangeFlexEventSet or the IndraWorks interface.

Assigning MotionProfile and axis

Up to four profiles can be created for each axis; in turn, each can consist of a maximum of 16 motion steps. The individual motion steps can either be defined with certain motion laws (VDI 2143 and special motion laws) or with the cam tables referenced to those. The cam tables are created as C-parameters (C-0-2001 to C-0-2099). The cam tables can either be configured using the PLC function block MB_ChangeCamData or the IndraWorks interface.

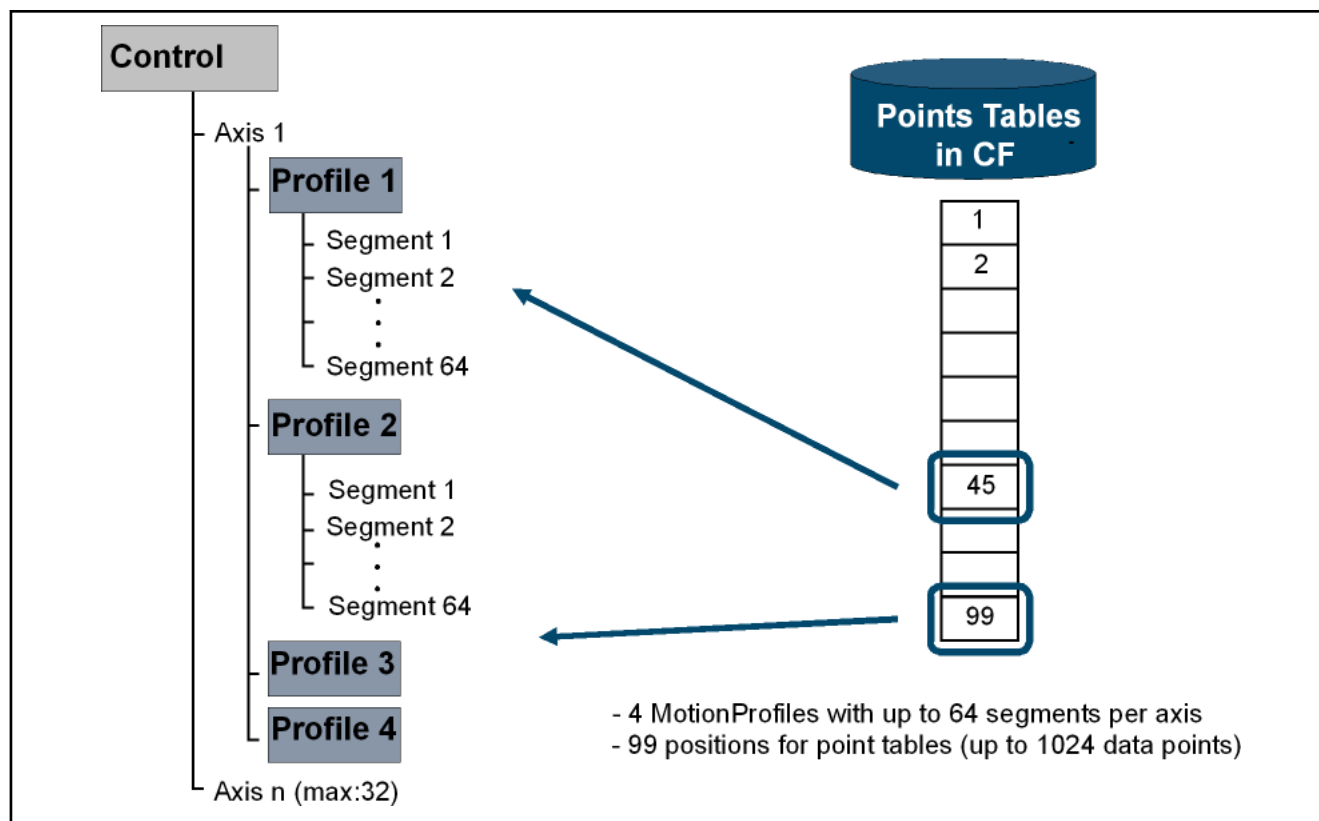


Fig. 7-62: Assigning MotionProfile and axis

FlexProfile – Configuration

Overview

FlexProfiles can either be configured using the FlexProfile Editor of the IndraWorks interface or the available function blocks of the PLC (see figure below).



Fig. 7-63: FlexProfile configuration possibilities

The FlexProfile Editor (IndraWorks) is a tool supporting the user to clearly and precisely create and modify MotionProfiles for the corresponding coupling requirements. Several options are available for this procedure.

Configuring via PLC function blocks

The PLC provides four function blocks allowing the FlexProfiles use. In general, these function blocks can be divided into two groups.

The first group consists of the function blocks "MB_ChangeFlexProfileSet", "MB_ChangeFlexEventSet" and "MB_ChangeCamData" permitting FlexProfiles and cam tables to be written and configured.

The second group consists of the "ML_FlexProfile" FB permitting a FlexProfile to be started.

The "MB_ChangeFlexProfileSet" FB is used to configure a FlexProfile. The individual motion steps are defined by structures (see the description of the

FB). Note that not all structural elements have to be defined during the motion step configuration, as these are provided with default values.

Analog to the "MB_ChangeFlexProfileSet" FB is the "MB_ChangeFlexEventSet" FB with which events can be written to the respective motion steps of the FlexProfile. In this case, configuration is also executed with structures.

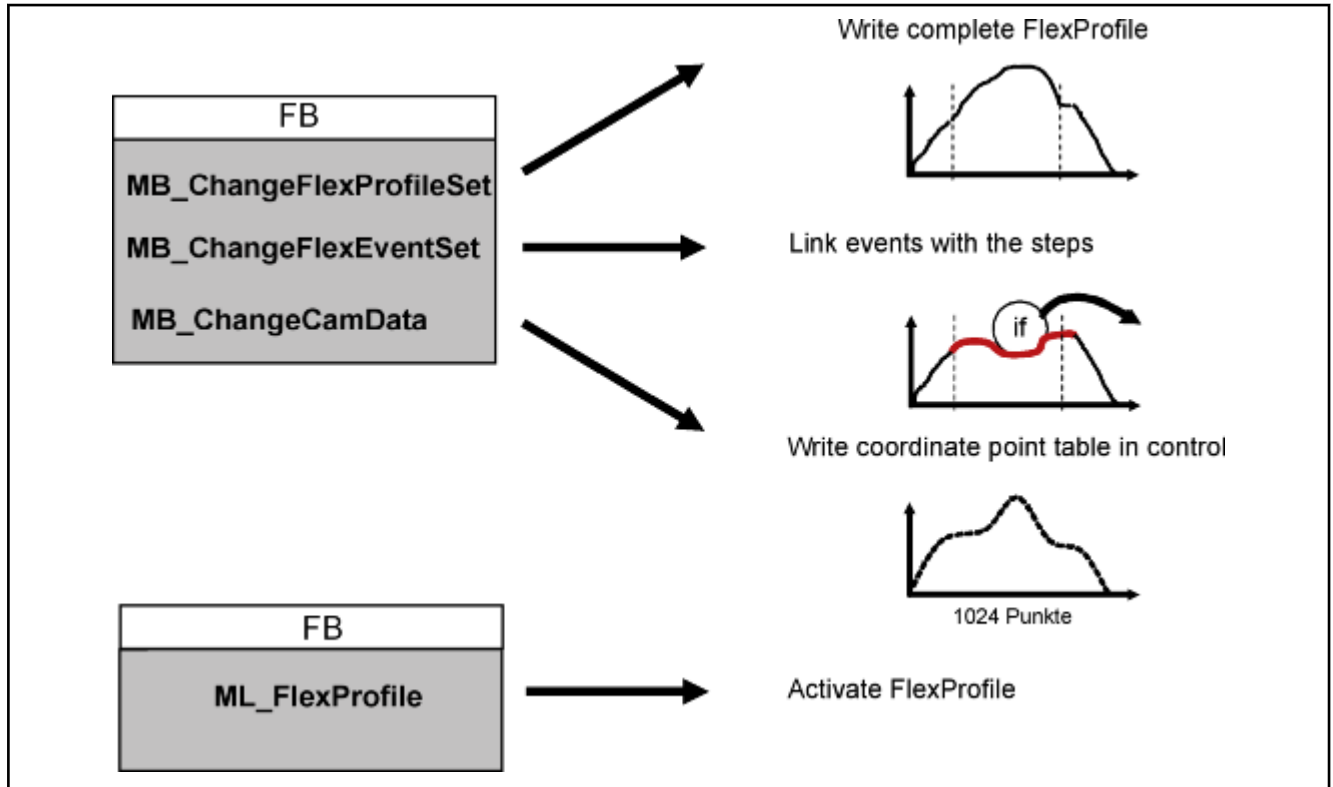


Fig. 7-64: Overview of the PLC function blocks

Finally, the corresponding motion steps can be linked to cam tables. These cam tables are defined among the C-parameters ("C-0-2001, ELS, point table1" ... "C-0-2099, Cam table 99") and can be written using function block "MB_ChangeCamData".

Configuring via IndraWorks

Click on the "FlexProfile" entry in the axis tree of the desired project and axis and a dialog opens to set the general profile configuration.

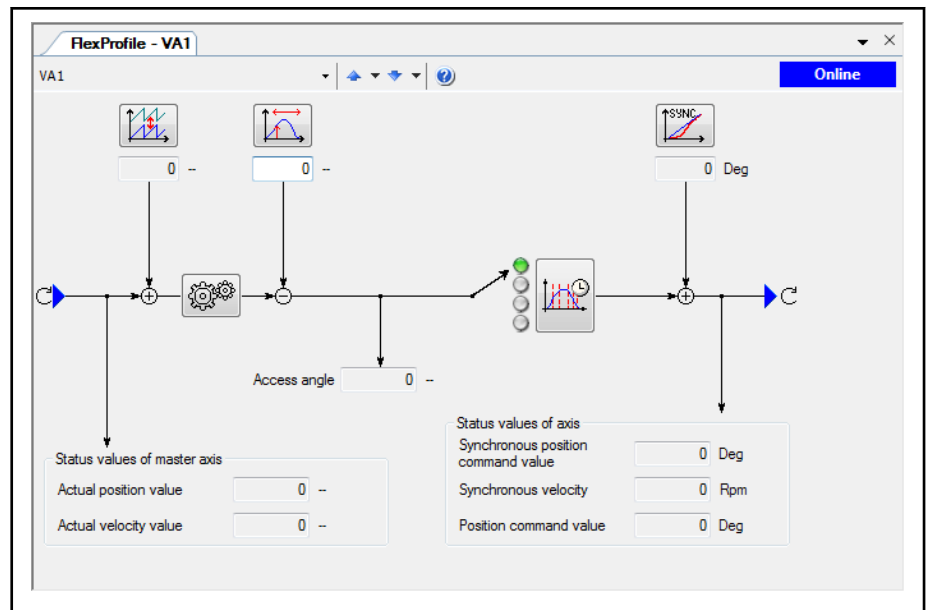


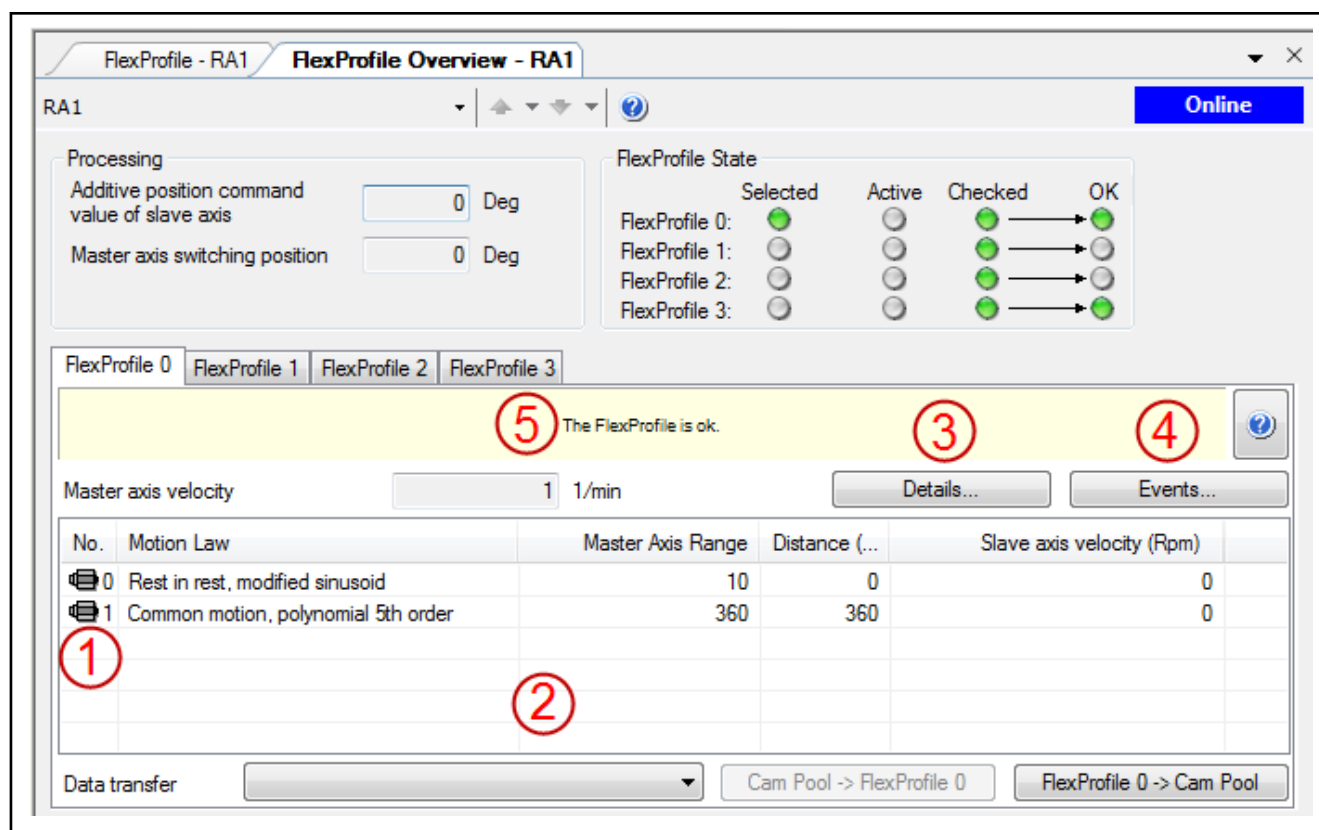
Fig. 7-66: FlexProfiles: Action chain between master axis and slave axis

Click on the "FlexProfile" icon in the middle of the dialog, to go to the MotionProfiles of the FlexProfile (see [fig. 7-66 "FlexProfiles: Action chain between master axis and slave axis" on page 621](#)). The current FlexProfile configuration is shown. This information is available for all MotionProfiles of the axis.



Four FlexProfile MotionProfiles can be stored for the axis.

Furthermore, the MotionProfile states and their processing status are shown in the status window. Errors in the profile definition are reported in the status window above it. A new MotionProfile can be created - or an existing one can be modified - using the **Details** button (see ③ in [fig. 7-67 "FlexProfile overview window" on page 622](#)).

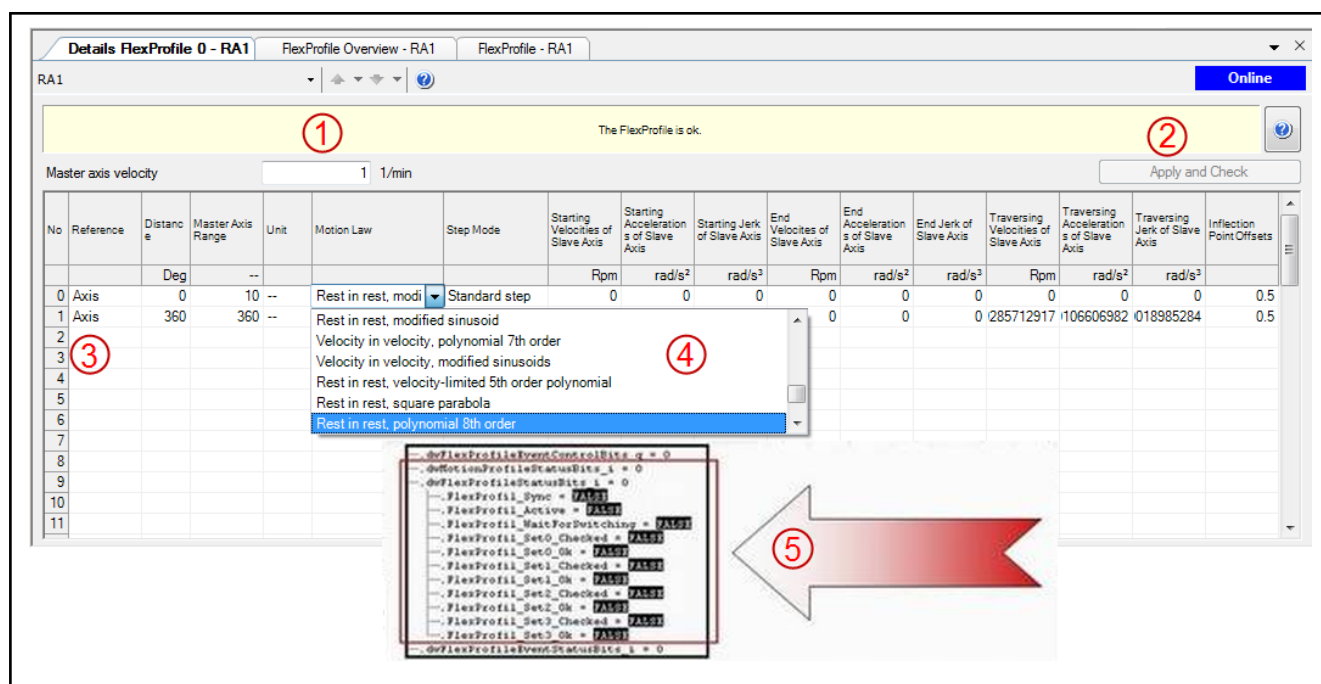


- ① Symbolic representation of the segment type (axis or time)
- ② FlexProfile settings
- ③ FlexProfile configurator
- ④ Event configurator
- ⑤ Error display

Fig. 7-67: FlexProfile overview window

After the action is completed, the FlexProfile Editor opens automatically. First, an empty configuration table is shown. Every line defines a profile step. The master axis sources, motion laws and motion step types required can be selected from a drop down menu. After the FlexProfile configuration has been completed, the changes have to be applied to the control. Apply the changes with the **Apply and check** button (see ② in [fig. 7-68 "FlexProfile configuration" on page 623](#)).

Note that a MotionProfile can only be started checked and marked as valid. This check consists of several plausibility tests, such as invalid boundary value combinations.



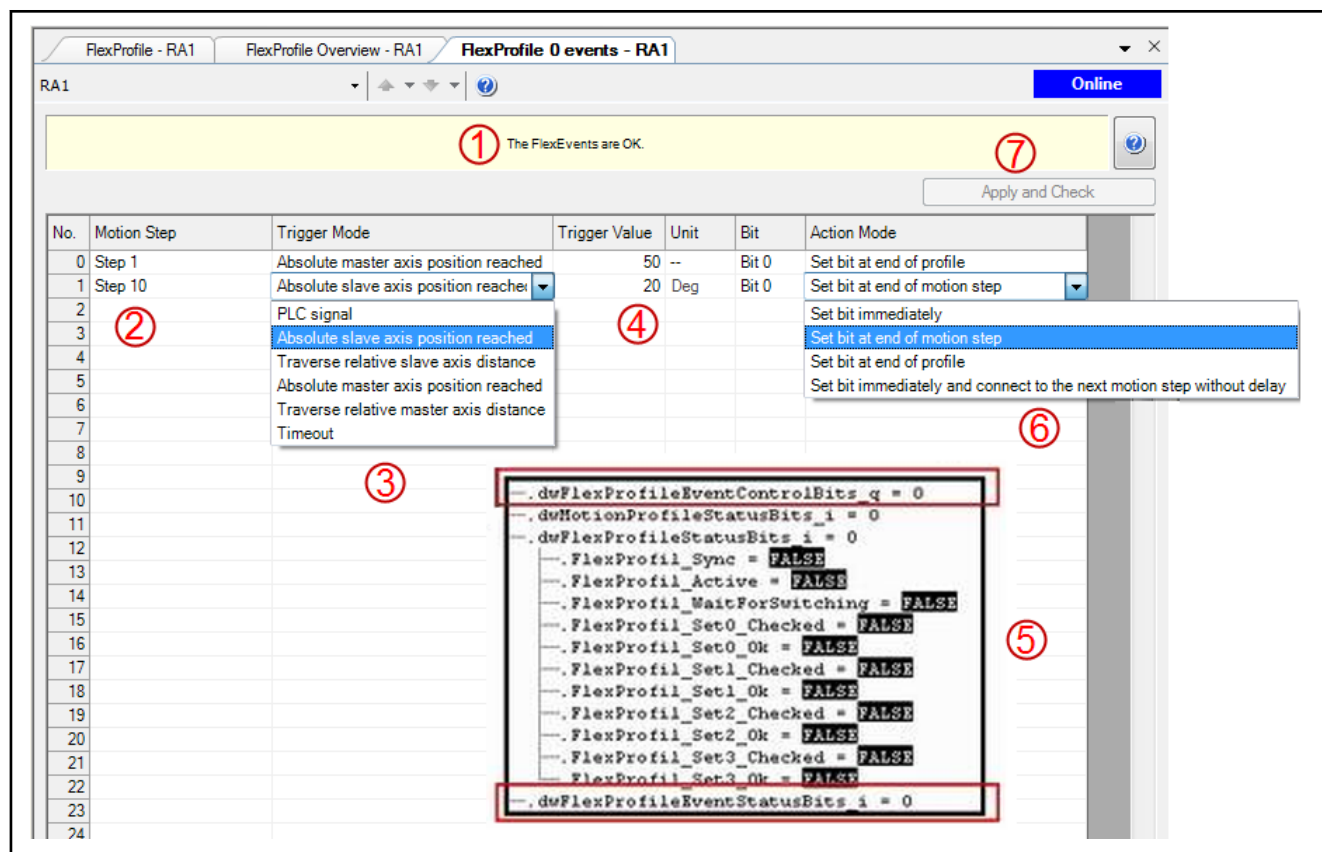
- ① Master axis velocity
- ② Applying and checking the configuration
- ③ Master axis source selection
- ④ Motion laws and motion types can be selected from a list
- ⑤ FlexProfile information in the AxisData

Fig. 7-68: FlexProfile configuration



If the profile is written using the PLC function block, the data is not permanently stored in the control or on the Compact Flash card.

The events of the respective motion steps of the profile can be assigned using the **Events** command button (see ④ in fig. 7-67 "FlexProfile overview window" on page 622). An empty configuration table is shown. Every line defines a new event. The actions and triggers required can be selected from a drop-down menu. Apply the events to the control with **Apply and Check** (see infig. 7-68 "FlexProfile configuration" on page 623).



- ① Diagnostic window
- ② Motion steps can be selected from a list
- ③ Trigger can be selected from a list
- ④ Trigger value specification
- ⑤ FlexProfile information in the AxisData
- ⑥ Action can be selected from a list
- ⑦ Applying and checking the configuration

Fig. 7-69: Event configuration window

Configuring via CamBuilder

For the description of the CamBuilder, refer to "Rexroth IndraWorks 14VRS CamBuilder" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC"](#) on page 6).

7.14 Touch probe

7.14.1 Introduction



The touch probe function is only available for controls based on the IndraControl L hardware.



The touch probe function is only available for IndraLogic XLC Lxx controls with variants with Sercos interface.

With a binary sensor (touch probe), the touch probe function allows a highly accurate position determination in the running production process. Based on determined values, the required position corrections can be made for the best adjustment between product and production process. Use cases: Printed

mark detection, register controller in printing and packaging industry as well as metal sheet processing.

7.14.2 Features

A touch probe has the following properties:

- Up to 72 touch probe inputs, depending on the hardware
- 100 touch probe evaluation units
- Measuring signals can be position values of all configured axes
- Free assignment of touch probe input to evaluation unit and axis
- Measuring position value differences
- Determination of time intervals between measuring signals
- Triggering measurement by positive or negative touch probe signal edges
- Single shot measurement or continuous measurement can be selected
- Counting measurement events during continuous measurement
- Determining a position value range ("expectation window") per touch probe in which the measurements should take place (activation of a "failure counter" when expectation window does not return measurement result)

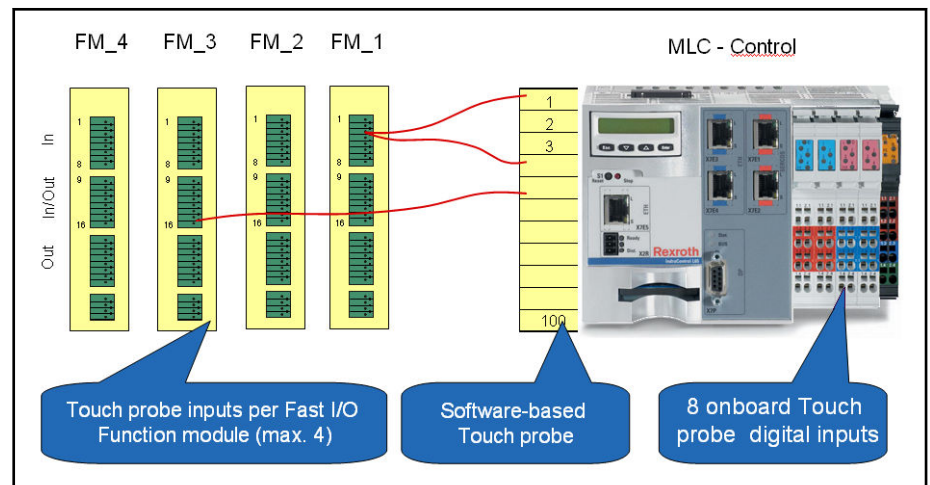


Fig. 7-70: Touch probe hardware architecture

7.14.3 Functional description

The touch probe input digitally evaluates the voltage level of the touch probe signal, i.e. only the signal states "high" (1) or "low" (0) can be detected. When actuating the touch probe, the signal state changes. The touch probe reports a rising (positive) or a falling (negative) switching edge.

The signal level ranges for "high" (1) and "low" (0) of the "fast" digital inputs are described in "IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

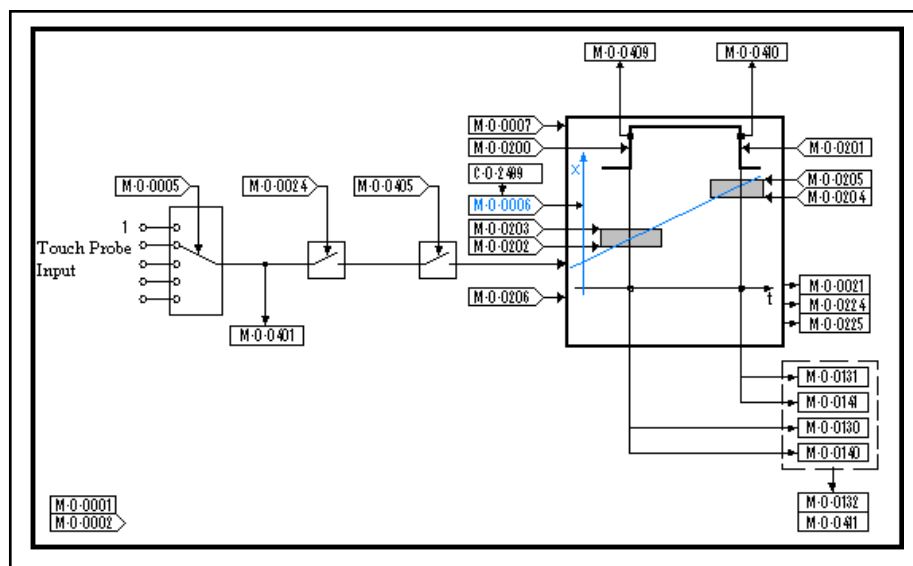


Fig. 7-71: Overview and mode of operation of the touch probe-related parameters

The following touch probe-related parameters are listed:

M parameter dataset for each touch probe

M-0-0001, Logic touch probe number
M-0-0002, Touch probe name
M-0-0005, Input selection
M-0-0006, Signal selection
M-0-0007, Control word
M-0-0009, Osci: list of all M-parameters that can be oscilloscoped
M-0-0010, List of all M-parameters
M-0-0016, Project identification number
M-0-0021, Status word
M-0-0024, Command: Activation
M-0-0130, Measured value, positive edge
M-0-0131, Measured value, negative edge
M-0-0132, Difference value
M-0-0133, Time difference
M-0-0140, Time stamp, positive edge
M-0-0141, Time stamp, negative edge
M-0-0200, Dead-time compensation, positive edge
M-0-0201, Dead-time compensation, negative edge
M-0-0202, Starting position of the expectation window, positive edge
M-0-0203, End position of the expectation window, positive edge
M-0-0204, Starting position of the expectation window, negative edge
M-0-0205, End position of the expectation window, negative edge

M-0-0206, Maximum number of marker failures
M-0-0224, Number of marker failures, positive edge
M-0-0225, Number of marker failures, negative edge
M-0-0401, Input status
M-0-0405, Enabling
M-0-0409, Counter of measured values, positive edge
M-0-0410, Counter of measured values, negative edge
M-0-0411, Counter of difference values
M-0-1000, Command: Load basic touch probe parameters
M-0-2100, List of all backup operation M-parameters

Common C-parameters for all touch probes

- C-0-2499, Touch probe, IDN list signal selection

The currently detected signal state at the respective touch probe input is displayed in parameter M-0-0401. If the input is positioned at a function module, the function module has to be activated (status LED flashes in green).

7.14.4 Accuracy

The position values are received in the grid of the set Sercos cycle time by the control or generated by the drive. The position value belonging to the point of time of the signal edge is determined by the configurable interpolation between the current and the following position value (M-0-0007, Control word).

7.14.5 Data acquisition of the touch probe

Activating measured value acquisition

A switching edge at the touch probe input can "trigger" the acquisition of a measured value. Switching edges only result in the acquisition of a measured value if the following conditions are fulfilled:

- The corresponding hardware input was selected in parameter "M-0-0005, Input selection"
- The presetting for the measured value acquisition in case of positive or/and negative switching edge at the respective touch probe input was activated in "M-0-0007, Control word"
- The measured value acquisition was enabled via "M-0-0024, Command: Activation"
- The respective touch probe input for the measured value acquisition was enabled in "M-0-0405, Enabling"

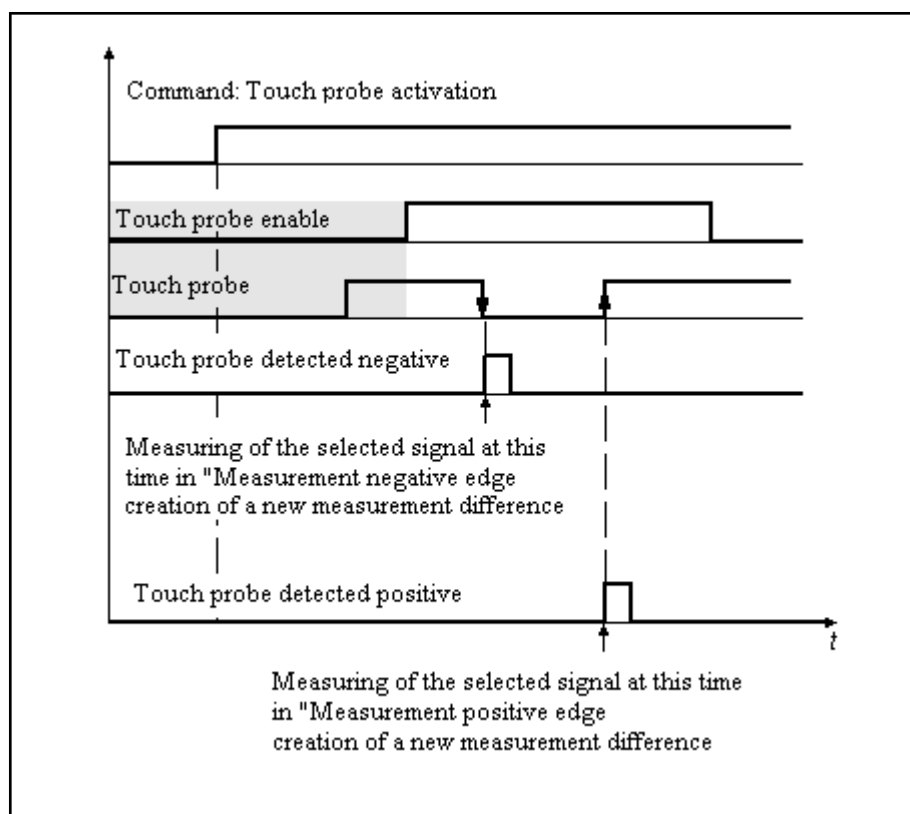


Fig. 7-72: Evaluation of touch probe edges (in case of switched on evaluation of positive and negative edges in M-0-0007)

Bit 0 and 1 are applied for exactly one cycle in parameter "M-0-0021, Status word". The bits are reset to 0 in the next cycle, unless another touch probe event occurred.

Selecting measuring signal

The signal selection, the value of which is measured during the respective measured value trigger, takes place by entering the respective IDN in the parameter "M-0-0006, Signal selection".

The IDN of parameters assigned to the measuring signals which can be selected are listed in the "C-0-2499, Touch probe, IDN list signal selection".

Measured value acquisition mode

The measurement mode can be set for each touch probe in the control parameter M-0-0007. The measured value acquisition has to be activated.

The following enable modes are possible:

- **Single shot measurement** - After the touch probe (M-0-0405) was enabled, a measured value is only applied during the first measured value trigger. Prior to every further measurement, a new enabling of the touch probe is necessary!
- **Continuous measurement** - After the touch probe (M-0-0405) was enabled, a new measured value is only applied during the first measured value trigger

Moreover, further configurations of the measured value acquisition can be preset in parameter M-0-0007:

- Limiting a range for position values (expectation window) in which measurements can take place

- No trigger failure monitoring registering the passing of this range without measuring event can be activated for the "expectation window"

Saving measured values

Depending on the switching edge of the touch probe signal (setting in [M-0-0007](#)) activated by the measured value trigger, the measured value of the signal selected from the list parameter C-0-02499 is saved in one of the following parameters:

- [M-0-0130](#), Measured value, positive edge
- [M-0-0131](#), Measured value, negative edge

In case of continuous measurement and single shot measurement, the difference from the last two measured values of the same touch probe are calculated which were measured during opposed (positive/negative/positive...) triggering of the measured values (setting in [M-0-0007](#)). This difference is saved in parameter "[M-0-0132](#), Difference value". The difference measurement type can also be changed via the parameter [M-0-0007](#).

The following settings can be made:

- the difference between negative and negative edge
- the difference between positive and negative edge
- the difference between negative and positive edge
- the difference between positive and positive edge

Dead time compensation

The following parameters can be used to compensate the signal runtime of the actual touch probe event up to the detection in the control:

- [M-0-0200](#), Dead-time compensation, positive edge
- [M-0-0201](#), Dead-time compensation, negative edge

The dead time is optimally set if the determined position remains constant irrespective of the axis velocity. This can be used to determine the system dead time.

The determined touch probe position is calculated from:

$$P_{\text{Det}} = P_{\text{Act}} + v_{\text{Act}} \cdot T_{\text{Dead}}$$

Fig. 7-73: Determining the master position

With

P_{Det} : Determined touch probe position

P_{Act} : Axis position when touch probe event occurs

v_{Act} : Actual axis velocity

T_{Dead} : Dead time of touch probe input

If the touch probe position is now measured at two different velocities, the dead time is calculated as follows (assumption: constant dead time):

$$T_{\text{Dead}} = \frac{P_{\text{Det2}} - P_{\text{Det1}}}{v_{\text{Act2}} - v_{\text{Act1}}}$$

Fig. 7-74: Dead time calculation

P_{Det1} , P_{Det2} : Determined touch probe position for measurement 1 and measurement 2

v_{Act1} , v_{Act2} : Actual axis velocity for measurement 1 and measurement 2

T_{Dead} : Dead time of touch probe input



The dead time can have a value of up to 128 cycles.

Example A touch probe is connected to an axis. The dead time should be determined for the positive and negative edge.

For the measurement, set the parameters "M-0-0200, Dead-time compensation, positive edge" and "M-0-0201, Dead-time compensation, negative edge" to 0!

Subsequently, the respective axis is traveled with 10 rpm and the "M-0-0130, Measured value, positive edge" and the "M-0-0131, Measured value, negative edge" are recorded.

To reduce encoder noise as well as inaccuracies occurring due to the touch probe sensor scanning for example the measured values were recorded during several measurements. This resulted in an average value of 100° of M-0-0130 and an average value of 110° of M-0-0131.

The same measurement is repeated with 3000 rpm. This resulted in an average value of 101° of M-0-0130 and an average value of 112° of M-0-0131.

The dead time for the positive edge is calculated as follows:

$$T_{TotPos} = \frac{101^\circ - 100^\circ}{3000 \left[\frac{U}{\min} \right] - 10 \left[\frac{U}{\min} \right]} = \frac{1^\circ}{2990 \cdot \frac{360^\circ}{60s}} = 55.74ns$$

Fig. 7-75: Dead time calculation for positive edge

The dead time for the negative edge is calculated as follows:

$$T_{TotNeg} = \frac{110^\circ - 112^\circ}{3000 \left[\frac{U}{\min} \right] - 10 \left[\frac{U}{\min} \right]} = \frac{1^\circ}{2990 \cdot \frac{360^\circ}{60s}} = 111.48ns$$

Fig. 7-76: Dead time calculation for negative edge

Restarting or disabling measured value acquisition

A single shot measurement or a continuous measurement restart is triggered when resetting the parameter for the touch probe enabling ($1 \Rightarrow 0$) and setting it again ($0 \Rightarrow 1$):

- M-0-0405, Enabling

Deleted are:

- M-0-0021, Status word
- M-0-0130, Measured value, positive edge
- M-0-0131, Measured value, negative edge
- M-0-0132, Difference value
- M-0-0140, Time stamp, positive edge
- M-0-0141, Time stamp, negative edge
- M-0-0224, Number of marker failures, positive edge
- M-0-0225, Number of marker failures, negative edge
- M-0-0409, Counter of measured values, positive edge

- [M-0-0410](#), Counter of measured values, negative edge
- [M-0-0411](#), Counter of difference values

Measured value status

Each measurement event generates a status information and increments a counter for each touch probe depending on the polarity of the respective measured value trigger. This is especially advantageous for the continuous measurement to identify new measurement events. This status information is displayed in the respective parameter:

- [M-0-0021](#), Status word
- [M-0-0409](#), Counter of measured values, positive edge
- [M-0-0410](#), Counter of measured values, negative edge

7.14.6 Touch probe expectation window

Using the expectation window

The value range of the signal to be measured, in which touch probe signal edges lead to a measured value acquisition, can be limited. In case of any limitation, measured value trigger signals are only expected in the set value range. Thus, this range is called "expectation window". The activation of the measured value acquisition limited to the "expectation window" is carried out separately for the positive and negative edge in the parameter "[M-0-0007](#), Control word".

Recording of marker failures with the activated "expectation window":

If the value of the signal to be measured is outside the range the "expectation window", touch probe signal edges do not lead to a measured value acquisition!

If no "marker" was detected after a complete run (exceeding both value range limits) which triggered a measured value, this status can be stored in the parameter "[M-0-0224](#), Number of marker failures, positive edge" or "[M-0-0225](#), Number of marker failures, negative edge" and can be displayed. Therefore, the "marker failure monitoring" has to be enabled in parameter "[M-0-0007](#), Control word"! If repeated, the value of [M-0-0224](#) or [M-0-0225](#) is incremented. If the value of [M-0-0224](#) or [M-0-0225](#) reaches a user-defined settable threshold ([M-0-0206](#), Maximum number of marker failures), a bit is set in the parameter "[M-0-0021](#), Status word".

When registering a measured value trigger in the "expectation window", the value in the parameter [M-0-0224](#) or [M-0-0225](#) is deleted.

Setting the expectation window

The limit values for the "expectation window" are set in the following parameters:

- [M-0-0202](#), Starting position of the expectation window, positive edge
- [M-0-0203](#), End position of the expectation window, positive edge
- [M-0-0204](#), Starting position of the expectation window, negative edge
- [M-0-0205](#), End position of the expectation window, negative edge

Marker detection

The request to detect a "marker" is determined by activating a positive or negative signal edge for the touch probe. A "marker" is detected if the following event occurs during a complete measured signal processing via the "expectation window" with regard to the settings in the parameter "[M-0-0007](#), Control word":

- A negative signal edge is detected in case of "activation of negative edge, touch probe"
- A positive signal edge is detected in case of "activation of positive edge, touch probe"
- A positive signal edge and a negative signal edge are detected in case of "activation of positive and negative edge, touch probe"

7.14.7 Overview on M-Parameters

M-0-0000, Dummy, M-parameter

- Function** A parameter serves as a placeholder; it does not have a function. A parameter can be described and read cyclically.
- Use** Measure down time for writing and reading.

M-0-0001, Logic touch probe number

- Function** The logical probe number can be read from this parameter. The number can deviate from the number of the input that is connected to the probe and can have values ranging from 1 to 100.

M-0-0002, Touch probe name

- Function** The descriptive text for the instance of the touch probe function can be saved in this parameter.
- The text does not provide any functional meaning.

M-0-0005, Input selection

- Function** By means of this probe, the digital input is selected that is to deliver the trigger signal for the probe function.
- It is possible to assign the same input to various instances of the probe function so that different parameters can be simultaneously registered by means of one trigger signal.

IndraMotion MLC L45/L65/L75 / IndraLogic XLC L45/L65/L75

- Input 1..8 - onboard module
- Input 110..117 (digital inputs), 120..127 (free configurable digital inputs) - fast I/O 1
- Input 210..217 (digital inputs), 220..227 (free configurable digital inputs) - Fast I/O 2
- Input 310..317 (digital inputs), 320..327 (free configurable digital inputs) - Fast I/O 3
- Input 410..417 (digital inputs), 420..427 (free configurable digital inputs) - Fast I/O 4



1xx always represents the fast I/O module first found, not the PSI slot, 2xx represents the second fast I/O module, etc.

M-0-0006, Signal selection

- Function** Here, the selection of the parameter is carried out, whose current value for a signal edge is to be stored at the assigned input.
- When selecting a parameter, the parameters for the measured values
- [M-0-0130](#), Measured value, positive edge,
 - [M-0-0131](#), Measured value, negative edge and

- [M-0-0132](#), Difference value,
as well as the parameters for the expectation window limits
- [M-0-0202](#), Starting position of the expectation window, positive edge,
- [M-0-0203](#), End position of the expectation window, positive edge,
- [M-0-0204](#), Starting position of the expectation window, negative edge
and
- [M-0-0205](#), End position of the expectation window, negative edge
automatically adopt the selected parameter's data type and unit.

If the signal selection is changed on applied enable, the enable signal is automatically reset.

Applies to the firmware versions 14V20 patch 4 and 14V22 patch 1 and above:

Due to a successful troubleshooting, the parameter response changed as follows:

If the touch probe is enabled ([M-0-0024](#)), [M-0-0006](#) is write-protected (error message 0xF00A700C "Operating date currently write-protected...").



The IDN of the selectable parameters are listed in "C-0-2499, Touch probe, IDN list signal selection".

Axis parameters can only be selected for axes that are actually provided.

Also refer to the Functional Description "Touch Probe Function".

Use The readability of the selected parameters is only checked when the control unit is in operation mode. IDNs of non-readable parameters are not accepted. If the control unit is in P0/P2, the IDN is checked only. It cannot be determined, whether the axis the parameter belongs to is actually existing. The reading check is carried out

- with an activated touch probe function if the operation mode is switched or,
- if the control unit is in operation mode - as soon as the touch probe function is activated.

If the selected parameter cannot be read, the signal source is reset.

Applies to the firmware versions 14V20 patch 4 and 14V22 patch 1 and above:

Due to a successful troubleshooting, the parameter response changed as follows:

The readability of the selected parameter is checked irrespective of the control mode. IDNs of non-readable parameters are not accepted.

It is checked in each phase whether the axis the parameter belongs to actually exists.

In case of incorrectly selected parameters, the signal selection is not reset anymore, as the parameter [M-0-0006](#) cannot be changed anymore after activation ([M-0-0024](#)) and enabling ([M-0-0405](#)).

M-0-0007, Control word

Function By means of this parameter the probe function can be configured. The settings affect

- the activation of the signal edges,

- switching the measured value acquisition mode,
- the activation of the time stamp recording,
- the activation of the expectation window,
- the activation of the marker failure monitoring
- and the difference measurement mode.

Structure

Bit	Values/function
0	Activation of positive edge 0: positive edge not activated 1: positive edge activated
1	Activation of negative edge 0: negative edge not activated 1: negative edge activated
2	Enable mode 0: single measurement → after every measurement, the enable signal for the probe must be deleted and reset in order to enable another measurement. The measuring results are maintained until the next enable signal is applied. 1: continuous measurement → the measurements are continuously carried out for as long as the enable signal for the probe is set.
3	Enable time stamp 0: the time stamp is not registered 1: the time stamp is registered
4	Activation of the probe window, positive edge 0: unrestricted range of measurement 1: range of measurement restricted to probe window (reserved)
5	Activation of the probe window, negative edge 0: unrestricted range of measurement 1: range of measurement restricted to probe window
6	Marker monitoring 0: not activated 1: activated
7	Extended difference measurement 0: not activated 1: activated
9, 8	Edge determination for extended difference measurement 00: difference from negative to negative edge 01: difference from positive to negative edge 10: difference from negative to positive edge 11: difference from positive to positive edge

Bit	Values/function
10 - 11	Interpolation of the measured values 00: interpolation is not carried out The measured value corresponds to the current value at the point of time when the edge is at the input. 01: The measured value is interpolated in linear form from the current value and the subsequent value. 10: The measured value is determined from 3 values by means of cubic spline interpolation. 11: The measured value is determined from 4 values by means of cubic spline interpolation.
31 - 12	(reserved)



"Positive edge" means that the level at the probe input moves from 0 V to +24 V.

"Negative edge" means that the level at the probe input moves from +24 V to 0 V.

Even with the expectation window activated, the restriction of the measurement range is only effective if the start and end position of the expectation window are not identical.

See also Functional Description "Touch Probe Function".

M-0-0009, Osci: list of all M-parameters that can be oscilloscoped

Function This parameter contains the list of all M parameters which can be oscilloscoped.

M-0-0010, List of all M-parameters

Function This list includes all M parameters. The entry is made in ID number format. The entries are sorted according to identity number in ascending order.

Structure Following is the identity number format:

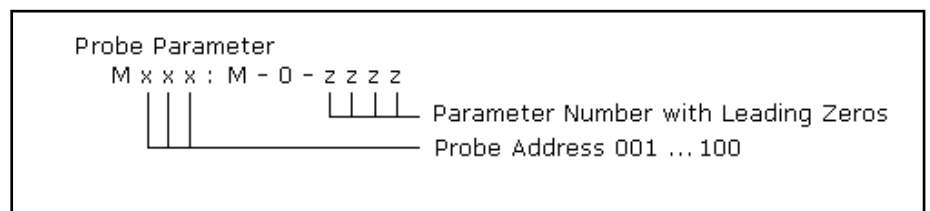


Fig. 7-77: Identity number format

Use M001: [M-0-0002](#) - Probe 1; Parameter [M-0-0002](#).

M-0-0016, Project identification number

Function IndraWorks entered a series of unique characters in this parameter to identify worldwide the project. This series of characters is one to one for each project. This parameter has no influence on the functions of the Motion Logic Control.



This parameter is for internal purposes only.

M-0-0021, Status word

Function This parameter indicates the status of the measured value acquisition in the current cycle.

The status parameter includes information on the

- availability of newly measured values
- exceedance of the marker failure threshold
- and the overflow of touch probe events

The parameter is reset with each touch probe enabling.

Structure

Bit	Name/function
0	Measured value at positive edge 0: no new measured value available 1: a new value was determined
1	Measured value at negative edge 0: no new measured value available 1: a new value was determined
2	Difference value calculation 0: no new difference value available 1: a new difference value was determined
3	Status of the marker failure monitoring 0: marker failure threshold not exceeded 1: marker failure threshold exceeded
4	Event overflow at positive edges 0: all positive edges could be detected 1: Various positive edges were detected in one Sercos cycle, but only the first was processed.
5	Event overflow at negative edges 0: all negative edges were detected 1: Various negative edges were detected in one Sercos cycle, but only the first was processed.
15 - 6	(reserved)



The status of the marker failure monitoring is set in relation to the parameterized limit value for the marker failure "M-0-0224, Number of marker failures, positive edge, touch probe". The status is reset as soon as the expectation window has been passed without marker failure.

If the maximum number of the marker failures is parameterized with "0", exceeding the limit value is not monitored.

Also refer to the Functional Description "Touch Probe Function".

M-0-0024, Command: Activation

Function The touch probe function is enabled using this input.



The touch probe function can only be enabled if the touch probe function is activated.

The parameter's data type and unit are only adapted for the measured values and the expectation window limits if the touch probe function is activated.

The touch probe function can only be activated if the values of parameter C-0-0400 and C-0-0503 are identical.



Applies to the firmware versions 14V20 patch 4 and 14V22 patch 1 and above:

Due to a successful troubleshooting, the parameter response changed as follows:

When leaving Sercos phase 4, the touch probe is disabled and enabling is reset (refer to [M-0-0405](#)). The reason is that possibly required data such as modulo and scaling can only be retrieved now in Sercos phase 4.

Up to now, the touch probe was enabled while switching from Sercos phase 3 to Sercos phase 4. The touch probe is not enabled anymore, as possibly required data such as modulo and scaling cannot be retrieved anymore at that point in time. Enable the touch probe manually after going into Sercos phase 4.

If a master axis position (A-0-2650, A-0-2651, A-0-2656) was configured in the parameter [M-0-0006](#), the touch probe can only be enabled when the slave axis is in a synchronous operation mode (error message 0xE0337008 "Invalid operating date...").

M-0-0130, Measured value, positive edge

Function In this parameter, the value of the selected parameter ("[M-0-0006](#), signal selection touch probe") is saved at the time of the positive edge at the entrance of the touch probe. When the release is granted, the measurement value is deleted.

- Use**
- Activating the probe function through parameter "[M-0-0024](#), Command: Activation",
 - Activating the positive edge by setting bit 0 in parameter "[M-0-0007](#), Control word",
 - Apply enable signal by setting "[M-0-0405](#), Enabling".



The counter for the measured values (parameter "[M-0-0409](#), Counter of measured values, positive edge") is incremented in the same cycle in which the measured value is output.

M-0-0131, Measured value, negative edge

Function In this parameter, the value of the selected parameter ("[M-0-0006](#), Signal selection") is saved at the time of the negative edge at the entrance of the touch probe. When the release is granted, the measurement value is deleted.

- Use**
- Activating the probe function through parameter "[M-0-0024](#), Command: Activation",
 - Activating the negative edge by setting bit 1 in parameter "[M1-0007](#), Control word",
 - Apply enable signal by setting "[M-0-0405](#), Enabling".



The counter for the measured values (parameter "[M-0-0410](#), Counter of measured values, negative edge") is incremented in the same cycle in which the measured value is output.

M-0-0132, Difference value

- Function** In this parameter, the difference value of two measured values is saved.
- For a normal difference measurement, the difference value is the difference between the last measured value with a positive edge and the last measured value with a negative edge.
- If an extended difference measurement is configured, various combinations are possible:
- Latest measured value at a positive edge - Latest measured value at a negative edge
 - Latest measured value at a positive edge - Penultimate measured value at a positive edge
 - Latest measured value at a negative edge - Latest measured value at a positive edge
 - Latest measured value at a negative edge - Penultimate measured value at a negative edge
- Since a difference value is not formed with each new measured value, there is a separate counter "[M-0-0411](#), Counter of difference values" for measuring differences.
- The difference value is deleted with each release.
- Use**
- Enabling the touch probe function through parameter "[M-0-0024](#), Command: Activation",
 - Enabling at least one negative edge by setting bit 1 to bit 0 in the parameter "M1-0007, Control word",
 - Enable signal by setting "[M-0-0405](#), Enabling".

M-0-0133, Time difference

- Function** The time difference between two probe edges is saved in this parameter in the unit micro seconds.
- In case of regular differential measurement, it is the time difference between the last positive and the last negative edge.
- If an extended difference measurement is configured, various combinations are possible:
- Time difference between the last positive and the last negative edge
 - Time difference between the last positive and the next to last positive edge
 - Time difference between the last negative and the last positive edge
 - Time difference between the last negative and the next to last negative edge
- Since a time difference value is not formed with each new measured value, there is a separate counter "[M-0-0411](#), Counter of difference values probes".
- The time difference value is deleted with each release.
- Use**
- Activating the probe function through parameter "[M-0-0024](#), Probe activation"
 - Activating at least one edge by setting bit 1 to bit 0 in parameter "M1-0007, Control parameter probe"

- Apply enable signal by setting "M-0-0405, Enabling probe"

M-0-0140, Time stamp, positive edge

Function The time stamp of the last positive edge of the probe is saved in this parameter. The time stamp refers to the time interval between the edge and the start of the sercos cycle in which the edge was found. The time interval is represented in micro seconds.

The value is deleted with each release.

- Use**
- Activating the probe function through parameter "M-0-0024, Command: Activation",
 - Activating the positive edge by setting bit 0 in parameter "M-0-0007, Control word",
 - Activating the time stamp recording by setting bit 3 in parameter "M1-0007, Control word",
 - Apply enable signal by setting "M-0-0405, Enabling".

M-0-0141, Time stamp, negative edge

Function The time stamp of the last negative edge of the probe is saved in this parameter. The time stamp refers to the time interval between the edge and the start of the sercos cycle in which the edge was found. The time interval is represented in micro seconds.

The value is deleted with each release.

- Use**
- Activating the probe function through parameter "M-0-0024, Command: Activation",
 - Activating the negative edge by setting bit 1 in parameter "M1-0007, Control word",
 - Activating the time stamp recording by setting bit 3 in parameter "M1-0007, Control word",
 - Apply enable signal by setting "M-0-0405, Enabling".

M-0-0200, Dead-time compensation, positive edge

Function The value of this parameter defines the reaction time to be compensated for the positive edge (output in μs).
Time delays arising through I/Os or through the sensor used can be compensated



The reaction time can have a maximum value of 128 cycles.

M-0-0201, Dead-time compensation, negative edge

Function The value of this parameter defines the reaction time to be compensated for the negative edge (output in μs).
Time delays arising through I/Os or through the sensor used can be compensated



The reaction time can have a maximum value of 128 cycles.

M-0-0202, Starting position of the expectation window, positive edge

Function This parameter determines the lower limit value of the expectation window for the measured value acquisition of the positive edge. The expectation window restricts the range where touch probe signal edges cause a measured value acquisition.

In order to activate the measurement with the expectation window, bit 5 must be set in parameter "[M-0-0007](#), Control word".



If the value of the start position of the expectation window is higher than that of the end position, the expectation window exceeds the modulo value.

The expectation window can only be used if modulo format is parameterized for the selected axis (cf. "A-0-0045, Modulo value").

M-0-0203, End position of the expectation window, positive edge

Function This parameter determines the upper limit value of the expectation window for the measured value acquisition. The expectation window restricts the range where touch probe signal edges cause a measured value acquisition.

In order to activate the measurement with the expectation window, bit 5 must be set in parameter "[M-0-0007](#), Control word".



If the value of the end position of the expectation window is smaller than that of the start position, the expectation window exceeds the modulo value.

The expectation window can only be used if modulo format is parameterized for the selected axis (cf. "A-0-0045, Modulo value").

M-0-0204, Starting position of the expectation window, negative edge

Function This parameter determines the lower limit value of the expectation window for the measured value acquisition of the negative edge. The expectation window restricts the range where touch probe signal edges cause a measured value acquisition.

In order to activate the measurement with the expectation window, bit 5 must be set in parameter "[M-0-0007](#), Control word".



If the value of the start position of the expectation window is higher than that of the end position, the expectation window exceeds the modulo value.

The expectation window can only be used if modulo format is parameterized for the selected axis (cf. "A-0-0045, Modulo value").

M-0-0205, End position of the expectation window, negative edge

Function This parameter determines the upper limit value of the expectation window for measured value acquisition of the negative edge. The expectation window restricts the range where touch probe signal edges cause a measured value acquisition.

In order to activate the measurement with the expectation window, bit 5 must be set in parameter "[M-0-0007](#), Control word".



If the value of the end position of the expectation window is smaller than that of the start position, the expectation window exceeds the modulo value.

The expectation window can only be used if modulo format is parameterized for the selected axis (cf. "A-0-0045, Modulo value").

M-0-0206, Maximum number of marker failures

- Function** This parameter is used to define the registration threshold for the registered number of marker failures.
- If the limit value is set to "0", exceeding the limit value is not monitored.
- The number of marker failures completed consecutively is displayed in parameter "M-0-0224, Number of marker failures, positive edge".
- If the number of marker failures reaches the specified limit value, bit 3 of "M-0-0021, Status word" is set.

M-0-0224, Number of marker failures, positive edge

- Function** There is the option to define an expectation window for the touch probe where the touch probe edges must be located in order to be evaluated.
- When the "expectation window" is active, a "marker failure monitoring" can be activated in "M-0-0007, Control word". This marker failure monitoring registers the passing of the expectation window for the positive edge without a marker been registered, and increments the value of "M-0-0224, Number of marker failures, positive edge, touch probe".
- The content of the parameter is reset to "0" if
- an edge has been registered when passing the expectation window,
 - the marker failure monitoring has been deactivated by resetting bit 6 in "M-0-0007 Control word",
 - the touch probe function is enabled in "M-0-0405, Enabling" touch probe 1.



The edges activated in "M-0-0007, Control word" are called markers.

A marker error is present as soon as the expectation window has been passed and an activated edge has not been registered.

Marker failure monitoring is only possible if modulo format is set for the selected axis (cf. "A-0-0045, Modulo value").

See also Functional Description "Touch Probe Function".

M-0-0225, Number of marker failures, negative edge

- Function** There is the option to define an expectation window for the touch probe where the touch probe edges must be located in order to be evaluated.
- When the "expectation window" is active, a "marker failure monitoring" can be activated in "M-0-0007, Control word". This marker failure monitoring registers the passing of the expectation window for the negative edge without a marker been registered, and increments the value of "M-0-0224, Number of marker failures, positive edge, touch probe".
- The content of the parameter is reset to "0" if
- an edge has been registered when passing the expectation window,
 - the marker failure monitoring has been deactivated by resetting bit 6 in "M-0-0007 Control word",
 - the touch probe function is enabled in "M-0-0405, Enabling" touch probe 1.



The edges activated in "[M-0-0007](#), Control word" are called markers.

A marker error is present as soon as the expectation window has been passed and an activated edge has not been registered.

Marker failure monitoring is only possible if modulo format is set for the selected axis (cf. "[A-0-0045](#), Modulo value").

See also Functional Description "Touch Probe Function".

M-0-0401, Input status

Function The switching status of the probe input signal is indicated in this parameter.

M-0-0405, Enabling

Function By means of this parameter the enable signal of the measurement with the probe is applied. From the point of time of the enabling the signal edges are registered at the assigned input and the parameter values are recorded.



The touch probe function can only be enabled if the values of parameter C-0-0400 and C-0-0503 are identical.

Applies to the firmware versions 14V20 patch 4 and 14V22 patch 1 and above:

Due to a successful troubleshooting, the parameter response changed as follows:

When leaving Sercos phase 4, the touch probe is disabled (refer to [M-0-0024](#)) and enabling is reset. The reason is that possibly required data such as modulo and scaling can only be retrieved now in Sercos phase 4.

Structure

Value	Release of the touch probe	Comment
0	No	
1	Yes	

Tab. 7-13: Relevant bits of M-0-0405, Enabling

Use As soon as the enabling signal is applied, the following parameters are deleted:

- [M-0-0021](#), Status word,
- [M-0-0130](#), Measured value, positive edge,
- [M-0-0131](#), Measured value, negative edge,
- [M-0-0132](#), Difference value,
- [M-0-0140](#), Time stamp, positive edge,
- [M-0-0141](#), Timestamp, negative edge,
- [M-0-0224](#), Number of marker failures, positive edge,
- [M-0-0225](#), Number of marker failures, negative edge,
- [M-0-0409](#), Counter of measured values, positive edge,
- [M-0-0410](#), Counter of measured values, negative edge,
- [M-0-0411](#), Counter of difference values.



If single shot measurement is parameterized and no edge is activated, the enable signal is reset immediately, as the condition "every activated edge has been registered once" it is fulfilled.

M-0-0409, Counter of measured values, positive edge

- Function** In this parameter, the number of measurements which were triggered by positive signal edges at the selected entrance is displayed. With every release, the counter is set to "0".
- Use**
- Activating the probe function through parameter "M-0-0024, Command: Activation",
 - Activating the positive edge by setting bit 0 in parameter "M-0-0007, Control word",
 - Apply enable signal by setting "M-0-0405, Enabling".

M-0-0410, Counter of measured values, negative edge

- Function** In this parameter, the number of measurements which were triggered by negative signal edges at the selected entrance is displayed. With every release, the counter is set to "0".
- Use**
- Activating the probe function through parameter "M-0-0024, Command: Activation",
 - Activating the negative edge by setting bit 1 in parameter "M1-0007, Control word",
 - Apply enable signal by setting "M-0-0405, Enabling".

M-0-0411, Counter of difference values

- Function** This parameter indicates the number of the registered difference values.
If the extended difference measurement is activated by setting bit 11 of parameter "M-0-0007, Control word", the difference is not calculated each time a measured value is output. Instead, the difference is only calculated if the edge matches the configured "difference to" edge.
With every release, the counter is set to 0.
- Use**
- Activating the probe function through parameter "M-0-0024, Command: Activation",
 - Activating the negative edge by setting bit 1 in parameter "M1-0007, Control word"
 - Apply enable signal by setting "M-0-0405, Enabling".

M-0-1000, Command: Load basic touch probe parameters

- Function** This parameter is used as a command to load the basic parameters of the touch probe instance.
- Use** *Execution in the parameter editor:*
- Enter the binary value "0000000000000011" (=0x0003) in this parameter. This triggers the loading of the basic parameters.
 - After the loading process is complete, the control automatically resets the parameter to "0000000000000000".
- When using the parameter, e.g. from the PLC:*
- Enter the binary value "0000000000000011" (=0x0003) in this parameter. This triggers the loading of the basic parameters.
 - When the loading is complete, the control automatically resets the parameter to "0000000000000000".

M-0-2100, List of all backup operation M-parameters

Function This list includes all M-parameters to be considered when backing up parameters. It is entered in the ID number format.

The entries are sorted according to identity number in ascending order.

Structure The ID number format is as follows:

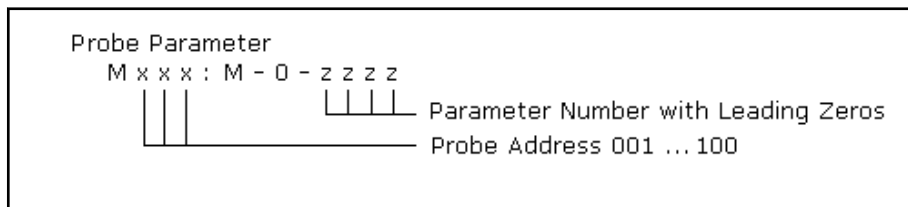


Fig. 7-78: ID number format

Use M0001: [M-0-0002](#) - Probe 1; Parameter [M-0-0002](#).

7.14.8 Function blocks for touch probes

The touch probe functionality of the control hardware is provided via the following function blocks of the ML_PLCopen library:

Function block	Description
ML_InitTouchProbe	Enables and configures the touch probe in the control
ML_WriteExpectWindow	Configures the expectation window for the touch probe functionality
ML_TouchProbe	Enables the selected touch probe, analyzes the status and provides the measured values after the trigger event
ML_TouchProbeContinuous	Enables the selected touch probe, analyzes the status and provides the measured values after the trigger event
ML_AbortTrigger	Cancels an active measurement

Tab. 7-14: Function blocks for the touch probe functionality of the control hardware

For the description of the function blocks, refer to the documentation "IndraLogic XLC IndraMotion MLC 14VRS PLCopen Libraries" (refer to [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

7.15 Programmable limit switch

The programmable limit switch generates binary switching signals depending on the position of an axis.

The switches of a programmable limit switch can be triggered independently of the direction of rotation of the axis:

- Triggering in a positive direction of rotation
- Triggering in a negative direction of rotation
- Triggering in both directions of rotation

Moreover, switches can be operated in two different switch track modes:

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

- Time-related mode: The switch remains active for a specified time based on the rising edge of the switch and possible corrections. If a slave switch becomes active during this time, the active time of the switch is extended accordingly

To compensate for internal processing times and for delay in the device connected, a lead time for switching on and off each switch track can be defined for every switch track.

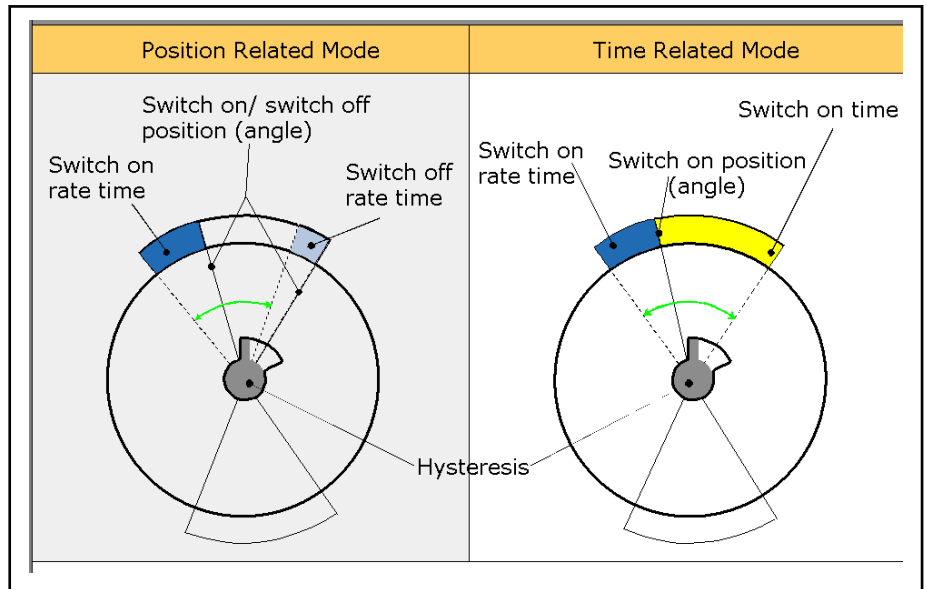


Fig. 7-79: Operating states

The programmable limit switch is available both as hardware and as software.

Software-based programmable limit switch

The software-based programmable limit switch is implemented by the function block MC_DigitalCamSwitch in the PLC library ML_TechBase. This function block enables up to 32 switches on eight binary outputs per axis.

The resolution of this software-based solution depends on the cycle time of the PLC task in which the function block runs. A task with 2 ms of cycle time can, for instance, resolve a switch with 12° at 1,000 rpm.

For a detailed description of the function block MC_DigitalCamSwitch, refer to the "IndraMotion MLC 14VRS Technology Basic Libraries" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

Hardware-based programmable limit switch

The hardware-based programmable limit switch is a function module connected on the left side of the control. Each of the four function modules allows 16 binary outputs. The programmable limit switch is directly parameterized in the function module via the "Programmable Limit Switch" dialog. The resolution is 125 μ s.



For IndraLogic XLC controls, function modules are only available with IndraControl variants with a Sercos interface.

For more information on the function module, refer to "IndraControl Lxx 14VRS Function Modules" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

8 Kinematics (Robot Control V2)

8.1 General information



The Robot Control V2 functionality is only provided for a the MLC system.

Programming environment

Predefined kinematics (Cartesian, Scara, delta pack) or user-defined kinematics can be created under the "Robot" folder.

Up to 16 kinematics are possible.

Robot Control is the programming environment for the Bosch Rexroth robot family. The advantages are:

- Faster implementation of robot applications
- Visualization of the implementation
- Diagnostics of the implementation

Characteristics

The programming environment contains the following components:

- **User interface**

The user interface is oriented at the Windows applications and thus allows the user to work intuitively and effectively.

All Robot Control components are integrated into the interface and can be optionally shown or hidden. All toolbar icons are provided with help texts. These are displayed when keeping the mouse cursor on the icon for a moment.

Additionally, information on the respective functions is shown in the status bar

- **Diagnostics**

All relevant status information of the respective kinematics is displayed in the "Status" dialog

8.2 Menu structure of the kinematics

8.2.1 Menu item: Robot

Select the "Robot" node to enable the menu item **Robot** in the IndraWorks main menu. The following functions are available under this menu item:

- **Commissioning kinematics** - Opens the commissioning dialog of the kinematics
- **Add** - Adds a kinematics or if not available yet, the node "Global Data"
- **Parameter** - Opens the parameter export and import for all kinematics
- **Export** - Exports the kinematic configuration
- **Import** - Imports an exported kinematic configuration
- **Compare** - Compares two projects

The same menu items can also be found in the context menu of the "Robot" node.

Additionally, the following menu items are available:

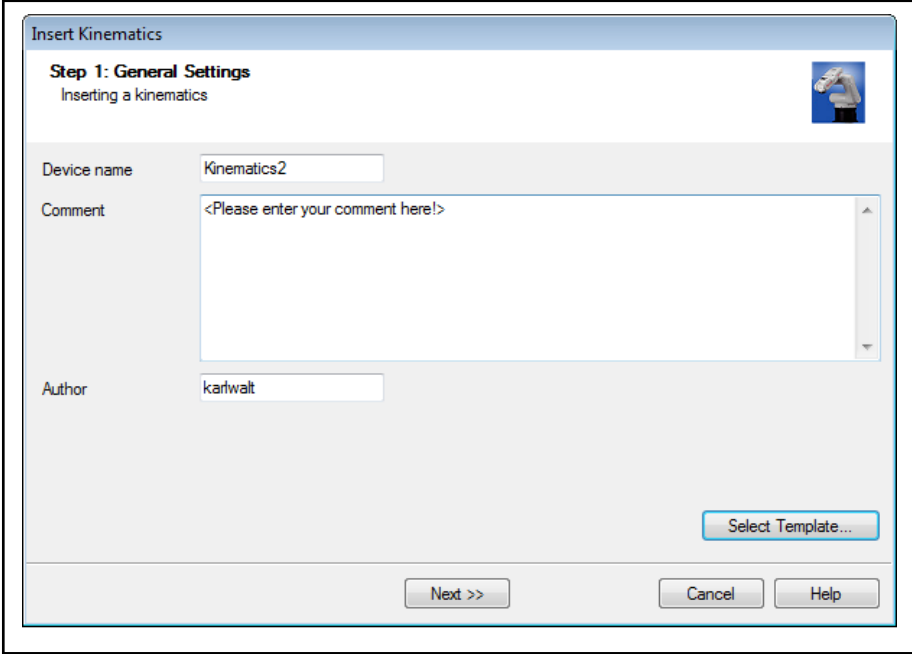
- **Element Search** - Searches within the kinematic configuration
- **New View** - The kinematic configuration is displayed in another Project Explorer window

8.2.2 Adding a new kinematics

To add a new kinematics, click on **Add** below the "Robot" node.

A wizard guides the creation of a new kinematics:

Step 1: Entering device names, comment and author



The screenshot shows a dialog box titled "Insert Kinematics". Inside, it says "Step 1: General Settings" and "Inserting a kinematics". There is a small icon of a horse in the top right corner. The form has three main input areas: "Device name" with the text "Kinematics2", "Comment" with a large text area containing the placeholder "<Please enter your comment here!>", and "Author" with the text "karlwalt". At the bottom right, there is a button labeled "Select Template...". At the very bottom, there are three buttons: "Next >>", "Cancel", and "Help".

Fig. 8-1: Creating kinematics, step 1

Step 2: Enter the Robot Control version, kinematic number and kinematic type

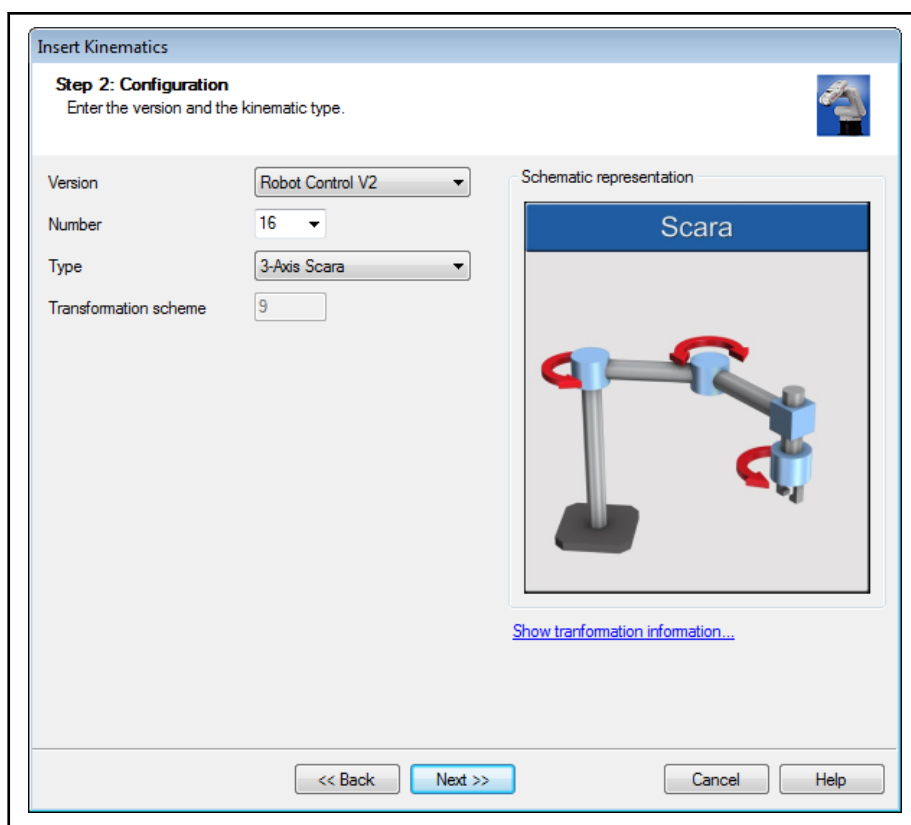


Fig. 8-2: Creating kinematics, step 2

Step 3: Assign axes

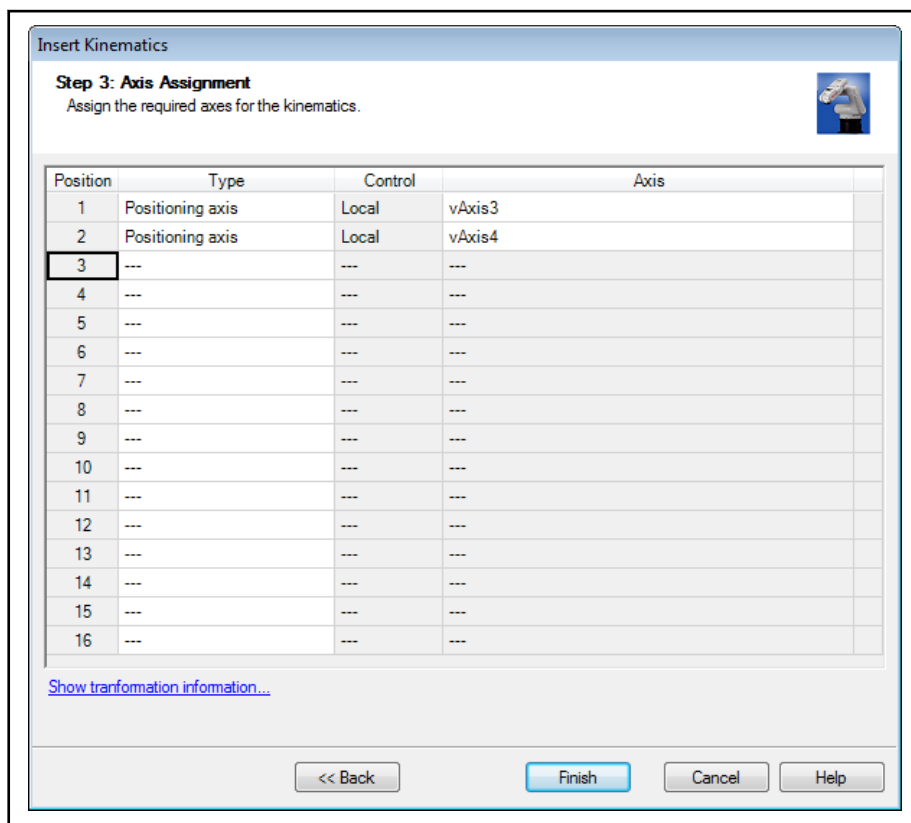


Fig. 8-3: Creating kinematics, step 3

The entered axes (positioning axes, orientation axes and belt axes) are applied to the parameter K-0-0008 (Axis configuration list).

After the kinematics has been created, a new menu item (kinematic name) is displayed below the "Robot" node.

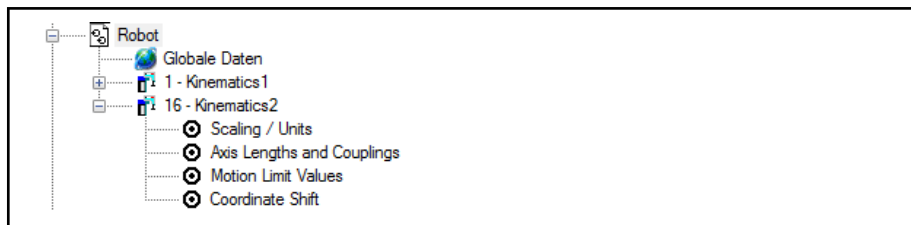


Fig. 8-4: New entry "Kinematics2"

8.2.3 Kinematic commissioning

Overview

Use the "Kinematic Commissioning" dialog in the context menu of the Robot node to move kinematics without writing a PLC program. This is especially useful during commissioning if the PLC program is not complete or if a kinematics is to be moved differently as intended in the PLC program for test purposes.



This dialog can only be selected in online mode. Furthermore, kinematics can only be operated in communication phase P4 (BB).

The dialog is divided into an overview and a details section.

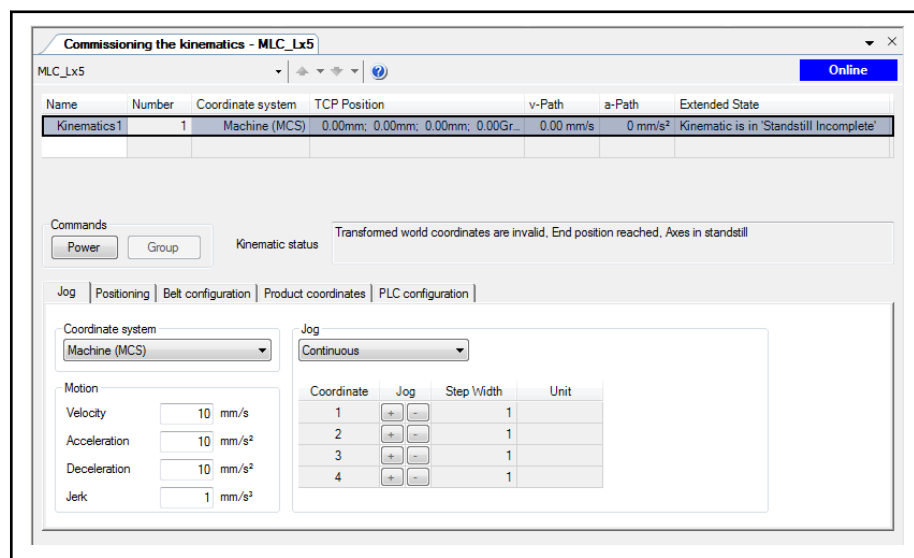


Fig. 8-5: Kinematic commissioning dialog

Overview section

The most important kinematic data can be displayed in the overview section. By selecting a configured kinematics in the "Name" column, the other columns are filled with data. The coordinate systems in which the TCP position is displayed can be selected.

Apart from the kinematic name, the following is displayed:

- Number: Kinematic number
- TCP position: Current TCP position in the selected coordinate system
- v-path: Current path velocity
- a-path: Current path acceleration
- Extended status: Extended kinematic status (corresponds to the decoded content of parameter K-0-0022)

To delete a kinematic, either use the blank entry in the "Name" column or use the <Del> key (after having select the relevant line).

Details section

In the details section, motion commands can be triggered, belt and production coordinate systems can be configured and PLC configuration blocks can be generated. These motion commands are oriented at the state diagram of the PLCopen (refer to "MLC 14VRS PLCopen Libraries", chapter "State diagram of a kinematics") and identical to the commands generated by an equivalent function blocks.

All commands and values refer to the kinematics selected in the overview section. Via the tabs, the relevant commands can be selected and command values can be specified. The fields in a tab are mere entry field, i.e., no status is specified. If an invalid value is entered, the input field and its tab are colored in red and an error message is displayed in the tooltip of the entry field. No motion command can be sent to the axis, i.e. corresponding buttons are disabled.

Furthermore, the power of all axes assigned to the kinematics in the overview section can be activated and the kinematics can be grouped. Via the "Kinematic status" field, the current status of the kinematics is represented, corresponding to the decoded content of parameter K-0-0021.

Safety functions

Before displaying the actual commissioning dialog, it has to be confirmed that all measures ensuring safe kinematic operation have been taken.

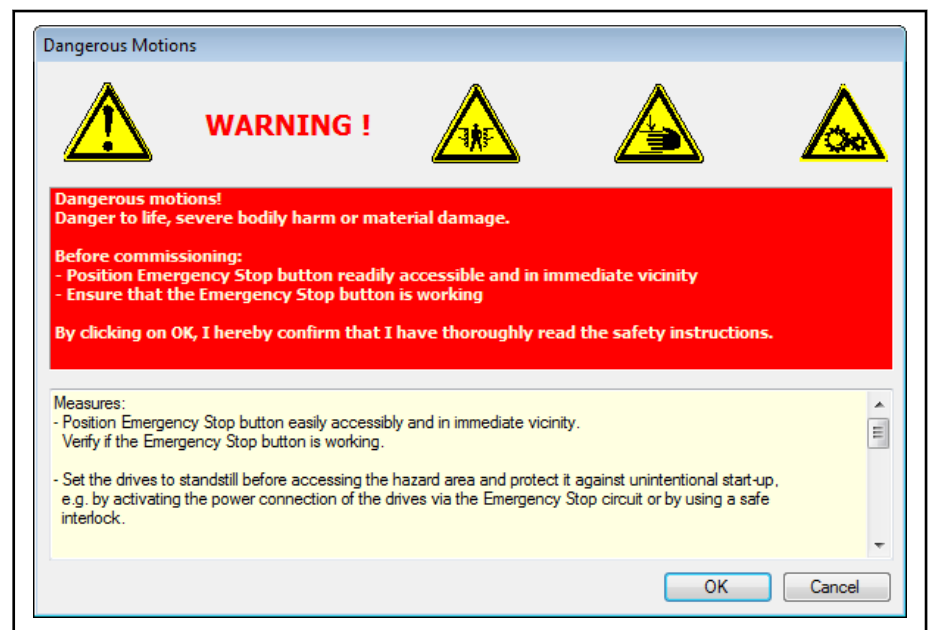


Fig. 8-6: Warning when opening the kinematic commissioning dialog

While the commissioning dialog is opened, all kinematic axes in the overview section can be stopped immediately using the "Kinematic OFF" window.

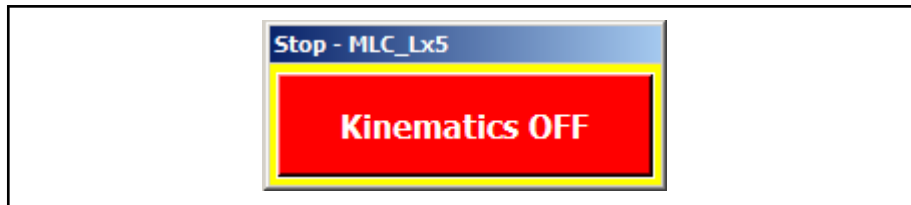


Fig. 8-7: Stop all kinematic axes

Kinematics may only be moved when they are displayed in the dialog. Thus, all axes are stopped when the dialog is closed. Furthermore, a running kinematics cannot be deleted or changed in the overview section.

To avoid conflicts with the PLC program, kinematics can only be moved if one of the following conditions apply:

- All PLC user applications are stopped
- All running PLC user application contain the variable "AllowKinematics-Commissioning". Its value is TRUE in the "UserVarGlobal" or "UserVarAppGlobal" if a device application is used. To move axes at a running PLC, create a Boolean variable called "AllowKinematicsCommissioning" in the node "UserVarGlobal" or "UserVarAppGlobal". Apply this variable to the symbol configuration of the PLC and set its value to TRUE. Thus, the PLC program can control whether and when moving axes via the dialog is permitted

If kinematics are moved via the commissioning dialog and if the previously mentioned conditions are not fulfilled anymore, all kinematics are immediately stopped and further motion commands are inhibited.



When closing the dialog, a stop command is sent to all running kinematics and it is waited for their standstill. If a kinematics requires more than two seconds up to the standstill, the dialog is still closed and a warning is issued in the IndraWorks status bar. In this case, the kinematics is still stopped, but remains in the "Stopping" state. To finally stop a kinematics ("Standstill" state), open the dialog at any time and issue the "Stop" command again to the kinematics. Optionally, stop the kinematics via the PLC.



Response when connection is interrupted between the IndraWorks interface and the control.

If the connection between PC and control is interrupted (e.g. network cable defective or removed), the control outputs the error "F536000E MLPI: Watchdog". This stops all commanding kinematics automatically.

Grouping a kinematics

In order to move a kinematics, activate the power of all corresponding axes and assign this axis to the kinematics. The enabling functionality corresponds to the one of the "MC_Power" function block (refer to the documentation "MLC 14VRS PLCOpen Library"). In case of a successfully completed power up of all axes assigned to the kinematics, the button **Power** is highlighted in green. In case of a successfully completed kinematic axis grouping, the button **Group** is highlighted in green.

By pressing the relevant button again, the axes can be ungrouped and the power can be switched off. Both cases (power up and grouping or ungroup-

ing and switching power off) can only be executed in the correct order. Consequently, a kinematics cannot be grouped if the axes were not powered up. If the power of the axes cannot be switched off if the kinematic is grouped.

To power up the axes and the kinematic can be grouped, the following prerequisites have to be met:

- Sercos bus is in P4 (operating mode)
- All corresponding axes are not in P2 (parameterization mode)
- Control and power section are ready for operation (i.e. bit 14 is set in the parameter A-0-0021)
- No error is pending at the kinematics or the corresponding axes

If one of the mentioned prerequisites is not met, power up is not possible and the missing prerequisites are shown as tooltip next to the buttons.

In case of virtual axes, power up is not explicitly necessary. These axes are enabled automatically and can be grouped if all other requirements are met.

Jogging

A grouped kinematics can be jogged continuously or incrementally in a coordinate system in the "Jog" tab. Under "Coordinate system" select the desired coordinate system and enter the velocity, acceleration, deceleration and jerk values under "Motion". Under "Jog", select continuous or incremental jogging. When selecting incremental jogging, the step width can still be specified. Using the buttons + and -, the command for the coordinate can be executed.

Coordinate	Jog	Step Width	Unit
1	+ -	1	
2	+ -	1	
3	+ -	1	
4	+ -	1	

Fig. 8-8: Kinematic commissioning; "Jogging" tab

The functionality corresponds to the functionality of the function blocks "ML_GroupJogStep" and "ML_GroupJogCont". By selecting the jogging type, the relevant function block is implicitly enabled. The input fields are analogously significant to the input parameters of the function block:

Incremental jogging

Input field in the dialog	Input parameters of the function block "ML_GroupJogStep"
"Coordinate system" section	CoordSystem
Motion/velocity	Velocity
Motion/acceleration	Acceleration
Motion/deceleration	Deceleration
Motion/jerk	Jerk
Jogging/step width	Distance

Tab. 8-1: Assigning the input fields in the dialog to the inputs of the "ML_GroupJogStep" function block

Continuous jogging

Input field in the dialog	Input parameters of the function block "ML_GroupJogCont"
"Coordinate system" section	CoordSystem
Motion/velocity	Velocity
Motion/acceleration	Acceleration
Motion/deceleration	Deceleration
Motion/jerk	Jerk

Tab. 8-2: Assigning the input fields in the dialog to the inputs of the "ML_GroupJogCont" function block

Positioning

A grouped kinematics can be positioned in any coordinate system in the "Position" tab. Select the coordinate system in the "Coordinate system" section as well as the target position and enter the intermediate position, if the positioning type "Circular" is selected. Under "Motion", select the positioning type and enter the values for velocity, acceleration, deceleration and jerk. Using the **Start** button, execute the command and stop the command with **Stop**.

The screenshot shows the 'Positioning' tab of a software interface. It is divided into two main sections: 'Coordinates' and 'Motion'.
 In the 'Coordinates' section, 'Machine (MCS)' is selected for the 'Coordinate system'. Below this is a table with 5 rows and 4 columns: 'Coordinate', 'TCP Position', 'Intermediate Positi...', and 'Unit'. The units for coordinates 1-4 are 'mm' and for coordinate 5 is 'Deg'.
 In the 'Motion' section, 'Linear' is selected for the 'Positioning type'. Below this are input fields for 'Velocity' (10 mm/s), 'Acceleration' (10 mm/s²), 'Deceleration' (10 mm/s²), and 'Jerk' (20 mm/s³). There are 'Start' and 'Stop' buttons at the bottom right of the motion section.

Fig. 8-9: Kinematic commissioning; "Positioning" tab

The functionality corresponds to the functionality of the function blocks "MC_MoveLinearAbsolute", "MC_MoveDirectAbsolute" and "MC_MoveCircularAbsolute". By selecting the positioning type, the relevant function block is implicitly selected. The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the "MC_MoveLinearAbsolute" and "MC_MoveDirectAbsolute" function blocks
Coordinates/coordinate systems	CoordSystem
Coordinates/position TCP	Position
Motion/velocity	Velocity
Motion/acceleration	Acceleration
Motion/deceleration	Deceleration
Motion/jerk	Jerk

Tab. 8-3: Assigning the input fields in the dialog to the inputs of the "MC_MoveLinearAbsolute" and "MC_MoveDirectAbsolute" function blocks

Input field in the dialog	Input parameters of the "MC_MoveCircularAbsolute" function block
Coordinates/coordinate systems	CoordSystem
Coordinates/position TCP	EndPoint
Coordinates/intermediate position	AuxPoint
Motion/velocity	Velocity
Motion/acceleration	Acceleration
Motion/deceleration	Deceleration
Motion/jerk	Jerk

Tab. 8-4: Assigning the input fields in the dialog to the inputs of the "MC_MoveCircularAbsolute" function block

Belt configuration

In the "Belt configuration" tab, belts can be configured that are part of the selected kinematics. If the kinematic has several belt axes, the belt axis to be configured can be selected under "Axis". In the sections "Belt" and "Coordinate offset", the belt type, the start and total length as well as the offset and the rotation against the machine coordinate system has to be specified. In the "Error reaction" section, specify the belt reaction in case of an error. Depending on the selected reaction time, specify the reaction type, the desynchronization time or the deceleration and the jerk. Using the **Write configuration** button, the belt is configured in the control.

Fig. 8-10: Kinematic commissioning, "Belt configuration" tab

The functionality corresponds to the functionality of the function blocks "ML_SetBeltConfiguration", "ML_SetRotaryTableConfiguration" and "ML_SetBeltErrorReaction". By selecting the belt type, the relevant function block is implicitly selected. The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the function block "ML_SetBelt-Configuration"
"Axis" section	ConveyorBelt
Belt/starting length	BeginLength
Belt/total length	TotalLength
"Coordinate offset" area	ConveyorBeltOrigin

Tab. 8-5: Assigning the input fields in the dialog to the inputs of the "ML_SetBeltConfiguration" function block

Input field in the dialog	Input parameters of the "ML_SetRotaryTableConfiguration" function block
"Axis" section	ConveyorBelt
Belt/starting length	BeginLength
Belt/total length	TotalLength
"Coordinate offset" area	RotaryTableOrigin

Tab. 8-6: Assigning the input fields in the dialog to the inputs of the "ML_SetRotaryTableConfiguration" function block

Input field in the dialog	Input parameters of the "ML_SetBeltErrorReaction" function block
Error reaction/reaction type	ErrorReactionType
Error reaction/desynchronization time	DeSyncTime
Error reaction/deceleration	Deceleration
Error reaction/jerk	Jerk

Tab. 8-7: Assigning the input fields in the dialog to the inputs of the "ML_SetBeltErrorReaction" function block

Product coordinates

Product coordinate systems can be defined in the "Product coordinates" tab. In the "Coordinate" section, the coordinate system to be defined as well as the coordinate type (Cartesian, cylindrical) can be selected. Specify the offset and the rotation of the workpiece coordinate system compared to the world coordinate system in the "Coordinate offset" section. Using the **Write configuration** button, the product coordinate system is configured in the control.

Fig. 8-11: Kinematic commissioning, "Product coordinates" tab

The functionality corresponds to the functionality of the function blocks "MC_SetCartesianTransform" and "ML_SetCylindricTransform". By selecting the coordinate type, the relevant function block is implicitly selected. The input fields are analogously significant to the input parameters of the function block:

Input field in the dialog	Input parameters of the "MC_SetCartesianTransform" and "ML_SetCylindricTransform" function blocks
Coordinates/coordinate systems	ConveyorBelt
"Coordinate offset" area	ConveyorBeltOrigin
Coordinate offset/offset X	TransX

Input field in the dialog	Input parameters of the "MC_SetCartesianTransform" and "ML_SetCylindricTransform" function blocks
Coordinate offset/offset Y	TransY
Coordinate offset/offset Z	TransZ
Coordinate offset/rotation X	RotAngle1
Coordinate offset/rotation Y	RotAngle2
Coordinate offset/rotation Z	RotAngle3

Tab. 8-8: Assigning the input fields in the dialog to the inputs of the "MC_SetCartesianTransform" and "ML_SetCylindricTransform" function blocks

PLC configuration

After a control restart, the configuration of belt coordinate systems and product coordinate systems is lost. To avoid reconfiguration, use the "PLC configuration" tab to continuously save the configuration in a function block. Thus, by calling the function block during the initialization phase of an application, the configuration can be restored quickly and easily.

There is the option to backup all or only the currently configured belts and product coordinate systems. In the "Product coordinate systems", select one of the two options. Using the **Generate PLC block** button, the function block is generated.

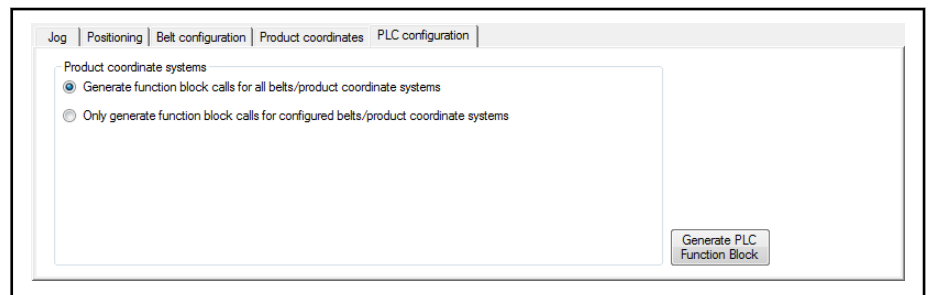


Fig. 8-12: Kinematic commissioning, "PLC configuration" tab

Press **Generate PLC function block** to create a new folder called "Kinematic-InitialConfig" below the application node. The function block is created in this folder. The function block name is composed of the kinematic name and the suffix "...InitialConfig". For each configured kinematics, a corresponding function block can be generated which configures the belt and product coordinate systems. If a function block already exists for the selected kinematics, it is replaced.

8.2.4 Menu item: Kinematics

Select the node of a kinematics in the Project Explorer and a new menu item is enabled for this kinematics (e.g. **Kinematics2**) in the IndraWorks main menu.

The name of the selected kinematics is displayed as name in the menu item.

There are multiple subitems under this menu item in the context menu of the kinematics.

8.3 Kinematics – Context menu

8.3.1 Kinematics – Context menu or context menu item "Kinematics", general information

There are the following menu items in the context menu of a kinematics **and** in the main menu item **Kinematics**:

- **Setup...** - Commissioning cycle of the kinematics, see [chapter 8.3.2 "Initial Commissioning" on page 658](#)
- **Parameter** - Edits parameters
- **Diagnostics** - Diagnostic functions of the kinematics, see [chapter 8.3.3 "Diagnostics" on page 658](#)
- **Export...** - Saves "Robot" elements to a file
- **Import...** - Imports Robot elements from a file
- **Compare...** - Compares and merges objects

The following menu items are **only** available in the context menu of the kinematics:

- **Delete** - Deletes the selected kinematics
- **Rename** - Renames the selected kinematics
- **Find Element...** - Searches for elements in the project
- **Print Preview...** - Provides a preview of the kinematic data
- **Print...** - Provides a printout of the kinematic data
- **New View** - Displays the kinematics in an individual window
- **Properties** - provides information on the kinematics (such as name or type)

8.3.2 Initial Commissioning

To set up a kinematics, the following dialogs are processed by a wizard:

- Loading basic parameters of the kinematics
- [chapter 8.4.2 "Scaling/units" on page 660](#)
- [chapter 8.4.3 "Axis lengths and couplings" on page 660](#)
- [chapter 8.4.4 "Motion limit values" on page 661](#)
- [chapter 8.4.5 "Coordinate offset" on page 662](#)

8.3.3 Diagnostics

This dialog graphically displays the status information of the respective kinematics. The upper part of the window displays general information on the kinematics.

The middle part displays the kinematic-specific information on all axes of a kinematics in a table. The information comprises the current position, the programmed end point (only in automatic mode) and the lagging of the individual axes.

The lower part of the window displays the kinematic status in detail.

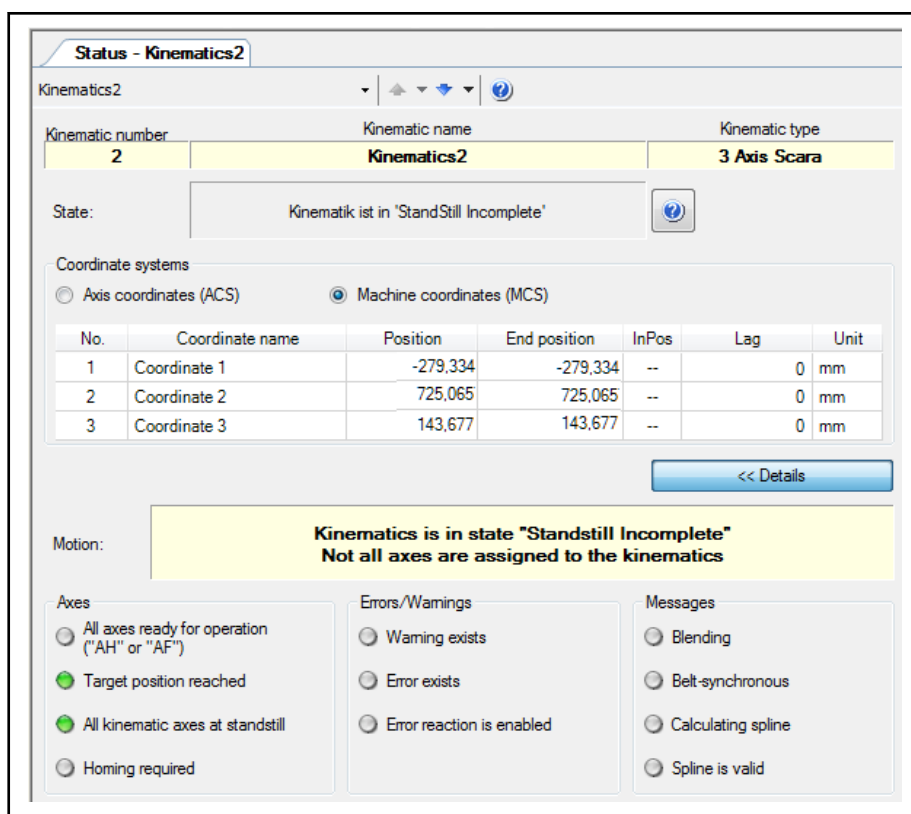


Fig. 8-13: Status display of a kinematics

Coordinate system

The setting under "Coordinate system" specifies the coordinate system in which the axis values or belt values are to be displayed.

There are two settings:

- **Axis coordinates (ACS)**= Displays the positions of the individual axes of the kinematics

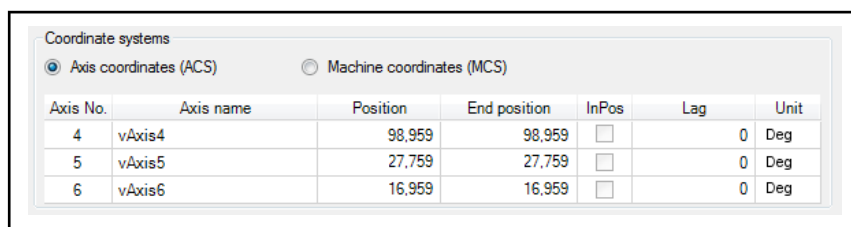


Fig. 8-14: Display of the axis coordinates (ACS)

- **Machine coordinates (MCS)** = Displays the coordinates in space related to the machine zero point

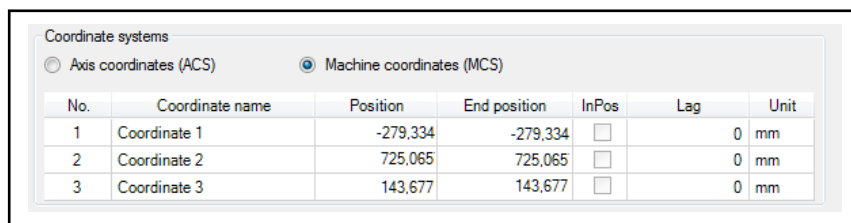


Fig. 8-15: Display of the machine coordinates (MCS)

List of axis coordinates

The list of the coordinates shows:

- Coordinate number
- Coordinate name

- Current position of the coordinates
- End position of the coordinate
- Lagging of the coordinate

An enabled checkbox in the "InPos" column provides information on whether the respective coordinate is "in Position".

8.4 Kinematics – Dialogs

8.4.1 Overview on dialogs

There are the following individual dialogs when opening the "Kinematics" folder in the Project Explorer.

These dialogs are disabled at first and enabled when the project is switched to online mode.

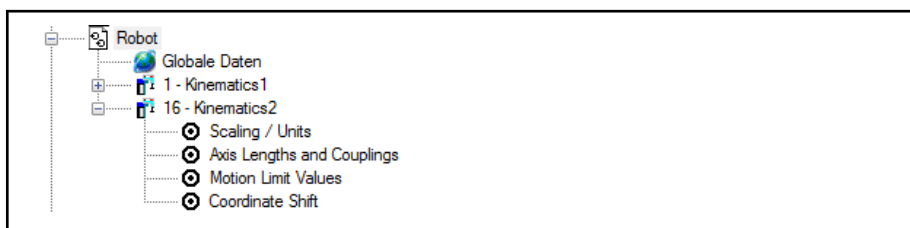


Fig. 8-16: Dialogs of a kinematics (Robot Control V2)

- [chapter 8.4.2 "Scaling/units" on page 660](#)
- [chapter 8.4.3 "Axis lengths and couplings" on page 660](#)
- [chapter 8.4.4 "Motion limit values" on page 661](#)
- [chapter 8.4.5 "Coordinate offset" on page 662](#)

8.4.2 Scaling/units

Use this dialog to toggle between the units millimeter [mm] and inch [in].

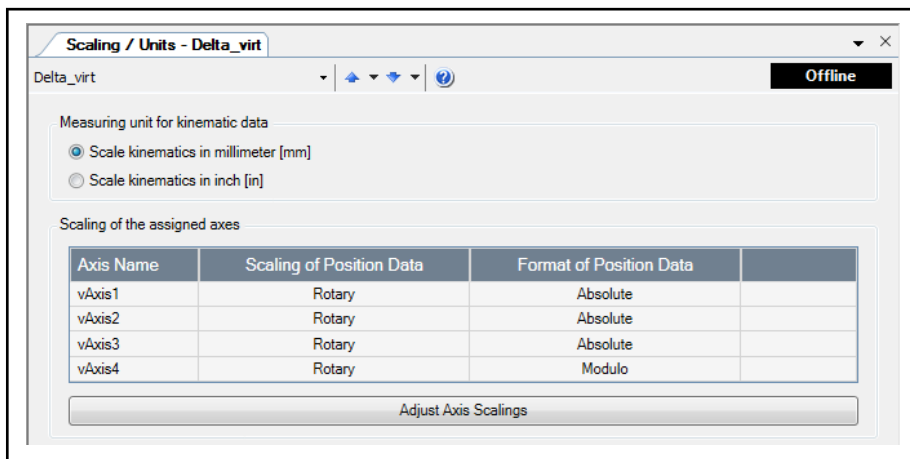


Fig. 8-17: Switching to unit

The following parameter is evaluated:

- K-0-0054, Measuring unit for kinematic data

8.4.3 Axis lengths and couplings

Set the transformation lengths and transformation factors required to transform axis coordinates into Cartesian coordinates in this dialog.

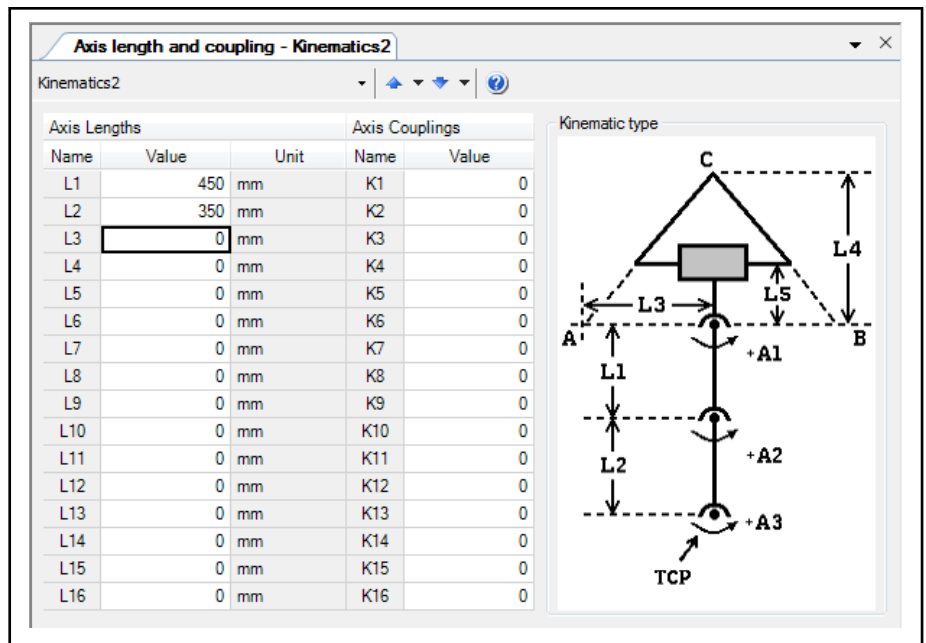


Fig. 8-18: Defining axis lengths and axis couplings

The following parameters are evaluated:

- K-0-0040, Transformation, lengths of the mechanics
- K-0-0041, Transformation, factors

8.4.4 Motion limit values

The following limit values can be entered:

- Maximum path velocity
- Maximum path acceleration (bipolar)
- Maximum path jerk (bipolar)
- Software limit switch, positive, MCS
- Software limit switch, negative, MCS

The dialog provides an overview on the preset motion limit values of the kinematics.

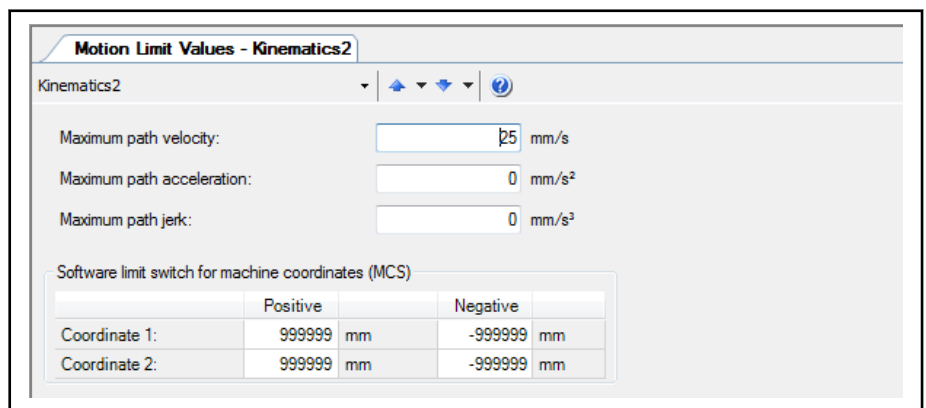


Fig. 8-19: "Motion limit values" dialog

The following parameters are evaluated:

- K-0-0003, Maximum path velocity
- K-0-0034, Maximum path acceleration (bipolar)

- K-0-0035, Maximum path jerk (bipolar)
- K-0-0005, Software limit switch, positive, MCS
- K-0-0006, Software limit switch, negative, MCS

8.4.5 Coordinate offset

Use this dialog to rotate and shift the basic coordinate system (BCS) of a kinematics with regard to the machine coordinate system. The values specified are position and rotation of a kinematics in space.

The dialog provides an overview on the preset coordinate offset of the kinematics.

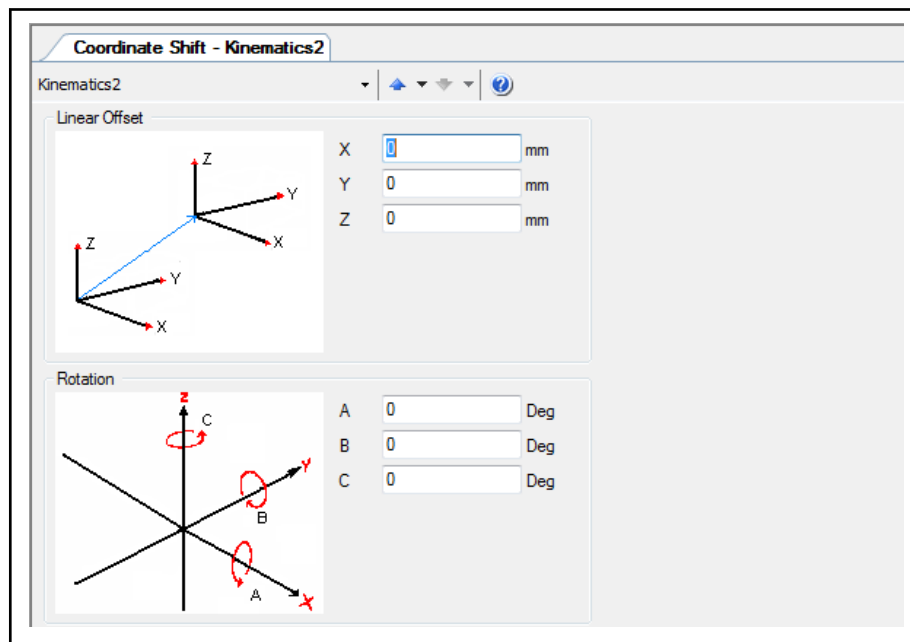


Fig. 8-20: Overview "Coordinate Shift"

The following parameter is evaluated:

- K-0-0042, Offset of BCS system

9 CamBuilder

9.1 CamBuilder functionality

The CamBuilder application is integrated in IndraWorks. The CamBuilder is described in detail in the "Rexroth IndraWorks 13VRS CamBuilder" documentation (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

10 Oscilloscope

10.1 Oscilloscope functionality

The oscilloscope functionality is integrated in IndraWorks. This function allows the signal recording of the control or axes (drives).

The use of the oscilloscope is described in detail in the documentation "IndraWorks 14VRS Engineering" in the chapter "Operating the oscilloscope function" (see [chapter 1.4 "Required and supplementing documentation XLC/MLC" on page 6](#)).

11 Error cases

11.1 Introduction and overview

This chapter describes different error categories as well as troubleshooting.

General questions in case of error

The following information has to be provided:

1. When does the error occur?
 - Upon control start
 - Upon login with IndraLogic
 - When going online
 - After an online change
 - Upon phase switching of the Sercos bus
 - After opening/operating a visualization
 - After a program change
2. Can the error be reproduced?
 - Upon a certain action
 - After a certain period
 - Cyclically in a certain interval
 - Sporadically
3. Can an IndraWorks project archive be provided?
4. Providing control files
5. Which firmware and IndraWorks version?
6. What periphery is connected to the control?

11.2 Error categories

11.2.1 Exception in IEC application

Definition The error entry F0390011, followed by an error text, is output on the control display if there is an exception in an IEC application. This text provides information on the specific IEC task of the specific IEC application that caused the error.

Example for a division by 0 occurring in the "MotionTask" of the application "AppPresse1":

EXCEPTION DivisionByZero AppPresse1 MotionTask

Cause A common cause is an incorrect IEC user program. Such an error can be caused by the self-programmed user code or the PLC libraries.

When throwing an exception, the application is switched to the "STOP" state. Depending on the configuration of the PLC settings (see ["Safe state" on page 342](#)), the I/Os are either set to the safe state or to the configured initial values. Axes are stopped.

An application can only be started after an exception if the control was reset (cold, warm, origin).

Troubleshooting tools

Real cases have shown that exceptions are often caused due to an incorrect pointer programming and incorrect array access.

Most non-initialized pointers are dereferenced, thus causing a possible exception. When using arrays, array limits are often not kept in loop cycles and

thus following data memory is overwritten. This can cause unpredictable aftereffects (SysError, control reboot).

By integrating special check functions, the complete IEC application can be monitored at runtime with regard to valid pointer access, division by 0 as well as falling below or exceeding array limits and can trigger a certain error response (division by 0) causing the application to stop. However, integrating these functions causes an increase in the cycle time of the PLC task. The cycle time rise depends on the application and increases with the number of access by pointers, arrays, divisions, etc.



During commissioning, integrate the check functions "CheckBounds" and "CheckPointer" to find the above described errors in the user program. After commissioning, remove these functions to reduce the PLC cycle times.

The implementation of the check functions is only an example and can be adapted to the application.

There are two options to check the application using check functions:

- Integrating the RIL_CheckRtv library into the library manager
All checks (pointer, arrays, divisions, etc.) are always performed by integrating this library. This increases the PLC program runtime significantly and might cause cycle time problems
- Targeted integration of check functions for certain checks
Add check functions to enable the checking of pointer, division and array access. The "RIL_CheckRtv" library may not be integrated into the project

Check functions are added via the context menu of the "Application" node:
Add ► POU templates ► .

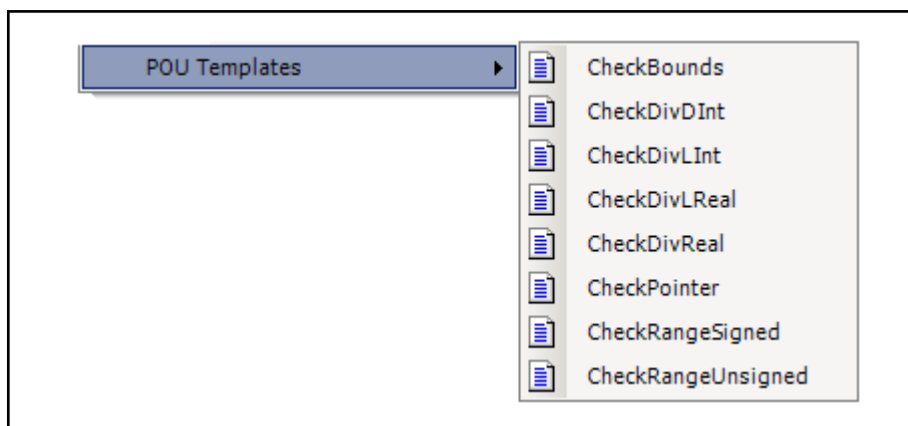


Fig. 11-1: Adding check functions via the PLC context menu

The following check functions are available:

- CheckBounds
Check index limits when arrays are accessed
- CheckDivInt
Check for division by 0 of INT-compatible data types
- CheckDivLInt
Check for division by 0 of LINT-compatible data types
- CheckDivLReal

- Check for division by 0 of LREAL data types
- CheckDivReal
 - Check for division by 0 of REAL data types
- CheckPointer
 - Check pointer access to NULL
- CheckRangeSigned
 - Check for signed, value-limited variables
- CheckRangeUnsigned
 - Check for unsigned, value-limited variables

If there is an exception, the error location in the IEC user program is displayed if this location is not in a compiled library or in FB_Init/Exit methods.

Starting from the check function, the call sequence can be retrieved, variable values checked and adapted to the user program via the call stack (menu "Debug/Call List").

11.2.2 SysError

Definition All fatal exceptions not occurring in an IEC user task (e.g. MotionTask, PlcTask) cause a **SysError**. In these cases, the control goes into the safe state, as a further operation of the runtime system cannot be ensured anymore.

The **SysError** state is visualized in the display of the control for **CML45, CML 65 und CML 75**. The "SysError" text is displayed, followed by an 8-digit error code starting with "F9" as well as by the first eight characters of the name of the task in which context errors were caused.

For the **XM21, XM22 und XM42** controls, the error state **SysError** is visualized via a cyclic flashing sequence which is simultaneously output at the LEDs "s", "DIA1", "DIA2", "STA", "ERR" and "BT".

If the control is in the "SysError" state, all I/Os are switched to the safe state. All axes are stopped. No communication is possible with the engineering tool, IMST, HMI devices, etc.

Cause A **SysError** is normally a software error in the firmware.

It can also occur if the periphery (e.g. function modules, I/O) responses incorrectly and if unexpected states occur in the firmware components.

In certain cases, a SysError can also be caused by the user program in the IEC application if the error does not occur in an IEC user task (e.g. MotionTask, PlcTask).

This is the case if there is a division by 0 in an FB_Init method. A SysError (in the communication task "BlkDrvTcp" or "BlkDrvUdp") is already caused during application download and will be present again after the control restart (then in the PLC initialization task "StartTask").

Data memories overwritten by the IEC user program can be another reason. This is caused for example by overwriting array limits in case of array access (writing).

The following operations and functionalities can also cause a SysError:

- Downloading application
- Making online change
- Monitoring functionality (forcing variables)
- Operating the integrated commissioning visualization

- Loading a boot project after control restart

Troubleshooting tools

1. If a SysError occurred, an "ExcData" directory is created in the USER partition on the storage medium with the following files required for the support to troubleshoot:
 - PLC boot application files *.app and *.crc
 - PLC configuration file *.cfg
 - PLC retain memory file PlcRetain.save
 - Exception log file ExcLog.dat
 - NV-RAM image Para.bin
 - Log swap file LogBook.bin
2. The control can load this directory from the context menu of the "Control" node in IndraWorks. In case of error, these files can be provided to Bosch Rexroth.
3. If there is again a SysError after control restart, reboot the control. It is possible to open the "BOOTSTOP" menu to perform further measures in this menu. Press "Esc" and <Enter> at the control display until "BOOTSTOP" is shown in the display.

11.2.3 Spontaneous control reboot

Definition In case of this error, the control starts again at runtime without outputting an error text.

Cause The main causes are insufficient power supply of the control, EMC affects, wiring errors or a control hardware error.

A reboot can also be triggered if the memory is overwritten by a corrupt user program (e.g. writing across array limits) or a firmware error.

To reduce the number of causes created by an incorrect user program, integrate check functions (see [chapter 11.2.1 "Exception in IEC application" on page 667](#)).

11.3 Core dump

Core dump refers to the backup of the complete RAM on the CF card of the control. This is only required for certain errors and requested by the support. The display or procedure to generate a core dump is target-specific.

IndraMotion MLC L45/L65/L75: [chapter 3.3.11 "Generating a core dump" on page 41](#)

IndraMotion MLC VPB 40.4: [chapter 3.5.12 "Generating a core dump" on page 94](#)

IndraMotion MLC XM: [chapter 3.4.10 "Creating a core dump" on page 56](#)

12 User-defined languages for parameter names, units, diagnostics and menu texts

12.1 General information

As of 12VRS, a user-defined language (language 3) can be used to load parameter names, units and diagnostics and to display the menu structure of the display in this language.

The texts are stored in XML files:

Parameter names and units in the parameter file, diagnostics in the diagnostic file and the menu for the display in the menu file.

12.2 File management

For the online application, store the files on the user partition of the Compact Flash card in the folder "Languagefile".



If the control firmware is updated, all data is deleted on the user partition!

For the offline application, the files are saved in the folder "Languagefile" in the IndraWorks project directory below the selected control (e.g. IndraMotionMlc1).

The file name is arbitrary and can be transferred to the system for the files currently used with the parameters C-0-0002 for the parameter file, C-0-0003 for the diagnostic file and C-0-0004 for the menu file.

Different files with different language packages can thus be saved and the language files can be selected.

12.3 File structure

The XML files require the following basic structure:

```
<?xml version="1.0" encoding="utf-8" standalone="yes"?>
<device vendor="xxx" name="xxx" desc="xxx" hw="xxx" bsp="xxx">
  <packagelist>
    <package name="">
      <idx>0</idx>
      <key>Axis-Parameter</key>
      <additional>
        <A-0-0000 name="Userdefined Text 1"/>
        <A-0-0001 name="Userdefined Text 2"/>
        <A-0-0002 name="Userdefined Text 3"/>
      </additional>
    </package>
  </packagelist>
</device>
```

Fig. 12-1: XML language files; here parameter file

The first line is the documentation declaration and has to be executed exactly as shown in the example above.

The attributes of the "Root" node "device" are secondary for file parsing.

The structure below the "Root" node is important. The structure is equal for all files.

- The first node is "packagelist" and different packages are declared below
 - The packages contain nodes with "idx", "key" and "additional"
 - The index "idx" is continuous for multiple packages and starts with "0"
 - The key "key" indicates the current general search text
 - All texts are stored in their individual child node below the "additional" node. The node name indicates the parameter or diagnostic number and the user-defined text is stored behind, below the attribute "name"
- Parameter.xml**
- Each parameter type (A, C, K, O, N, M) and the units are provided with an individual package
 - The keys for the packages have to be named as follows:
 - A: "Axis parameters"
 - C: "Control parameters"
 - K: "Kinematic parameters" (only IndraMotion MLC)
 - O: "Oscilloscope parameters"
 - N: "ProgLimSwitch parameters"
 - M: "Touch probe parameters"
 - Units: "Units"
 - The node name below the "additional" node names the parameter or unit
 - The user-defined text is stored under the "name" attribute at the respective parameter/unit
- For the present node names for the units, refer to [chapter 12.5 "Node names for units" on page 674](#).
- Diagnoses.xml**
- Only one package is required for the diagnostic file
 - The key for the package has to be "Diagnosis"
 - The node name below the "additional" node designates the diagnostic number
 - The user-defined text is stored under the "name" attribute at the respective diagnostic number
- Menue.xml**
- Only one package is required for the display file
 - The key for the package has to be "Menue"
 - The node name below the "additional" node names the menu item or display text
 - The user-defined text is stored under the "name" attribute at the respective menu item/display text

Node names

- [chapter 12.5 "Node names for units" on page 674](#)
- [chapter 12.6 "Node names for menu texts \(display texts\)" on page 675](#)

12.4 Function

Select the language via the parameter C-0-0001.

Furthermore, German, English, user-defined and "empty" (easier editability) XML files can be created for parameters, diagnostics and display.

C-0-0001 can assume the following values:

- 0: Loads German from the installation storage location
- 1: Loads German from the installation storage location
- 99: Parses XML files with the user-defined language and applies it as language 3
- 100: Creates XML files from the installation storage location

All other values are disabled.

Options to load a user-defined language

1. **When booting** the control, the value of the parameter C-0-0001 is set to "99".

All parameter names, diagnostics and display texts are read from the files defined in the parameters C-0-0002, C-0-0003 and C-0-0004 and saved in the installation storage location under the user value (language 3).

2. **At runtime**, the value of the parameter C-0-0001 is set to "99".

It is not important whether the control is in phase 0, phase 2 or phase 4. Thus, different language packages can be loaded at runtime considering the file parameters.

If certain parameters, units, diagnostics or display texts are not defined in the XML file or if errors occur while parsing or searching in files, the English texts are saved as default language under the user value.

All texts found are stored in the user-defined language. This ensures that every text is displayed.

The **XML files can only be created from the installation storage location** at runtime:

If the value of the parameter C-0-0001 is set to "100", this is only a command to create the files and the value is reset to the previous existing value after creation.

For parameters, diagnostics and the display, German, English, user-defined and "empty" XML files are created each. The "empty" files only contain the basic structure of the XML files and no texts at the attributes. Thus, they can be edited more easily.

Restrictions

Parameter names are limited to 60 characters, diagnostics are limited to 61 characters and units are limited to 20 characters.



These lengths refer to characters only without the zero terminator "\0".

Characters, that is "BYTE" and not UTF-8-letter. These can either be 1, 2, 3 or 4 BYTE!

Three different maximum lengths are defined at the display:

1. 8 characters for menu items (that means non-scrolling displays).
2. 60 characters for scrolling displays such as menu, note and error texts.
3. 4 characters for three special texts, that is the change of first number of the IP address, subnet mask and gateway address.

The lengths also refer to characters without zero terminator.

- If texts are stored in the XML files exceeding the maximum length, the text is limited to a maximum length and the rest is cut off.
- Special features** Due to UTF-8 coding of XML files, Greek, Cyrillic, Chinese and Japanese characters can also be displayed like German umlauts.
- This does not apply for the display, since the standard 7-bit ASCII character set can only be implemented here.

12.5 Node names for units

No.	Node name	Unit English	No.	Node name	Unit German
1	Unit_1_100K	1/100K	42	Unit_MasterUnit	nicht_aktiviert (not_enabled)
2	Unit_1_GradK	1/K	43	Unit_Mbaud	Mbaud
3	Unit_1_min	1/min	44	Unit_mH	mH
4	Unit_1000_min	1000/min	45	Unit_min	min
5	Unit_A	A	46	Unit_mm	mm
6	Unit_A_eff	A eff	47	Unit_mm_min	mm/min
7	Unit_A_V	A/V	48	Unit_mm_s	mm/s
8	Unit_A_Vmin	A/Vmin	49	Unit_mm_ss	mm/s ²
9	Unit_BeschlVorst_Lin	mN/(mm/s ²)	50	Unit_mm_sss	mm/s ³
10	Unit_Byte	Byte	51	Unit_mm_U	mm/rev
11	Unit_DrehMomKonst_Lin	N/A	52	Unit_mNms2_rad	mNm/(rad/s ²)
12	Unit_Grad	Degree	53	Unit_ms	ms
13	Unit_Grad_s	Degree/s	54	Unit_N	N
14	Unit_Grad_ss	Degree/s ²	55	Unit_N_Aeff	N/Aeff
15	Unit_Grad_sss	Degree/s ³	56	Unit_Nm	Nm
16	Unit_GradC	°C	57	Unit_Nm_A	Nm/A
17	Unit_GradF	°F	58	Unit_Nm_Aeff	Nm/A eff
18	Unit_h	h	59	Unit_Nm_rad_s	Nm/(rad/s)
19	Unit_Hz	Hz	60	Unit_Nm_U_min	Nm/rpm
20	Unit_Hz_100A	Hz/100A	61	Unit_NoUnit	--
21	Unit_Hz_s	Hz/s	62	Unit_Ohm	Ohm
22	Unit_in	in	63	Unit_Polpaare	Pole pairs
23	Unit_in_min	in/min	64	Unit_Prozent	%
24	Unit_in_s	in/s	65	Unit_rad_ss	rad/s ²
25	Unit_in_ss	in/s ²	66	Unit_rad_sss	rad/s ³
26	Unit_in_sss	in/s ³	67	Unit_s	s
27	Unit_in_U	in/rev	68	Unit_ss	s ²
28	Unit_Inkr	Incr	69	Unit_TP	TP
29	Unit_Inkr_ss	Incr/s ²	70	Unit_TP_U	TP

No.	Node name	Unit English	No.	Node name	Unit German
30	Unit_Inkr_sss	Incr/s ³	71	Unit_Traegheit_Lin	Kg
31	Unit_Inkr_Umdr	Incr/rev	72	Unit_U	rev
32	Unit_inlbf	inlbf	73	Unit_U_min	rpm
33	Unit_kBaud	kBaud	74	Unit_U_s	rev/s
34	Unit_KByte	KByte	75	Unit_us	µs
35	Unit_kgm2	kgm ²	76	Unit_V	V
36	Unit_kHz	kHz	77	Unit_V_A	V/A
37	Unit_kW	kW	78	Unit_V_eff	V eff
38	Unit_lbf	lbf	79	Unit_V_ms	Vel * ms
39	Unit_m	m	80	Unit_VreglerPVerst_Lin	N/(mm/min)
40	Unit_mA	mA	81	Unit_Watt	Watt
41	Unit_mA_rad_s	mA/(rad/s)			

12.6 Node names for menu texts (display texts)

No.	Node name	Text English	Characters
1	Menue_MlState	ML:OK	8
2	Menue_PlcState	PLC:OK	8
3	Menue_RiState	RI:OK	8
4	Menue_DpState	DP:OK	8
5	Menue_Ethernet	Ethernet	8
6	Menue_ShowIpAAA	IP=	4
7	Menue_ShowSubNetAAA	SN=	4
8	Menue_ShowGatewayAAA	GW=	4
9	Menue_OK	OK: ?	8
10	Menue_Device	Device	8
11	Menue_Info	Info	8
12	Menue_OHCctrlFanReset	ResetOHC	8
13	Menue_Hardware	Hardware	8
14	Menue_Plc	PLC APP	8
15	Text_IpAddress	IP-Address	60
16	Text_SubnetMask	Subnet-Mask	60
17	Text_GatewayAddress	Gateway-Address	60
18	Text_MacAddress	Mac-Address	60
19	Text_Firmware	Firmware	60
20	Text_HwMatNr	Material number	60
21	Text_HwTypeCode	Type code	60

No.	Node name	Text English	Characters
22	Text_HwMatIndexNr	Index	60
23	Text_HwSerNr	Serial number	60
24	Text_Temperature	Temperature	60
25	Text_OHCCTRL	OHC Control	60
26	Text_OHCCTRLFan	OHC Fan	60
27	Text_ShowDHCPState	DHCP	60
28	Text_ShowDHCPStateEnabled	ENABLED	60
29	Text_ShowDHCPStateDisabled	DISABLED	60
30	Text_ChangeDHCPStateEnable	ENABLE	60
31	Text_ChangeDHCPStateDisable	DISABLE	60
32	Text_DHCPIsActive	DHCP is enabled, no changes possible	60
33	Text_LoadBaseParameter	Command: Load Network default	60
34	Text_LoadBaseParameterDone	Command execution done	60
35	Text_Axis	Axis	60
36	Text_Sercos	Sercos-Device	60
37	Text_Kinematic	Kinematic	60
38	Error_IpAddress	ERROR: Getting IP-Address	60
39	Error_SubnetMask	ERROR: Getting Subnet-Mask	60
40	Error_GatewayAddress	ERROR: Getting Gateway-Address	60
41	Error_MacAddress	ERROR: Getting Mac-Address	60
42	Error_BaseParameter	ERROR: During execution of command	60
43	Error_SerialNumber	ERROR: Getting serial number	60
44	Error_OHCCTRL	ERROR: Getting OHC STRG time	60
45	Error_Temperature	ERROR: Getting temperature	60
46	Error_TemperatureScaling	ERROR: Getting temperature scaling	60
47	Error_FwVersion	ERROR: Getting firmware version	60
48	Error_TypeCode	ERROR: Getting type code	60
49	Error_Plc	ERROR: Getting PLC application name	60

13 Remote support

13.1 Definition of terms and introduction



Please note that the remote support software "I-Remote" is not supported anymore as of IndraWorks 14V20!

Term definitions

Service PC	A PC that can either remotely control a remote client PC or establish a direct connection to a control via a router in the remote network
Client PC	A PC that can be remotely controlled from the service PC
VNC	Virtual Network Computing
UltraVNC	UltraVNC is an open source software based on VNC displaying the screen content of a removed system (server) on a local system (client). UltraVNC is not a component of the IndraWorks automation platform

Tab. 13-1: Definition of terms

The controls "IndraLogic XLC" and "IndraMotion MLC" are all provided with an Ethernet interface. The control can be programmed and applications can be commissioned (debugging, monitoring) using this interface. Data can also be exchanged with other controls as well as operating and visualization devices via this Ethernet interface. The protocols are IP-based.

The task of enabling remote access to services of the controller consists of connecting two separated IP networks.

13.2 Connecting via internet

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

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

Also refer to [chapter 3.18 "Protocols - System security" on page 155](#)

13.3 Related documentation

For detailed information on the topic "remote support", refer to the application description

DOK-IWORKS-REMOTE**V14-AP01-EN-E (R911382628)

14 Cross communication between controls - CrossComm Sercos III

14.1 General information on cross communication between controls

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

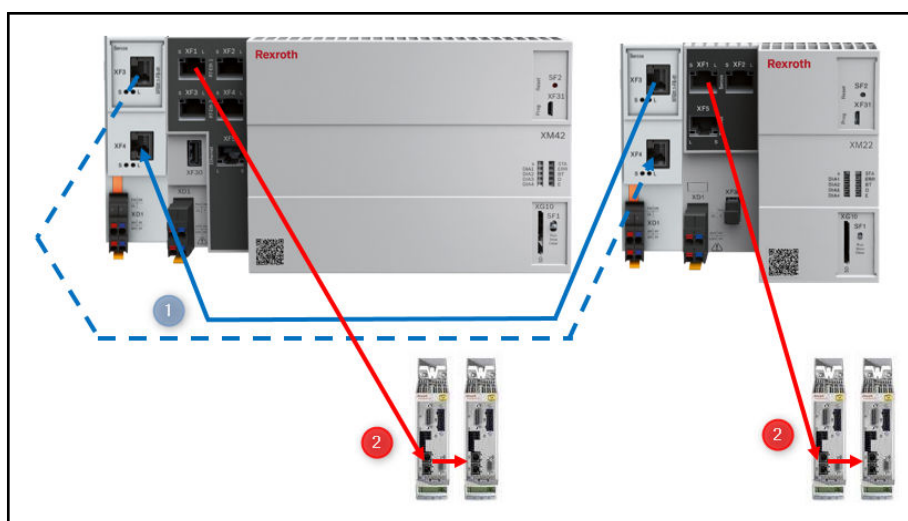
The cross communication of the controls is carried out with the **CrossComm Sercos III** function module.

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

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

Tab. 14-1: Technical data CrossComm via Sercos III

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



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

Fig. 14-1: CrossComm topology

Maximum of 64 controls in the link

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

Maximum of 128 master axes in the link

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

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

Cycle time in link

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

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



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

Line(s) or ring

The link can be operated either as line, double line or ring (see [chapter 14.2 "Link as line, double line or ring" on page 681](#)).

The ring topology provides the following advantages:

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

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

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

	Slave $\leq$ MLC11VRS	Slave $\geq$ MLC12VRS
Master $\leq$ MLC11VRS	Yes	Yes
Master $\geq$ MLC12VRS	No	Yes

Tab. 14-2: Sercos III cross communication: Compatibility of different MLC versions

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

14.2 Link as line, double line or ring

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

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

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

Double line and line

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

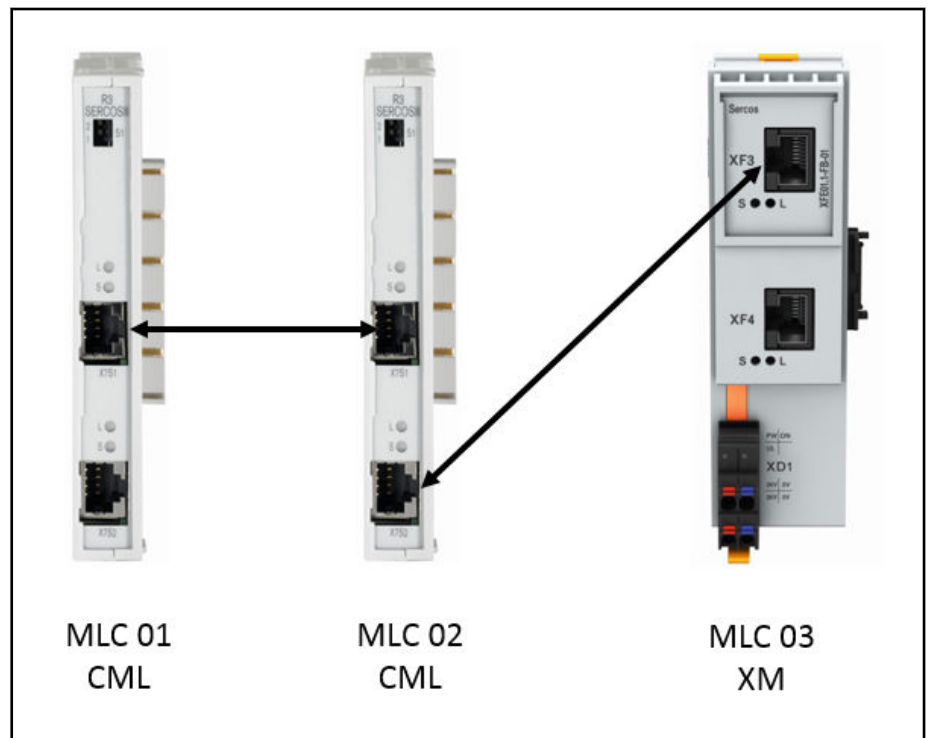


Fig. 14-2: Wiring example: Line, (Sercos III (CFL01.1-R3, XFE01.1-FB-01))

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

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

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

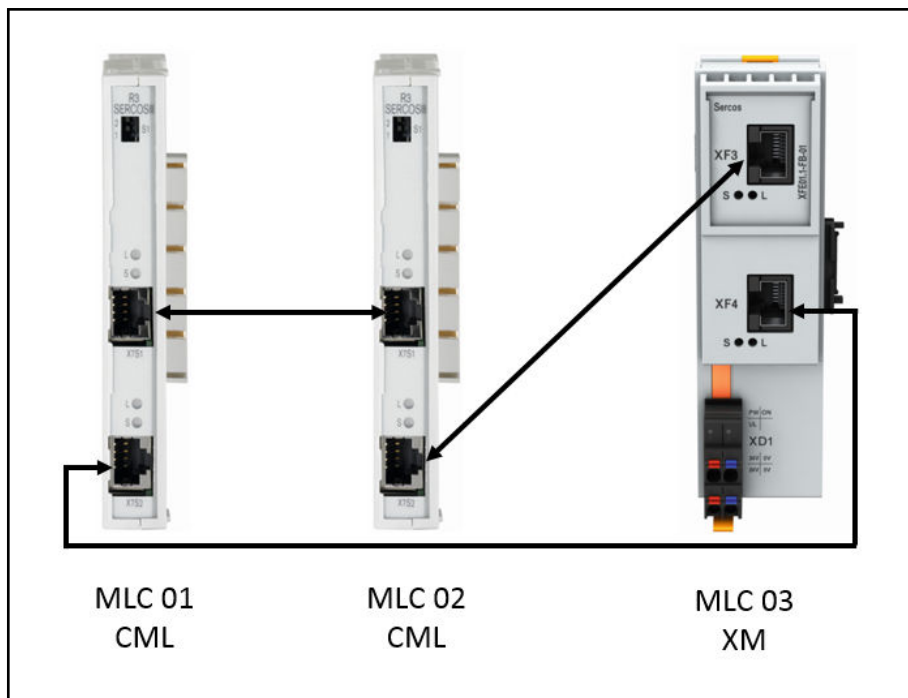


Fig. 14-3: Wiring example: Ring, (Sercos III (CFL01.1-R3, XFE01.1-FB-01))

14.3 Configuration

14.3.1 Creating and configuring the CrossComm Sercos III

To configure the participation of the MLC control in the link using the CrossComm Sercos III the drive master communication has to run based on Sercos III and the "CrossComm Sercos III (CFL01.1-R3)" (for IndraControl L controls) function module or "CrossComm Sercos III (XFE01.1-FB-01)" (for IndraControl XM controls) has to be created below the control. There are two options:

1. When creating an MLC control, the wizard provides the connection of function modules. You can select the "CrossComm Sercos III (CFL01.1-R3)" function module for the IndraControl L. The function module name for an IndraControl XM is "CrossComm Sercos III (XFE01.1-FB-01)".

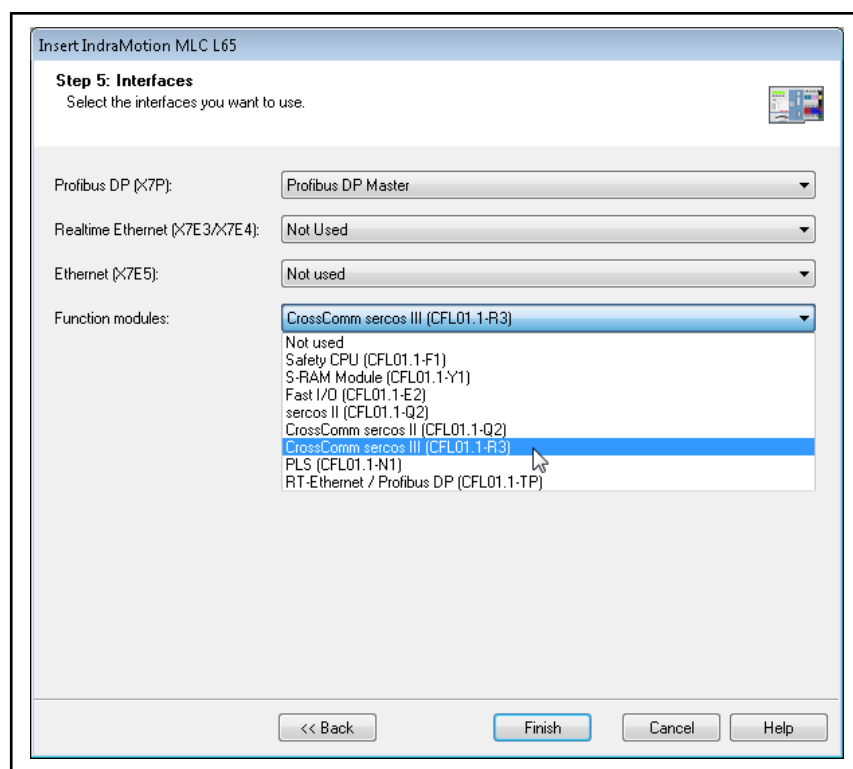


Fig. 14-4: Adding a CrossComm Sercos III function module via the wizard

2. Drag and drop the "CrossComm Sercos III (CFL01.1-R3)" function module (or "CrossComm Sercos III (XFE01.1-FB-01)") of the "Function module" group from the library to the control....

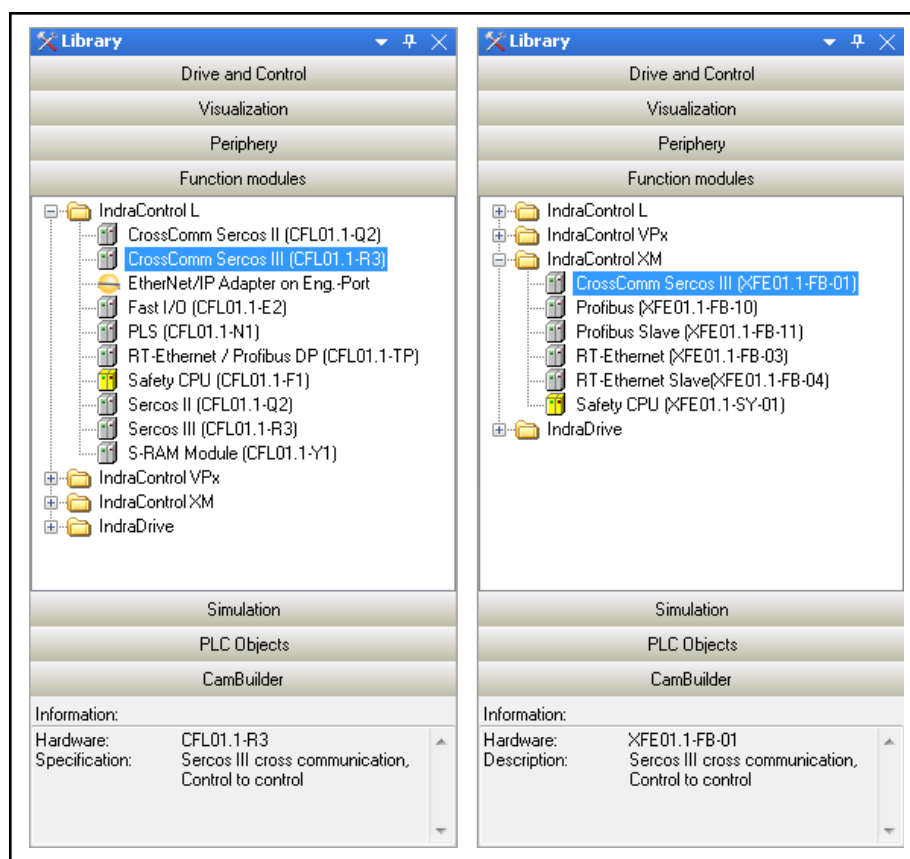


Fig. 14-5: Dragging the module
.... and "dropping" it on the control or above the Sercos node.

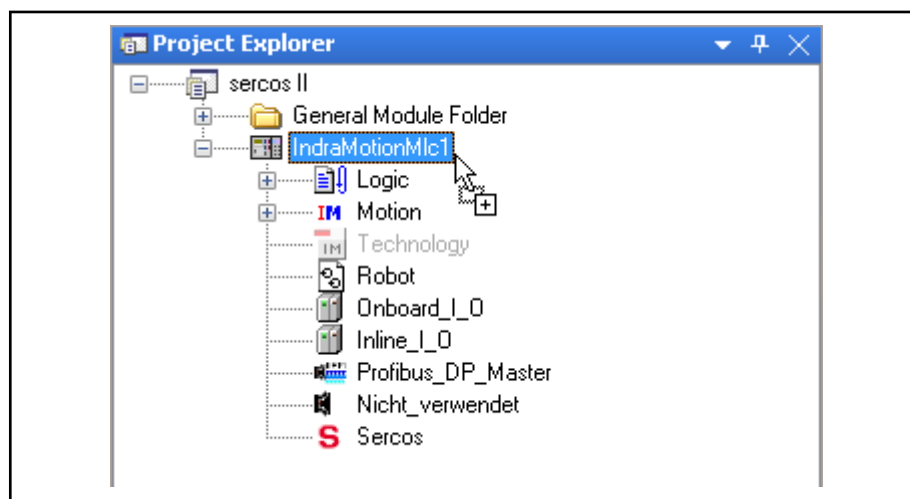


Fig. 14-6: Adding the module



These settings are only available in offline mode.

The creation of a function module is supported by a wizard.

The control address in the ring and the function of the control, e.g. whether the control is a link master or a link slave, is specified in the "General Settings". Additionally, the cycle time of the link is selected.

Link cycle time In the link, 1 ms, 2 ms, 4 ms or 8 ms are supported as cycle time.

Add Function Module CrossComm Sercos III

Step 1: Control settings
Please specify a control address in the ring and specify if it is a master or a slave in the link.

Control settings
Control address in the ring:
Function: ☒ Master ☐ Slave

Central link settings
Cycle time: ☐ 1 ☒ 2 ☐ 4 ☐ 8 ms

Next >> Cancel Help

Fig. 14-7: Adding the function module CrossComm Sercos III - General Settings (Master)



The control address has to be in the range from 1 to 64.
Gaps in the addressing are allowed.

Function

With regard to its function in the cross communication, the control acts as a:

- Link master [data producer (provider) and consumer (user), message monitoring and management]
- Link slave [(data producer (provider) and consumer (user))]

Link master

The link master controls the cross communication. The link master specifies the timing (cycle time) in the link in the drive rings for all controls participating in the link. The link master collects and cyclically distributes the master axis positions of all slaves in the link. The master specifies the phase in the link ring. The phase in the link ring can be specified via the parameter "C-0-0751, C2C, target mode". The phase in the link ring can be changed irrespective of the phase in the drive ring.

Link slave

A link slave provides a connection to the ring/the line(s) of the link. The link slave synchronizes the telegram processing for its drive ring with the cross communication.



The link is a Sercos ring in which exactly one device **must** be configured as master. Only this master monitors and manages all telegram traffic.

Add Function Module CrossComm Sercos III

Step 1: Control settings
Please specify a control address in the ring and specify if it is a master or a slave in the link.

Control settings
Control address in the ring:
Function: ☐ Master ☒ Slave

Central link settings
Cycle time: ☐ 1 ☒ 2 ☐ 4 ☐ 8 ms

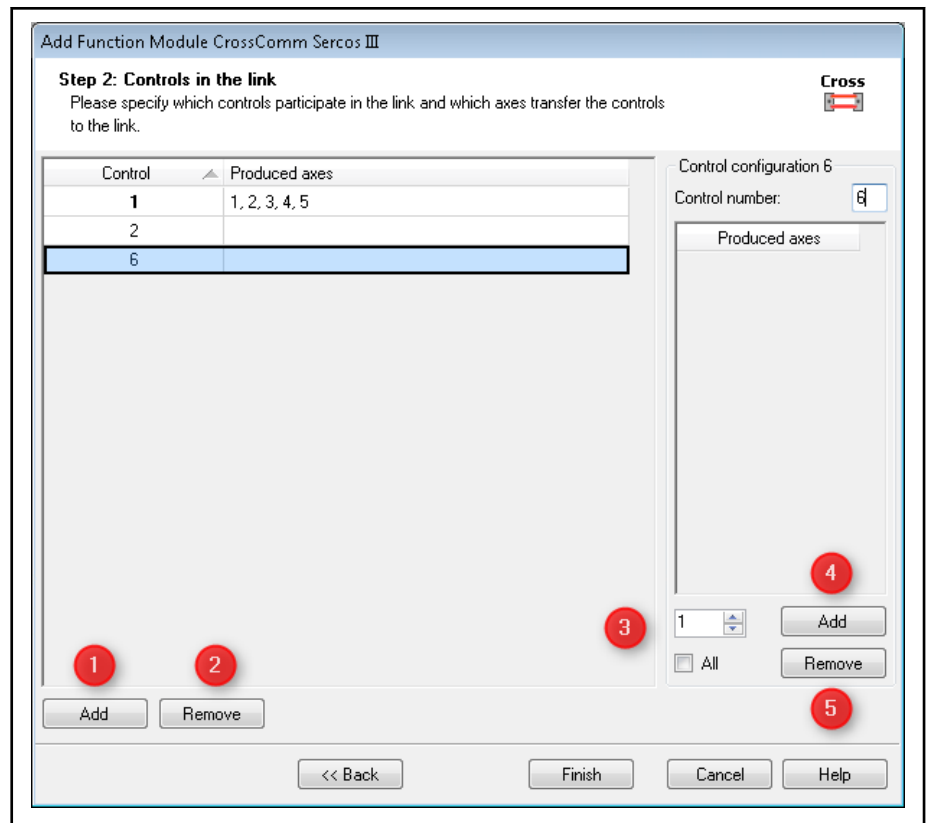
Fig. 14-8: Adding the function module CrossComm Sercos III - General Settings (slave)

Configuration of the link devices and link data in the master

If the control is configured as link master, the wizard provides a dialog to configure the controls in the link. Refer to [fig. 14-9 "Adding the function module CrossComm Sercos III - Controls in the link" on page 687](#).

The left section of the page is provided with an overview on all controls in the link. The controls can be added and removed. The link master is highlighted and cannot be removed from the list. Default numbers are given first when adding controls.

Controls can be configured in the right section of the page. The control number can be changed if the control is not the master. Axes produced from the control in the link can be defined. The axis number is used for identification. The axes can be added or removed via the respective buttons. Default numbers are given first when adding axes. Subsequently, the standard numbers can be directly changed in the list.



- ① Add control
- ② Remove control
- ③ Number of axes to be added
- ④ Adding axis
- ⑤ Remove axis

Fig. 14-9: Adding the function module CrossComm Sercos III - Controls in the link

The configuration is transferred to the control when going online. If you are online at a link device with IndraWorks, the complete configuration can be read in the "Properties" dialog .



These settings can be changed at any time via the context menu item **Properties...** of the function module in the Project Explorer.

The function module is implemented in the project.

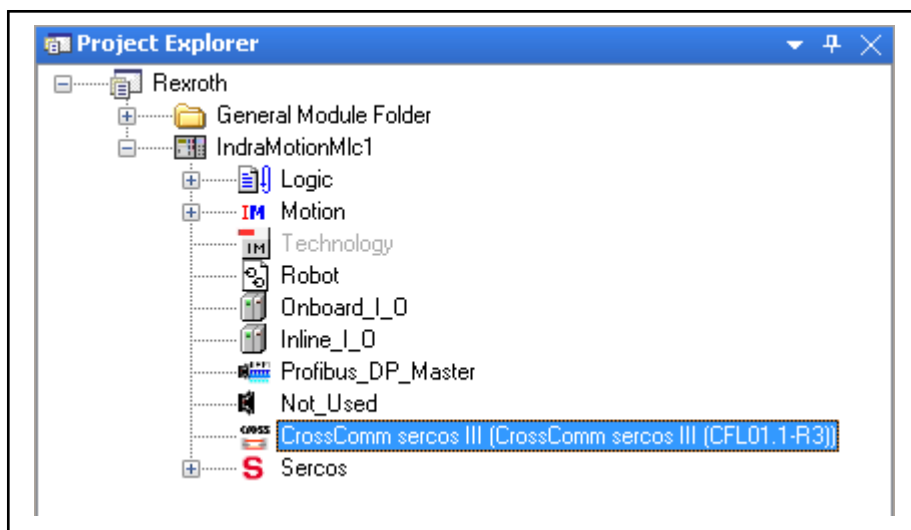


Fig. 14-10: CrossComm Sercos III, function module created

14.3.2 Configuring the link and link devices

Recommended procedure for control link configuration

The following configuration sequence of the control link is recommended:

1. Configuration of the link slaves.
 - Add the required axes and drives to the controls
 - Add a function module "CrossComm Sercos III" to each MLC control and configure this control as "Slave".
2. Configuration of the link master.
 - Add the required axes and drives to the control
 - Add the "CrossComm Sercos III" function module to the control and configure this control as "master". Subsequently, configure the controls and its provided (produced) axes in the link. Specify the respective control numbers and axis numbers. Refer to [fig. 14-9 "Adding the function module CrossComm Sercos III - Controls in the link"](#) on page 687.
3. Create the PLC programs for the link devices and use the master axes of the link devices configured in the master. It is recommended to create one variable of type "AXIS_REF" each for the master axes to be used in a Global Variable List and to use the variables in the PLC program. These variables may not be created in "MlcVarGlobal". This variable list is automatically generated and changes are overwritten if necessary)

Example of the variable declaration:

```
Master: AXIS_REF := (CtrlNo := CNTRL_2, AxisNo :=
  AXIS_15);
```

Parameters involved:

- C-0-0031, Control address
- C-0-0700, C2C, cycle time (Tcyc), command value
- C-0-0701, C2C, configuration of function modes
- C-0-0778, C2C, command configuration

CrossComm topologies

The CrossComm Sercos III function module supports:

- Line

- Double line
- Ring

Line

For this line, the CrossComm Sercos III function modules of all controls are interconnected. The link master must be at one of the two link ends.

Double line

For this line, the CrossComm Sercos III function modules of all controls are interconnected. The link master is not located at one of the link ends.

Ring

In the ring, the CrossComm Sercos III function modules of all controls are interconnected. In addition, the gap between the first and the last control is closed.



The topology is automatically detected by the link master.

14.4 Parameters for the link

The following list includes all of the configuration and diagnostic parameters relevant to the link.

Parameters
C-0-0031, Control address
C-0-0035, C2C, identification number
C-0-0041, Local and function module bus, actual configuration
C-0-0400, Motion, cycle time, command value
C-0-0503, sercos master, cycle time
C-0-0700, C2C, cycle time (Tcyc), command value
C-0-0701, C2C, configuration of function modes
C-0-0703, C2C, configuration of master axes
C-0-0704, C2C, binary inputs, command values
C-0-0710, C2C, cycle time (Tcyc), actual value
C-0-0711, C2C, error counter MDT
C-0-0712, C2C, link data, status
C-0-0713, C2C, binary inputs, status
C-0-0714, C2C, function module, status
C-0-0715, FM, sercos III, FPGA, image
C-0-0716, C2C, sercos III, error counter for data loss
C-0-0735, C2C, error counter for Port1/Port2
C-0-0750, C2C, startup target mode
C-0-0751, C2C, target mode
C-0-0752, C2C, current mode

Parameters
C-0-0778, C2C, command configuration
C-0-0779, C2C, device information

Tab. 14-3: Configuration and diagnostic parameters for the link

14.5 Diagnostic messages for the link

Problems with the link are reported by the diagnostics (errors/warnings/messages) in IndraWorks, by binary status variables in PLC components (see [chapter 14.6.2 "Link - Binary PLC inputs in the link/binary status in the link" on page 693](#)) and at the function module itself.

Diagnostics
C0280101, C2C-C0100: incomplete/invalid parameter set
C0280102, C2C-C0100: communication parameter limit exceeded
C0280108, C2C-C0100: invalid timing parameter (cycle time)
C0280109, C2C-C0100: invalid offset in HotPlug field (MDT address)
C0280113, C2C-C0100: invalid ratio of cycle times (motion/sercos)
C0280171, C2C-C0100: maximum length for connections exceeded
C0280172, C2C-C0100: no delay measuring executed (S-0-1024)
C0280173, C2C-C0100: maximum number of connections exceeded
F0160035, Error during configuration of link communication
F0160036, Error during configuration of link communication
F0160037, Error during configuration of link communication
F0280004, Link ring broken
F0280005, Link ring: masterposition incorrect MDT
F0280006, Link ring: masterposition incorrect AT
F0280007, Link ring: variant cycle time detected
F0280010, Link axis not projectable, C2C is not configured yet
F0280011, C2C: Connection not applicable, as not configured
F0280012, C2C: Connection error
F0280020, Semaphore error while switching C2C phase
F0280021, Invalid commanded C2C phase
F0280022, Internal error due to the C2C service channel
F0280023, Incompatible C2C device found
F0280024, C2C ring not closed
F0280025, C2C: Configuration not consistent
F0280027, C2C: Error device not found
F0280029, C2C: Error switching phase 3
F0280030, C2C: Error command S-0-0127, P3 transition check

Diagnostics
F0280031, C2C: Error switching phase 4
F0280034, Invalid configuration of C2C timing
F0280041, C2C: sercos cycle time not possible
F0280060, C2C master: hot plug slave w/o sercos III-interface (HP0)
F0280061, C2C master: misconfigured hot plug slave (HP0)
F0280062, C2C master: error while scanning the hot plug slaves (HP1)
F0280063, C2C master: HP1 parameters faultily receipted (HP1)
F0280064, C2C master: error running the service channel (HP1)
F0280065, C2C master: hot plug mechanism aborted
F0280066, C2C master: HotPlug not supported
F0280067, C2C master: invalid slave address detected (HP1)
F0280080, C2C slave: hot plug via C2C master impossible (HP0.1)
F0280081, C2C slave: HP0 parameters defective/incomplete (HP0.2)
F0280082, C2C slave: HP0 parameters defective/incomplete (HP0.2)
F0280083, C2C slave: HP1 parameters defective/incomplete (HP01.1)
F0280084, C2C slave: error within C2C service channel (HP1.2)
F0280085, C2C slave: faulty scan algorithm within C2C master (HP1.2)
F0280086, C2C slave: error running switch command S-0-0127/8 (HP2)
F0280087, C2C slave: hot plug mechanism failed
F0280101, Initialization of the C2C hardware failed
F0280109, Generic (configuration) error due to the C2C interface

Tab. 14-4: Error messages for link errors

Possible reasons:

- incorrect parameterization of the link (no link, several masters, PLC time slot too large...)
- defective network cable
- Defective hardware

14.6 Link - PLC components

14.6.1 Binary PLC outputs/binary link inputs

In the link operation of several MLC controls, an additional binary information exchange between the controls is possible apart from exchanging the axis data. There are also PLC outputs to handle the link ring.

The necessary data is summarized in a structure of the "ML_Base.lib":

ControlData AT #MBzz:

**ARRAY[MB_MIN_CONTROL_NUMBER..MB_MAX_CONTROL_NUMBER]
OF ML_CONTROLDATA_SM;**

The variable "ControlData" is defined as array with only one element for future extensions. Currently, only data of the local control can be accessed. It is recommended to always use the "LOCAL_CNTRL" when programming.

The data can also be read via the parameter "C--0-0704, C2C, binary inputs, command values".



Writing the binary inputs via the parameter "C--0-0704, C2C, binary inputs, command values" is only possible if no PLC program is loaded.

Name in ControlData	Function in the link
ControlData[LOCAL_CNTRL].LINK_SYNC1	Set/delete "Link SYNC1"
ControlData[LOCAL_CNTRL].LINK_SYNC2	Set/delete "Link SYNC2"
ControlData[LOCAL_CNTRL].LINK_SYNC3	Set/delete "Link SYNC3"
ControlData[LOCAL_CNTRL].LINK_SYNC4	Set/delete "Link SYNC4"
ControlData[LOCAL_CNTRL].LINK_REBUILD_RING	Set/delete "Restore redundancy"
ControlData[LOCAL_CNTRL].LINK_ENABLE_HOTPLUG	Set/delete "Enable hot plug"

Tab. 14-5: Binary PLC outputs in the link

Restore redundancy

This bit is only effective for a C2C master.

This link input allows the ring structure to be restored at runtime if there are no more interruptions in the ring and all devices temporarily decoupled from the link are integrated again via hot plug.

Enable hot plug

This bit is only active with a C2C master with a Sercos III interface.

If this bit is set, the C2C master executes the hot plug mechanism. If a new (or rebooted) C2C slave has been physically added to the running link the C2C master will insert the slave into the link during operation. If no new device exists, the C2C master reports a hot plug error.

After deleting bit 5, the C2C master does not execute the hot plug mechanism, even if a new (or rebooted) C2C slave has been physically added to the running link. If the new or reset C2C slave detects that the C2C master does not support or execute a hot plug, a respective diagnostic message is generated.

Synchronous link inputs

The link consists of a link master and a maximum of 63 link slaves. Each of the maximum 64 link devices has four binary inputs link SYNC1...link SYNC4. These inputs can be set or deleted via the data structure ControlData by the PLC program (see [chapter 14.6.3 "Link, mode of operation for the synchronous link Inputs" on page 698](#)).

Access to the binary link inputs

Writing the binary link inputs (PLC outputs) in case of an active link is primarily executed via the PLC. In exceptional cases, a parameter access is possible.

ControlData

With the PLC program, the user can set the MLC link inputs using the binary outputs in the ControlData structure and control the interaction of the devices in the link in real-time. This access to the link inputs is dominant.

Link - Binary inputs command values

As long as no PLC program is loaded, the binary link inputs can be written by setting bits from 0 to 4 in the parameter "C--0-0704, C2C, binary inputs, command values".



When the PLC program is loaded, the command value specification via the parameter becomes ineffective.

14.6.2 Link - Binary PLC inputs in the link/binary status in the link

The communication in the link is monitored by all link devices.

The diagnostic data is summarized in a structure of the "ML_Base.lib":

ControlData AT #MBzz:

**ARRAY[MB_MIN_CONTROL_NUMBER..MB_MAX_CONTROL_NUMBER]
OF ML_CONTROLDATA_SM;**

The variable ControlData is defined as array with only one element for future extensions. Currently, only data of the local control can be accessed. It is recommended to always use the "LOCAL_CNTRL" when programming.

Errors and system states are reported to the PLC using the listed PLC inputs.

Name in ControlData	Status in the link
ControlData[LOCAL_CNTRL].LINK_ERROR	Link transmission error
ControlData[LOCAL_CNTRL].LINK_ERROR_PRI	Error port 1
ControlData[LOCAL_CNTRL].LINK_ERROR_SEC	Error port 2
ControlData[LOCAL_CNTRL].LINK_ERROR_RED	Link- Redundancy error
ControlData[LOCAL_CNTRL].LINK_ERROR_HOTPLUG	Hot plug error
ControlData[LOCAL_CNTRL].LINK_ERROR_HOT-PLUG_BIT0	Hot-plug error bit 0
ControlData[LOCAL_CNTRL].LINK_ERROR_HOT-PLUG_BIT1	Hot plug error bit 1
ControlData[LOCAL_CNTRL].LINK_ERROR_HOT-PLUG_BIT2	Hot-plug error bit 2
ControlData[LOCAL_CNTRL].LINK_PHASESWITCH_ACTIVE	Phase switching active
ControlData[LOCAL_CNTRL].LINK_HOTPLUG_ACTIVE	Hot plug active in current link
ControlData[LOCAL_CNTRL].LINK_HOTPLUG_ABORTED	Hot plug aborted in current link
ControlData[LOCAL_CNTRL].LINK_HOTPLUG_BIT0	Hot-plug error bit 0
ControlData[LOCAL_CNTRL].LINK_HOTPLUG_BIT1	Hot plug status bit 1
ControlData[LOCAL_CNTRL].LINK_HOTPLUG_BIT2	Hot-plug error bit 2
ControlData[LOCAL_CNTRL].LINK_MASTER_ACTIVE	Cyclic exchange of link data active
ControlData[LOCAL_CNTRL].LINK_PLL_LOCKED	PLL locked, synchronized with link master
ControlData[LOCAL_CNTRL].LINK_ACYC_PARA_UPDATE	Acyclically transferred parameters currently adjusted
ControlData[LOCAL_CNTRL].arLinkValid-Bits_i[CNTRL_1].iLinkBit0	Link device 1 data valid
ControlData[LOCAL_CNTRL].arLinkValid-Bits_i[CNTRL_2].iLinkBit0	Link device 2 data valid
ControlData[LOCAL_CNTRL].arLinkValid-Bits_i[CNTRL_3].iLinkBit0	Link device 3 data valid
...	...
ControlData[LOCAL_CNTRL].arLinkValid-Bits_i[CNTRL_64].iLinkBit0	Link devices 64 data valid

Name in ControlData	Status in the link
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_1].iSyncBit0	Status input link SYNC1, device 1
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_1].iSyncBit1	Status input link SYNC2, device 1
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_1].iSyncBit2	Status input link SYNC3, device 1
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_1].iSyncBit3	Status input link SYNC4, device 1
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_2].iSyncBit0	Status input link SYNC1, device 2
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_2].iSyncBit1	Status input link SYNC2, device 2
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_2].iSyncBit2	Status input link SYNC3, device 2
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_2].iSyncBit3	Status input link SYNC4, device 2
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_3].iSyncBit0	Status input link SYNC1, device 3
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_3].iSyncBit1	Status input link SYNC2, device 3
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_3].iSyncBit2	Status input link SYNC3, device 3
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_3].iSyncBit3	Status input link SYNC4, device 3
...	...
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_64].iSyncBit0	Status input link SYNC1, device 64
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_64].iSyncBit1	Status input link SYNC2, device 64
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_64].iSyncBit2	Status input link SYNC3, device 64
ControlData[LOCAL_CNTRL].arLinkSync-Bits_i[CNTRL_64].iSyncBit3	Status input link SYNC4, device 64

Tab. 14-6: Binary PLC inputs in the link

Link transmission error

This status is set if one of the following errors is present in the link:

- Due to missing telegrams (AT and/or MDT), the transfer of the master axis position is malfunctioning
- Only for cross communication with a line topology: a cable break has been detected in the line

Error Port 1

This status is only relevant in redundant systems, i.e. for cross communication with a ring. The status is set if a link device detected a cable break at Port 1.

Error Port 2	This status is only relevant in redundant systems, i.e. for cross communication with a ring. The status is set if a link device detected a cable break at Port 2.
Link redundancy loss	This status is only relevant in redundant systems, i.e. for cross communication with a ring. The status is set by every link device if at least 1 device reports an "Error Port 1" or an "Error Port 2".
	 The three status messages "Error port 1", "Error port 2" and "Link redundancy error" do not necessarily lead to "Link transmission error" status.
CrossComm Sercos III - Hot-plug error	An error occurred during hot plug (accepting more devices in the link at runtime). For more error information, refer to the following three hot plug error bits.
CrossComm Sercos III - Hot-plug error bits 0...2	The three hot plug error bits indicate an error offset on the error messages of the C2C hot plug driver. The combination of these three bits result the error offset 0...7 for the basic error messages. These error offsets of the basic error messages depend on the C2C functionality. Error offsets and error messages: • C2C master, basic error message F0280060: 0...7 (error message F0280060 ... error message: F0280067) • C2C slave, basic error message F0280080: 0...7 (error message F0280080 ... error message: F0280087)
CrossComm Sercos III - Phase switching active in link	This bit indicates that a phase switching is active in the link.
CrossComm Sercos III - Hot-plug active	A hot plug is executed (accepting more devices in the link at runtime).
CrossComm Sercos III - Hot-plug canceled during running link	This bit indicates that a new link startup was triggered with the parameter C-0-0751 during an active hot plug process. In this case, the hot plug mechanism is aborted. The bit is deleted after a successful C2C startup. The C2C master can abort the hot plug as well if any problems occur during startup.
CrossComm Sercos III - Hot-plug status bits 0...2	The three hot plug status bits indicate the current state of the hot plug mechanism. The hot plug status bits display the current hot plug phase. The state machines depend on the hardware. The phase 0...4 apply respectively: Hot-plug phase 0...Hot-plug phase 4 (HP0 -> Start hot-plug ... HP4 -> Hot-plug completed successfully).
CrossComm Sercos III - Link master active	The data in the link is cyclically changing.
CrossComm Sercos III - PLL engaged	The PLL (phase-locked loop) is locked. The link slaves synchronized their local Sercos drive rings to the link master. Now the axis data or the data validity and synchronous link bits are valid.
CrossComm Sercos III - Adjusting the acyclically transmitted parameters	A part of the link data (modulo value A-0-0045 and feed distance slave drive A-0-0046) is acyclically transferred via the link. If one of these parameters is changed at an axis produced in the link, the link data (A-0-0045 and A-0-0046) are updated on all link devices via acyclic communication. This bit remains set during the adjustment. At the same time, bit 30 "Position data of (external) master axis is valid" is deleted in the parameter A-0-0021.
Link device n data valid	After the cross communication has been established in the link ring/the (double) line, the status "Link device n data valid" is set if the following 5 conditions were met: • of devices "n" is located in the ring/in the (double) line • the data sent from device "n" (link AT) is valid and

- the data received from device "n" (link MDT) was identified as valid
- the link ring and drive ring of the device "n" were started in phase 4
- the device "n" runs synchronously to the link master

Example:

If a link axis of the control with the control address '4' follows a master axis of the control with the control address '12', the "Link device 12 data valid" in the control '4' should be evaluated.

Synchronous link status

Furthermore, each link device has the binary status link SYNC1[n] to Link SYNC4[n], (n = 1 to 64). The link SYNC1[n]... link SYNC4[n] are transmitted to the controls participating in the link depending on the binary inputs link SYNC1 ... link SYNC4 above and can be evaluated by the user in the PLC using the data structure ControlData (see [chapter 14.6.3 "Link, mode of operation for the synchronous link Inputs" on page 698](#)).

Access to the binary status in the link

The evaluation of the binary status in the link is possible via either the PLC or IndraWorks.

ControlData

In the PLC program, the user can use the binary inputs in the "ML_Control-Data_SM" structure to evaluate the binary status in the link and monitor the state in the MLC link in real-time.

Dialog "Diagnostics" - Cross-Comm Sercos III

In online mode, IndraWorks provides a diagnostic window for the link in the context menu of the CrossComm function module:

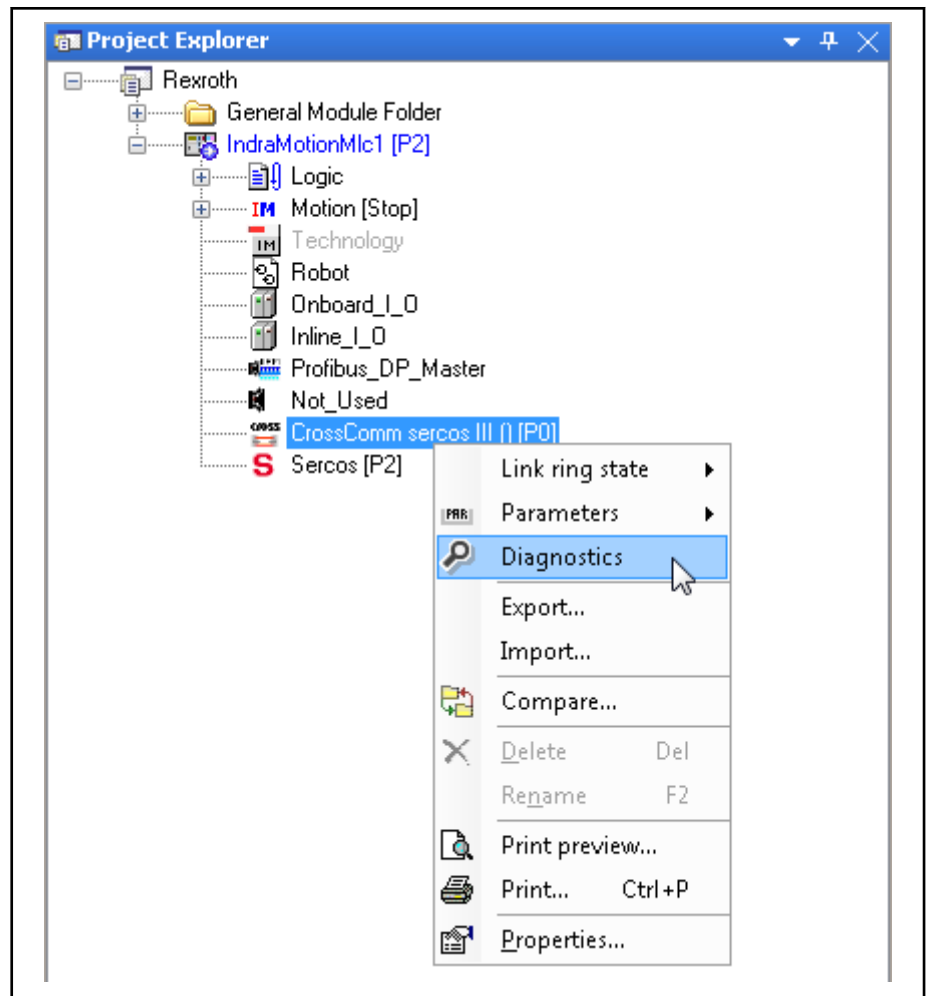


Fig. 14-11: Context menu item "Diagnostics" of the function module CrossComm Sercos III

In the left of the dialog "Diagnostics", the addresses of the MLC controls are displayed in the link and the status bits of the binary inputs are displayed. The information about the individual control are highlighted.

In the area on the right, information about the cross link status, the redundancy and the hot-plug is displayed. Additionally, the redundancy can be restored or the hot plug can be enabled if it cannot be written on these PLC outputs in the PLC program.

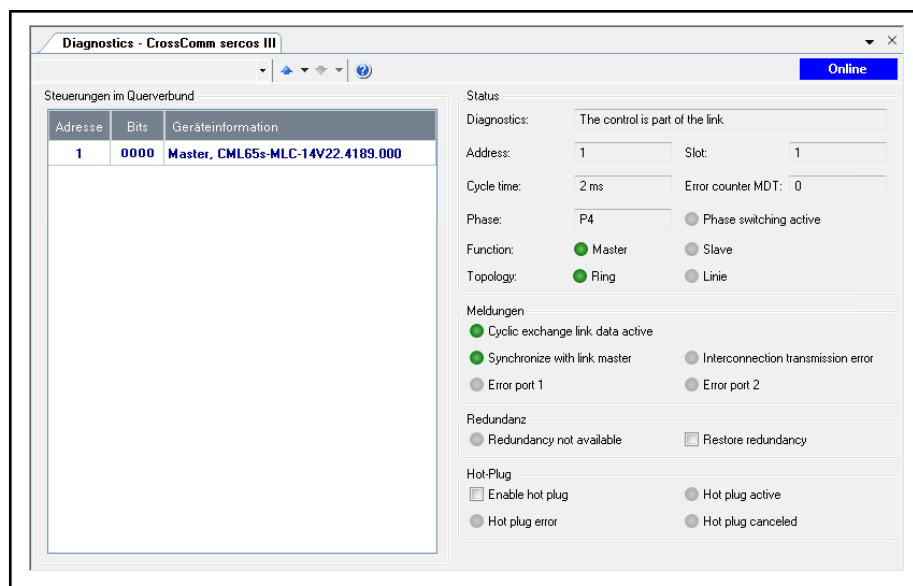


Fig. 14-12:

The following parameters are used in the dialog:

- C-0-0012
- C-0-0031, Control address
- C-0-0041, Local and function module bus, actual configuration
- C-0-0626
- C-0-0700
- C-0-0701, C2C, configuration of function modes
- C-0-0704, C2C, binary inputs, command values
- C-0-0710, C2C, cycle time (Tcyc), actual value
- C-0-0711, C2C, error counter MDT
- C-0-0712, C2C, link data, status
- C-0-0713, C2C, binary inputs, status
- C-0-0714, C2C, function module, status
- C-0-0752, C2C, current mode
- C-0-0779

14.6.3 Link, mode of operation for the synchronous link Inputs

For active link devices, the synchronous link inputs "Link SYNCn" are used for simultaneous setting and deleting of the binary "Status input link SYNCn, device m" status ($n = 1...4$, $m = 1$ to 64).

To assign the inputs to the status, the following applies:

Sets/deletes the link device m ($m = 1$ to 64) to/from the input "Link SYNCn" ($n = 1$ to 4), then sets/deletes all link devices (including device m) simultaneously to/from the status "Status input link SYNCn, device m ".

As for the master axis positions, there is dead time between changing the link input and changing the corresponding link status (cause: data transfer across the link ring).

If the data transfer across the link ring malfunctions, the respective synchronous link status are deleted.

Example of the temporal sequence

The following table shows an example of the temporal sequence for the interaction of the synchronous link inputs/status:

PLC action	Effect (PLC diagnostics)
Link device 5 sets output ControlData[LOCAL_CNTRL].LINK_SYNC1	The input is set simultaneously (after dead time) for all link devices: ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_5].iSyncBit0
Link device 12 sets outputs - ControlData[LOCAL_CNTRL].LINK_SYNC1 - ControlData[LOCAL_CNTRL].LINK_SYNC2 - ControlData[LOCAL_CNTRL].LINK_SYNC3	Simultaneously, the inputs are set for all link devices (after dead time): - ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_12].iSyncBit0 - ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_12].iSyncBit1 - ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_12].iSyncBit2 The output of device 5 (see in the table above), remains set for all link devices
Link device 7 sets output ControlData[LOCAL_CNTRL].LINK_SYNC4	The input is set simultaneously (after dead time) for all link devices: ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_7].iSyncBit3 The outputs of devices 5 and 12 (see in the table above), remain set for all link devices
Link device 5 deletes output ControlData[LOCAL_CNTRL].LINK_SYNC1	Simultaneously, the input is deleted for all link devices (after the dead time): ControlData[LOCAL_CNTRL].arLinkSyncBits_i[CNTRL_5].iSyncBit0 The outputs of devices 7 and 12 (see in the table above), remain set for all link devices

Tab. 14-7: Example of the temporal sequence of the interaction of the synchronous link inputs/status

Use cases

- Synchronous start of Motion function blocks or processes on all or several controls.
- Local monitoring of the link regarding occurred errors at the devices by outputting an error bit on a synchronous link input.

14.6.4 Link – Data of remote axes

To use a distant axis as master axis, a variable of type AXIS_REF is defined in the PLC program. This variable is initialized with the control number and the axis number (to a distant control).

Example: Axis 15 is provided to the link on control 2. To use this axis as master axis in a different control, the following variable is defined:

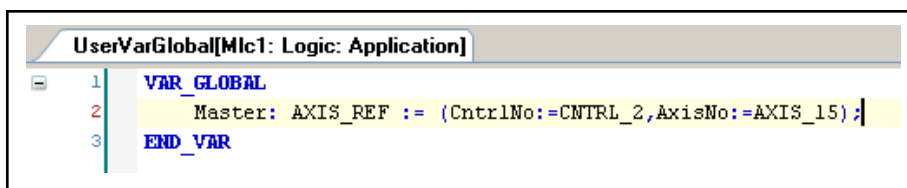


Fig. 14-13: Definition of a variable of type "AXIS_REF"

The "Master" variable can be transferred to the function blocks, e.g. MC_GearIn() or to the AxisInterface.

Even if the axis "Master" is used as master axis on the local control 2, "CntrlNo" has to be set unequal to "LOCAL_CNTRL" so that all axes that follow the master axes "Master" run synchronously. With the specification "CntrlNo" unequal to "LOCAL_CNTRL", the master axis data is queried from the link with a respective delay.

For all axes provided (produced) in the link, the data is summarized as "consumer axis" in a two-dimensional array on each link device in the "ML_Base" library:

GV_LinkAxis: **ARRAY[MB_MIN_GLOBAL_CONTROL_NUMBER..MB_MAX_GLOBAL_CONTROL_NUMBER, MB_MIN_AXIS_NUMBER..MB_MAX_AXIS_NUMBER] OF ML_GlobalVarAxis;**

The following data is available:

Name in GV_LinkAxis (Example: Control 2 and axis 15)	Data type	Description of the data
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_0021	DWORD	Axis status, parameter A-0-0021
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_0045	LREAL	Modulo value, parameter A-0-0045
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_0046	LREAL	Slave drive feed distance, parameter A-0-0046
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_0101	LREAL	Actual position value, parameter A-0-0101
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_0102	REAL	Actual velocity value, parameter A-0-0102
GV_LinkAxis[CNTRL_2, AXIS_15].A_0_2800	DWORD	Dead time compensation for consumer axis, parameter A-0-2800

Tab. 14-8: Elements of the global variable list GV_LinkAxis

Even on the local control 2 providing (producing) the axis to the link, data should be accessed via the "GV_LinkAxis" so that the data on all controls is synchronized. When accessing via "GV_LinkAxis", also the data of a local axis synchronous to the link data is created and delayed respectively.

For cascaded master axes distributed across several controls, it might be required to parameterize an additional dead time compensation to achieve data synchronicity across all controls. Therefore, parameter A-0-2800 of the consumer axis can be written via "GV_LinkAxis[].A_0_2800".

14.7 Link – Redundancy and error tolerance

In contrast to the line or the double line, the ring has the advantage that the control link remains fully functional between the devices in case of cable break. The ring topology becomes a line or a double line if the fractured area is located between master and slave or between two slaves. The link ring tolerates a cable linkage. All axes keep operating without programs.

In case of more cable breakages, the line/double line ends at the fractured point. All following devices up to the final device are separated from the link.

Every device in the link monitors its reception channels at port 1 and port 2.

If there is a cable break in the receiving channel, the respective MLC control reports its error via the binary output, see [chapter 14.6.1 "Binary PLC outputs/binary link inputs"](#) on page 691.

Procedure to restore redundancy

To restore the redundancy for a ring structure, the following procedure is required:

- Correct ring interruptions, activate all devices
- If the ring was interrupted or a device was switched off, integrate all devices again in the link via hot plug (see below).
- Restore redundancy via the **LINK_REBUILD_RING** input at the C2C master
- As soon as the **"LINK_ERROR_RED"** output is **"FALSE"**, there is redundancy again

Procedure for the hot plug

To integrate a device again in the control link after an interruption, the **LINK_ENABLE_HOTPLUG** input has to be set at the C2C master.

If multiple devices should be integrated, one edge at the **LINK_ENABLE_HOTPLUG** has to be created for each device.

The following example code creates an edge at the **LINK_ENABLE_HOTPLUG** input until a hot plug is completed. Subsequently, **LINK_REBUILD_RING** is used to restore the redundancy.

Example program: Restore hot plug/redundancy at the C2C master

Declaration of the example:

```
VAR
  // Example: how to rebuild the ring on a C2C master
  bHotPlug and RebuildRing: BOOL; // start Hotplug and rebuild ring
  uiState: UINT;
  fbR_TRIG: R_TRIG;
END_VAR
```

Implementation of the example

```
//----- Handling of the link ring -----
//-----

fbR_TRIG(CLK:=bHotPlug_and_RebuildRing);
IF fbR_TRIG.Q THEN
  uiState:=1; // Start Hotplugging with rising edge
ELSIF bHotPlug_and_RebuildRing = FALSE THEN // reset everything when not active
  ControlData[LOCAL_CNTRL].LINK_REBUILD_RING := FALSE;
  ControlData[LOCAL_CNTRL].LINK_ENABLE_HOTPLUG := FALSE;
END_IF

CASE uiState OF
  0: // Do nothing
    ;

  1: // start HotPlug
    ControlData[LOCAL_CNTRL].LINK_ENABLE_HOTPLUG := TRUE; // Enable Hotplug
    uiState := 2;

  2: // check HotPlug finished
    IF ControlData[LOCAL_CNTRL].LINK_HOTPLUG_ACTIVE = FALSE THEN
      ControlData[LOCAL_CNTRL].LINK_ENABLE_HOTPLUG := FALSE; // Finished Hotplug
      // Go to state uiState := 1 to Hotplug next....
      // No others to Hotplug? -> Start Rebuild Ring
      ControlData[LOCAL_CNTRL].LINK_REBUILD_RING := TRUE; // Start Rebuild Ring
      uiState := 3;
    ELSIF ControlData[LOCAL_CNTRL].LINK_ERROR_HOTPLUG THEN
      // Error on Hotplug
      ; // ??
    END_IF

  3: // check Rebuild Ring finished
```

```

IF ControlData[LOCAL_CNTRL].LINK_ERROR_RED = FALSE THEN
  ControlData[LOCAL_CNTRL].LINK_REBUILD_RING := FALSE; // finished...
  uiState := 0;
END_IF

```

```

END_CASE

```

14.8 Link - Configuration examples

14.8.1 Modularly-structured system

Three controls are connected to one link. The cross communication is executed via a line.

The control with the control address '2' is configured as a link master and the controls with the addresses '1' and '3' function as link slaves.

All slave axes should follow local axis 7 of the link master (MLC 2).

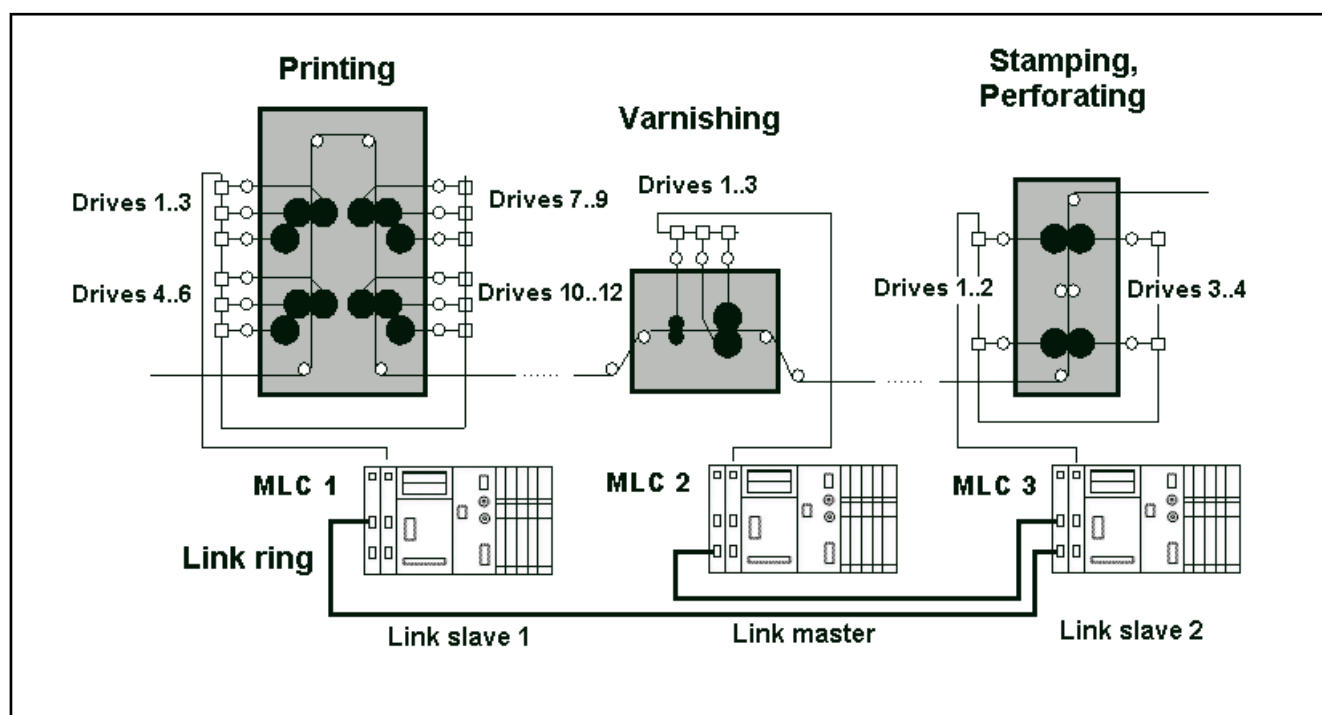


Fig. 14-14: Configuration example of a modular setup

Configuring the link devices

After the configuration with IndraWorks, for all link devices, the bits have to be set as follows in parameter "C-0-0701, C2C, configuration of function modes":

Link device	MLC link - Configuration functional modes (C-0-0701)
Link master (MLC 2)	00000000 00000011
Link slave 1 (MLC 1)	00000000 00000001
Link slave 2 (MLC 3)	00000000 00000001

Tab. 14-9: Configuration example: 3 link devices

Master axis assignment

The desired master axis (MLC 2, local axis 15) can be assigned dynamically to all local axes on the individual link devices in the PLC program. This takes place at the "Master" input using the PLCopen function blocks or the AxisInterface with an `AXIS_REF := (CntrlNo:=CNTRL_2, AxisNo := AXIS_15)`.

14.8.2 Rotary printing with two outputs (changed path control)

Rotary printing with web guide 1

The first output is identified by the assignment of printing tower 1 and folder A to section control A and from the printing towers 2, 3 and folder B to section control B.

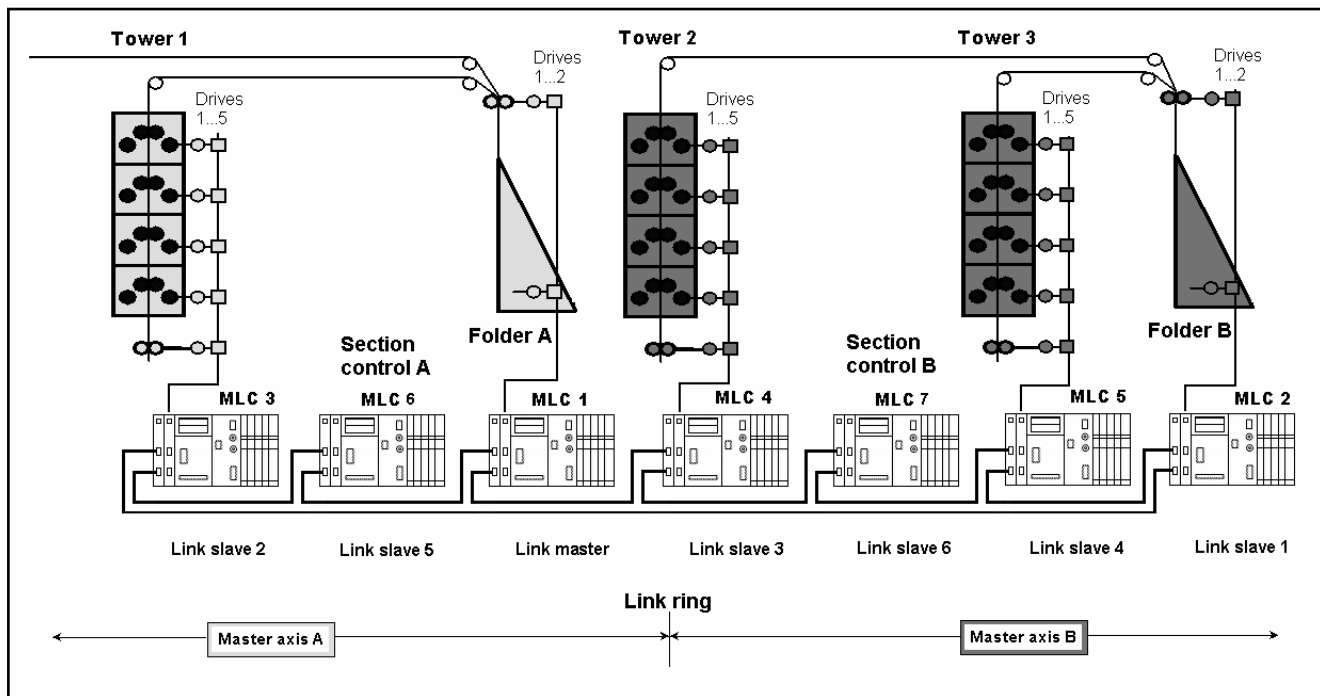


Fig. 14-15: Configuration example of the master axis link output 1

Configuring the link devices

Following the configuration via IndraWorks, the bits for an active link device in the parameter "C0-0701, C2C, configuration of function modes" have to be set as follows for all link devices:

Link device	MLC link - Configuration functional modes (C-0-0701)
Link master (MLC 1)	00000000 00000011
Link slave 1 (MLC 2)	00000000 00000001
Link slave 2 (MLC 3)	00000000 00000001
Link slave 3 (MLC 4)	00000000 00000001
Link slave 4 (MLC 5)	00000000 00000001
Link slave 5 (MLC 6)	00000000 00000001
Link slave 6 (MLC 7)	00000000 00000001

Tab. 14-10: Configuration example: 7 link devices in the ring

Master axis assignment

Printing tower 1 and folder A work with section control A.

Towers 2, 3 and folder B are assigned to section control B.

Folder A

Folder A, printing tower 1 and section control A run synchronously, i.e. all of the axes involved in this process follow the same master axis. For example, the local axis 3 of the link slave 5 (master axis A, integrated into the link by MLC 6).

The relevant master axis (MLC6, local axis 3) can be assigned dynamically to all local axes on MLC 1, MLC 3 and MLC 6 in the PLC program at the "Mas-

ter" input using the PLCopen function blocks or the AxisInterface with AXIS_REF := (CntrlNo:= CNTRL_6, AxisNo := AXIS_3).

Folder B Printing towers 2, 3 and folder B and section control B run synchronously, i.e. all of the axes involved in this process follow the same master axis: For example, the local axis 1 of the link slave 6 (master axis B, integrated into the link by MLC 7).

The desired master axis (MLC 7, local axis 1) can be assigned dynamically to all local axes on the MLC 2, MLC 4, MLC 5 and MLC 7 in the PLC program. This takes place at the "Master" input using the PLCopen function blocks or the AxisInterface with an AXIS_REF := (CntrlNo:=CNTRL_7, AxisNo := AXIS_1).

Changeover to a changed web guide

All 3 printing towers and folder B should now work with section control B and the local axis 6 as the master axis.

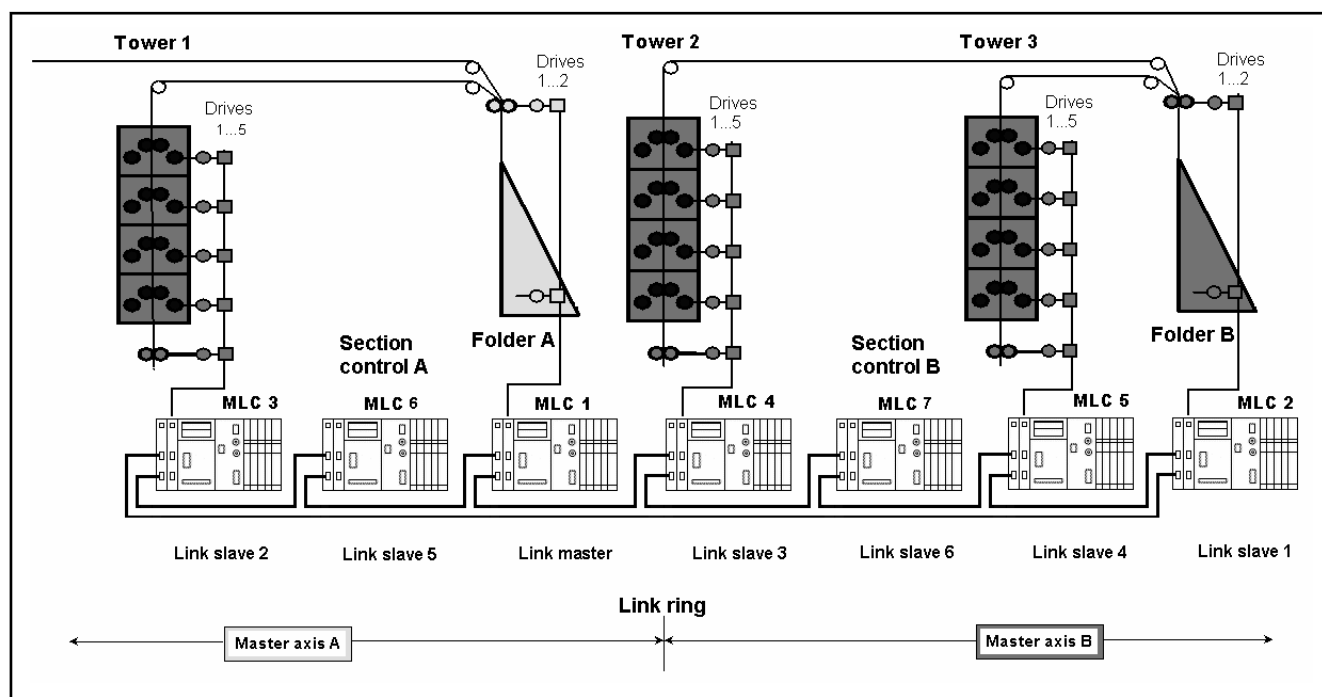


Fig. 14-16: Configuration example of the master axis link output 2

Configuring the link devices

The master/slave configurations of the controls remain unchanged.

Master axis assignment

The desired master axis (MLC 7, local axis 6) can be assigned dynamically to all local axes on the individual link devices in the PLC program at the "Master" input using the PLCopen function blocks or the AxisInterface with an AXIS_REF := (CntrlNo:=CNTRL_7, AxisNo := AXIS_6).

14.9 Procedure to convert the cross link Sercos II to the Cross Link Sercos III

14.9.1 General information

This section describes a procedure to convert an MLC cross link via Sercos II (function module CrossComm Sercos II (CFL01.1-Q2)) to an MLC cross link via Sercos III.

The prerequisite is that all projects whose controls participate in the link are available.

14.9.2 Removing link axes

First, the link axes are removed from the project. It has to be determined before which axes (control number + axis number) are assigned to the link axes since this information is required for the later configuration of the cross link via Sercos III.

To retrieve this information for one axis, the assignments of the link axes must be taken from their properties dialogs.

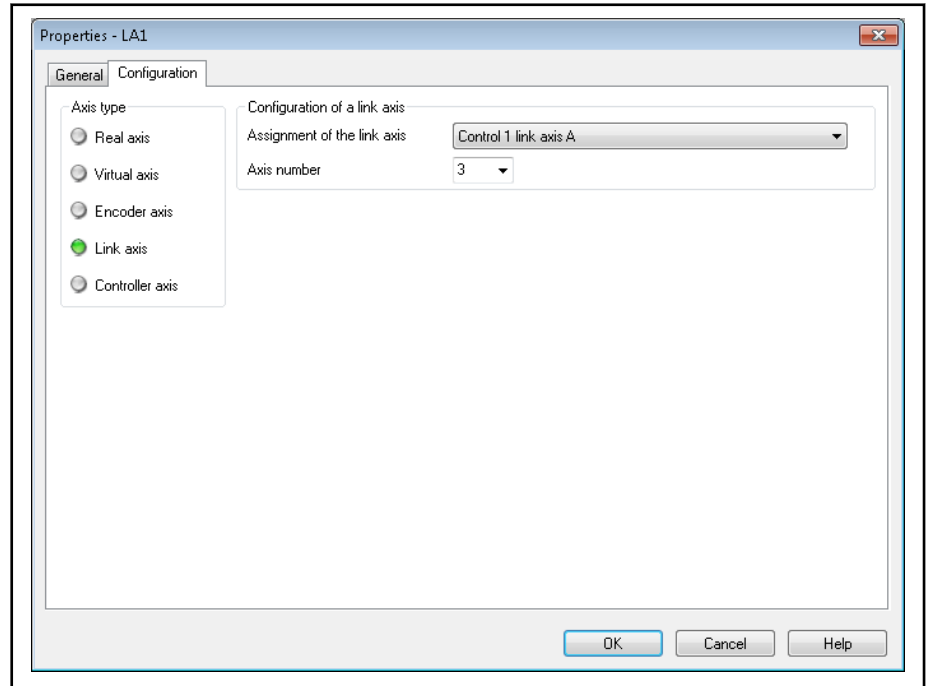


Fig. 14-17: "Properties" dialog for the link axis

Subsequently, the project containing the respective control provides information on the axis behind the respective link axis. This information can be found in the dialog "MLC link settings". This dialog is only available in case of an online connection to the control.

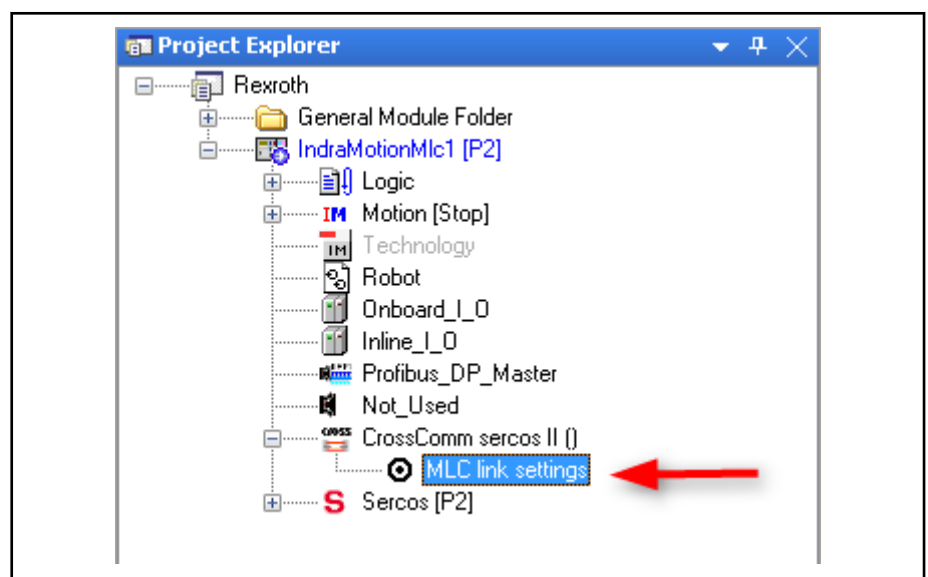


Fig. 14-18: Project Explorer – Selection "MLC link settings"

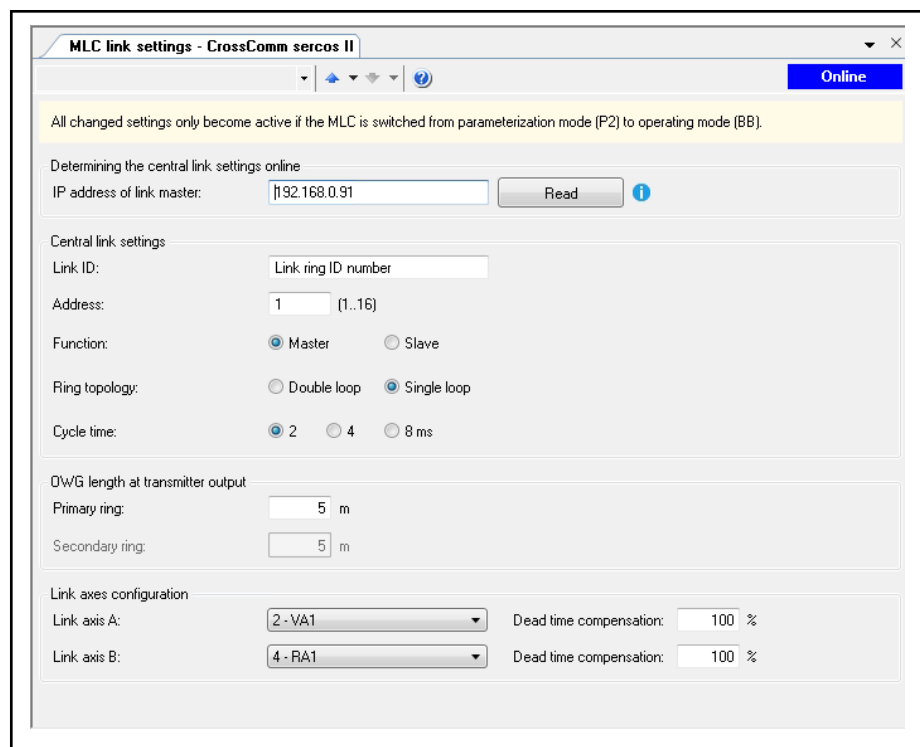


Fig. 14-19: Dialog "Settings for the MLC link"

The properties dialog of the respective axis provides the axis number.

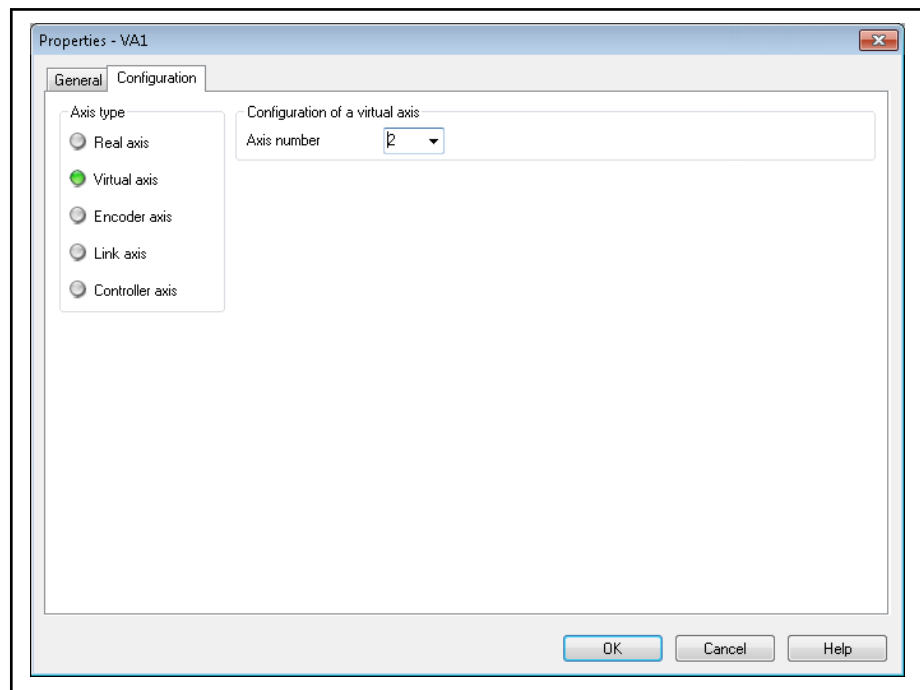


Fig. 14-20: Properties dialog of the axis

After all link axis assignments have been determined, the link axis assignments can be deleted.

14.9.3 Replacing the function modules

In the third step, the function module "CrossComm Sercos II (CFL01.1-Q2)" is removed and the function module "CrossComm Sercos III (CFL01.1-R3)" is

added (see [chapter 14.3.1 "Creating and configuring the CrossComm Sercos III" on page 682](#)).

Execute this action for all link slaves. Enter the same control address into the wizard as the control in the Sercos II cross link. The function is "Slave". Complete the wizard with **Finish**.

Fig. 14-21: Adding the CrossComm Sercos III (CFL01.1-R3) wizard function module (slave)

To apply the configuration of the link slaves, the controls must be switched to online mode. A restart of the controls is necessary. A respective message is displayed to request you to restart.

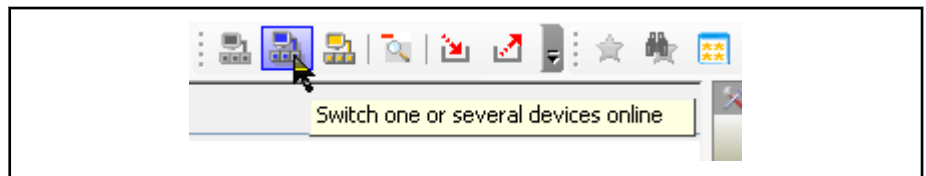


Fig. 14-22: Switch MLC online

If all slaves are configured, exchange the function module at the link master. Restart the configuration wizard and specify the control address, the function of the control ("master") and the cycle time of the link ring.

Cross communication between controls - CrossComm Sercos III

Add Function Module CrossComm Sercos III

Step 1: Control settings

Please specify a control address in the ring and specify if it is a master or a slave in the link.

Control settings

Control address in the ring:

Function: ☒ Master ☐ Slave

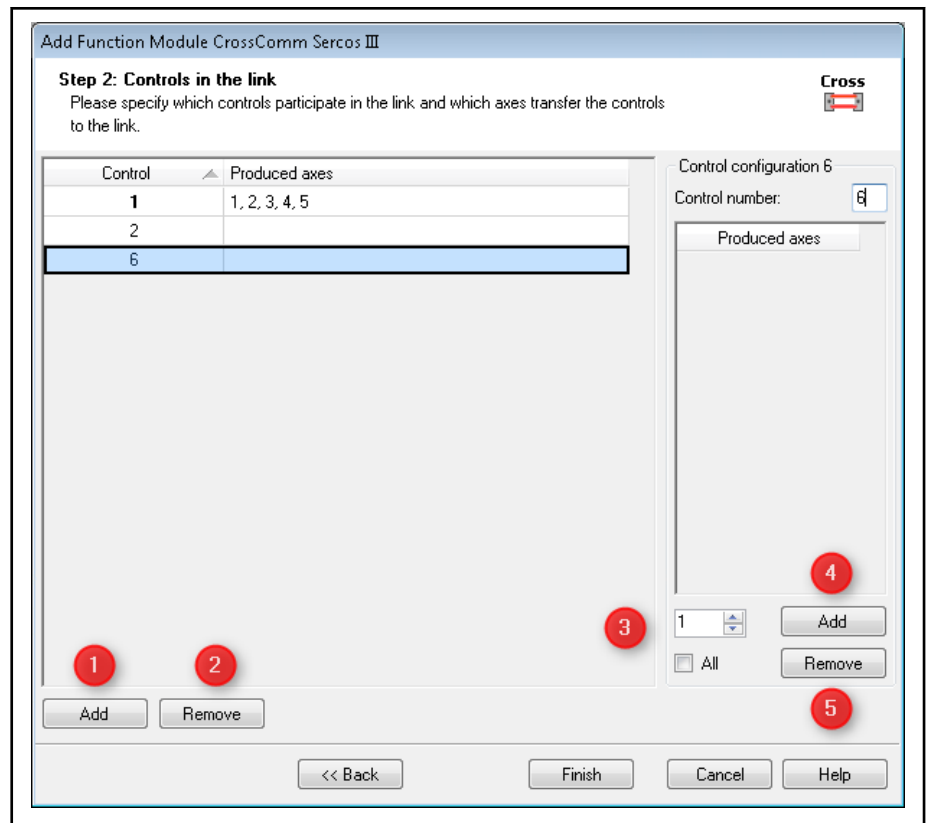
Central link settings

Cycle time: ☐ 1 ☒ 2 ☐ 4 ☐ 8 ms

Next >> Cancel Help

Fig. 14-23: Adding the CrossComm Sercos III (CFL01.1-R3) function module (master)

Define the controls participating in the link and which axes provide (produce) the controls in the link on the second page of the wizard.



- ① Add control
- ② Remove control
- ③ Number of axes to be added
- ④ Adding axis
- ⑤ Removing axis

Fig. 14-24: Adding the CrossComm Sercos III (CFL01.1-R3) wizard function module (controls)

To apply the configuration of the link master, the control must be switched to online mode. A restart of the control is necessary. A message is displayed requesting a restart.

14.9.4 Adapting the PLC program

In the last step, the conversion must be adapted to the PLC program. It is recommended to create variables for the required axes to be consumed in a global variable list (e.g. "UserVarGlobal"). "MlcVarGlobal" may not be used as global variable list. This list is automatically generated with the project. Manual changes are lost.

It is recommended to name the variables like the link axes. This has the advantage that the remaining PLC program does not have to be adapted.

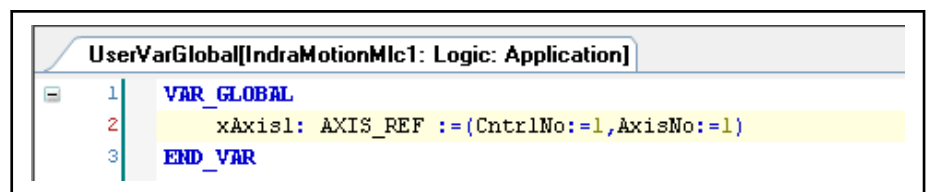


Fig. 14-25: Creating variables in the Global Variable List "UserVarGlobal"

If no global variables should be created or the variables should be named differently, all locations where old link axes are used in the PLC program have to be identified. These locations have to be adapted accordingly.

14.10 Procedure to convert a cross link of Sercos III MLC 04VRS to Sercos III $\geq$ MLC 10VRS

The project conversion with the cross link Sercos III (C2C) in the MLC 04VRS to the cross link Sercos III in version $\geq$ 10VRS is executed similarly to the conversion of the cross link Sercos II to the cross link Sercos III.

The procedure differs in the following:

1. The determination of the axis numbers described in the first step "Remove link axes" (see [chapter 14.9.2 "Removing link axes" on page 705](#)) has to be executed in the 04VRS, since the dialog "MLC link settings" for the function module "CrossComm Sercos III (CFL01.1-R3)" is not available in the $\geq$ 10VRS.
2. The third step "Exchanging the function modules" is also different. There is no need to exchange the function modules. The configuration is carried out via the properties dialogs of the existing function modules and not with the wizard, since the function modules do neither have to be deleted nor newly added.

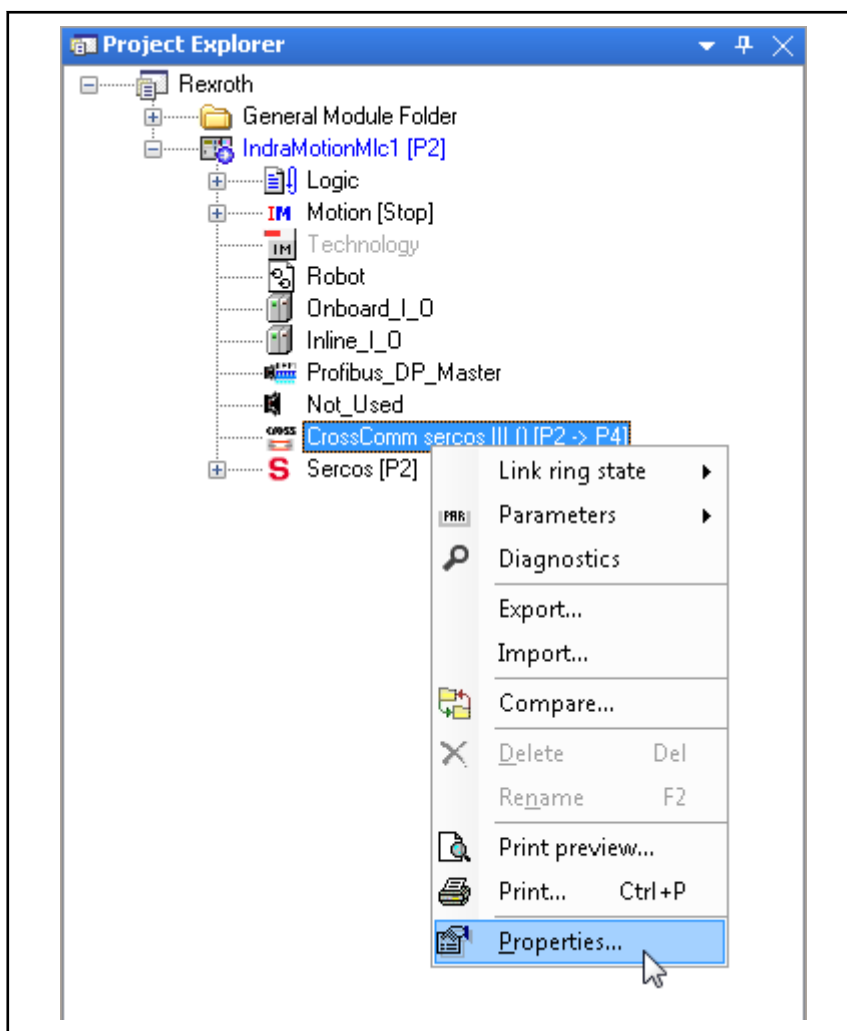


Fig. 14-26: Opening the "Properties" dialog of the CrossComm Sercos III (CFL01.1-R3) function module

14.11 CrossComm Sercos III (CFL01.1-R3, XFE01.1-FB-01) - Context menu

The context menu includes the menu items

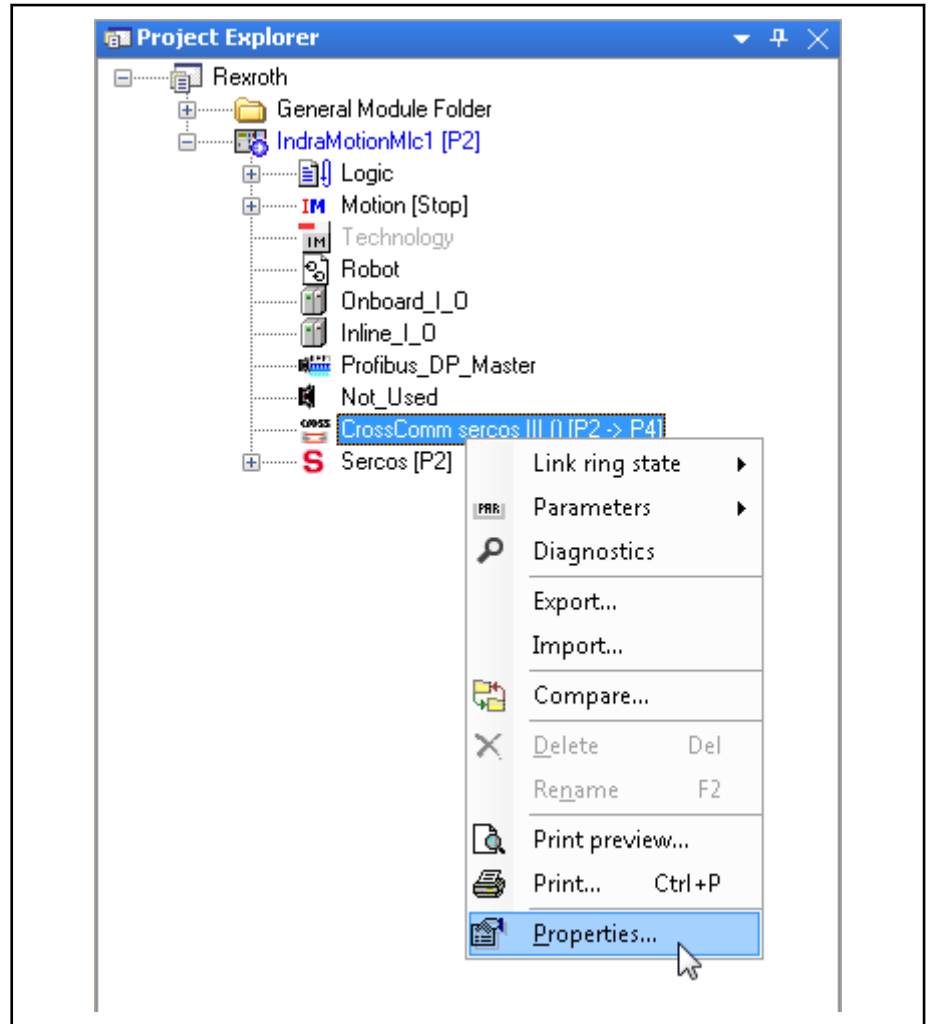


Fig. 14-27: Context menu CrossComm Sercos III (CFL01.1-R3, XFE01.1-FB-01)

- **Link Ring State** - Provides information on the current status
- **Parameter** - Calling the parameter editor, the parameter group and parameter search
- **Diagnostics for MLC link...** - Calls the diagnostics for the link
- **Export...** - saves function module elements in a file
- **Import...** - Imports elements to the current project from a file
- **Compare...** - compares and merges objects
- **Delete** - deletes the function module from the project
- **Rename** - changes the function module name in the Project Explorer
- **Print preview...** - Print preview of the configured properties
- **Print...** - Prints the configured properties
- **Properties...** - Opens the configuration dialog of the module

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Index

A

- Abbreviations..... 12
- About this documentation..... 1
 - Validity of the documentation..... 3
- Access protection configuration
 - Group names conventions..... 297
 - Password conventions..... 292
 - User name conventions..... 292
- Access protection to devices
 - 'Groups' tab..... 292
 - 'Rights' tab..... 297
 - 'User' tab..... 287
- Access protection in practice..... 304
- Assign group members..... 296
- Assign group membership..... 291
- Assign group rights..... 296
- Auto login..... 304
- Configuration dialog..... 284
- Configuration dialog - Elements..... 286
- Configure access protection..... 284
- Copy group..... 295
- Copy user..... 289
- Create new group..... 294
- Create new user..... 289
- Delete group..... 295
- Delete login information..... 306
- Delete user..... 290
- Delivery state/default user..... 282
- Devices notes: - Restrictions..... 307
- Functional principle..... 281
- General information..... 281
- Individual rights - Overview..... 299
- Insufficient user rights of stored login information..... 305
- Login to the control..... 282
- Login user..... 282
- Make devices safe..... 307
- Manually store login information..... 304
- Note on firmware update on controls..... 307
- Note to devices with 14V20 firmware..... 307
- Option 'Save login data for this device'..... 283
- Overview..... 281
- Prerequisites and notes on resetting passwords..... 291
- Reload data..... 291, 296
- Reset password..... 291
- Rights categories - Overview..... 299
- Rights category..... 300, 301, 302, 303, 304
- User change password..... 283
- Users, groups and rights..... 282
- Active Watchdog..... 336
- Add device
 - Information..... 212
 - Logging..... 210
 - Ordering number..... 212
- Add POU to task..... 336
- Adjust command/actual configuration..... 526
- Adjust the behavior of the axis synchronization dialog..... 531
- ANSI Z535.6-2006..... 5
- Applications on control..... 209
- Archive device data..... 259
- Archive project..... 110
- Archive SYSTEM/OEM/USER (backup of system firmware)..... 65
- Axes – Introduction and overview..... 359
- Axes in IndraMotion
 - Operation modes for synchronous motions with electronic gear function..... 546
 - Single-axis modes..... 539
- Axis
 - Active..... 536
 - Deactivated..... 535
 - Parameterization mode..... 539
 - Parked..... 536
- Axis - Dialog
 - Cam table, gear settings..... 467
 - Dimensional reference - Optional encoder..... 456
 - Drive halt..... 454
 - E-Stop function..... 459
 - Initial values..... 462
 - Measuring systems - Optional encoder..... 446
 - MotionProfile, gear settings..... 474
 - Scaling/units extended..... 449
 - Scaling/units settings..... 447
- Axis - Dialogs
 - Overview..... 433
- Axis – context menu
 - Diagnostics, error/diagnostic memory..... 387
- Axis – Context menu
 - Communication, signal control word..... 384
 - Communication, signal status word..... 382
 - Diagnostics..... 385
 - Diagnostics, average value filter display..... 388
 - Diagnostics, clear errors..... 387
 - Diagnostics, IDN list of invalid operating data..... 387
 - Diagnostics, status..... 385
 - Initial commissioning..... 377
- Axis – Dialog
 - Axis configuration..... 493
 - Brake..... 445
 - Cam table, cam table phase offset..... 468
 - Cam table, cam table selection..... 469
 - Cam table, dynamic phase offset..... 469
 - Cam table, dynamic synchronization - Phase synchronization..... 470
 - Cam table, master axis position offset..... 467
 - Closed-loop control..... 452

Compensation functions/corrections.....	463	Enable axis.....	556
Compensation functions/corrections, backlash on reversal correction.....	464	FlexProfile.....	559
Drive-integrated command value genera- tor.....	465	Overview.....	554
Error reaction can be switched off.....	457	Phase offset.....	558
Error response.....	456	Position synchronization.....	558
Error response, drive.....	456	Positioning.....	557
Error response, power section.....	458	Safety functions.....	555
Establish dimensional reference.....	455	Stop.....	559
FlexProfile, cam table – Phase offset be- gin of profile.....	481	Velocity control.....	557
FlexProfile, dynamic synchronization - Phase synchronization.....	484	Velocity synchronization.....	558
FlexProfile, gear settings.....	481	Axis error messages.....	562
FlexProfile, general information.....	478	Axis Modes.....	535
FlexProfile, master axis position offset.....	480	Axis name, encoder axis.....	429
FlexProfile, overview.....	482	Axis name, real axis.....	372
Gear with phase synchronization - Gear settings.....	492	Axis name, virtual axis.....	393
Gear with phase synchronization - Gen- eral information.....	489	Axis number, controller axis.....	402
Gear with velocity synchronization - Gear settings.....	488	Axis number, encoder axis.....	429
Gear with velocity synchronization - Gen- eral information.....	485	Axis number, real axis.....	372
Measuring systems – Motor encoder.....	445	Axis number, virtual axis.....	393
Motion limit values.....	460	Axis overview.....	361
MotionProfile.....	471	Axis properties.....	361, 389
MotionProfile, cam table phase offset.....	474	Axis synchronization dialog.....	530
MotionProfile, dynamic phase offset.....	475	Axis types.....	359
MotionProfile, dynamic synchronization - Phase synchronization.....	477	Axis warning messages.....	582
MotionProfile, general information.....	471		
MotionProfile, master axis position offset....	473	B	
MotionProfile, MotionProfile overview.....	475	Backing up and restoring	
Motor.....	443	Back up and restore using First Touch.....	60
Motor temperature monitoring.....	444	Back up and restore XM control data with IndraWorks.....	59
Operation mode settings.....	437	Restore without PC via SD card.....	60
Position switching point.....	496	Update backup file after online change.....	61
Settings of status messages.....	453	Backing up remanent data.....	60
Touch probe.....	496	Backing up restoring	
Axis (IndraDrive) - Dialog		Reset an XM control to factory settings.....	61
Cam table.....	465	Backup.....	59
Cam table, general information.....	465	Backup and restore	
Mechanical gear.....	451	Back up remanent data for XM2 controls.....	60
Axis (IndraDrive) – Dialog		Behavior while updating/upgrading.....	26
Compensation functions/corrections.....	463	Byte order.....	355
Drive-integrated safety engineering.....	495		
Gear with phase synchronization - Dy- namic synchronization.....	492	C	
Gear with phase synchronization - Mas- ter axis position offset.....	491	C-0-0036	
Gear with velocity synchronization - Dy- namic synchronization.....	489	Multicore control configuration.....	318
Gear with velocity synchronization - Mas- ter axis position offset.....	487	Cam Pool.....	110
Axis commissioning.....	554	Cam table.....	465
		CamBuilder connection.....	663
		CMP ID.....	210
		Command	
		Reset device origin [device name].....	268
		Command value decoupling	
		Display.....	537
		Mode of operation.....	537
		Commission and operate.....	29
		Commissioning	
		Offline parameterization.....	110
		Commissioning and operation	

PLC programming.....	321	Compare/merge.....	272
Compare control and project configuration.....	532	Compare/merge, axes.....	273
Compare Motion project data and control data.....	534	Compare/merge, control.....	273
Complaints.....	12	Compare/merge, function modules.....	274
Complete backup		Compare/merge, robot (only for MLC).....	273
Complete backup.....	310	Device data.....	259
Complete data backup.....	309	Device data, archive.....	259
General Information.....	309	Device data, Explorer.....	265
Complete project backup		Diagnostic, MLPI connections.....	243
Restore a project.....	314	Diagnostics, clear errors.....	238
Configuration file		Diagnostics, device status.....	234
Network settings.....	37	Diagnostics, error/diagnostic memory.....	238
Configuration task.....	336	Diagnostics, invalid parameters.....	241
Configure drive bus (Sercos II).....	203	Diagnostics, load.....	236
Configure the measuring encoder.....	431	Diagnostics, task list/configuration.....	242
Configuring the CrossComm Sercos III.....	682	Export.....	268
Container libraries.....	323	Import.....	270
Context menu		Language settings.....	216
Parameters, Load basic parameters.....	397	Parameters.....	222
Context menu of the project folder.....	109	Print.....	276
Control		Print preview.....	274
"Motion" node.....	168	Reset device origin [device name].....	268
"Robot" folder.....	186	Runtime licenses.....	274
"Robot" folder, context menu.....	186	Simulation.....	268
Context menu items.....	206	Synchronize, compare control and project configuration.....	532
Function modules folder.....	189	Control error messages.....	566
Inline I/O folder.....	188	Control IndraLogic XLC/IndraMotion MLC –	
Logger.....	210	Context menu	
Onboard I/O folder.....	187	Device data, restore.....	263
Overview on nodes.....	163	Control mode.....	163
Profibus/M folder.....	188	Control properties.....	277
S20 I/O folder.....	188	Enable/disable offline parameterization.....	280
Sercos node.....	189	Extended settings tab.....	280
Technology node.....	171	Function packages tab.....	281
Control - Context menu		Interfaces tab.....	281
Diagnostics, task list/configuration.....	242	PLC properties.....	280
Control – "Logic" node		Tab General information.....	277
Application – Toolbar.....	166	Tab Hardware/communication.....	277
Context menu.....	165	Control warning messages.....	586
Context menu, "Application" subfolder.....	167	Controller axis.....	398
Subfolders.....	165	Controller axis - Context menus	
Control – "Motion" node		Menu items.....	415
Context menu.....	170	Controller axis - Dialogs	
Control – "Sercos " node		Dialog: Extend Sytronix.....	414
Context menu.....	191	Overview (central Sytronix controller).....	412
Control – "Sercos" node		Overview (freely programmable).....	410
Sercos - Toolbar.....	205	Overview (hydraulic central controller).....	411
Control – "Technology" node		Overview (hydraulic synchronization controller).....	412
Context menu.....	173	Controller axis - General information.....	398
Dialogs.....	178	Controller axis – Context menu	
Options menu.....	173	Diagnostics.....	416
Technology wizards.....	174	Diagnostics, clear errors.....	417
Control – Context menu		Diagnostics, status.....	416
Cam explorer.....	217	Initial commissioning.....	416
Communication, interfaces.....	214	Controller axis – Use cases.....	418
Communication, TCP settings.....	213	Core dump.....	41, 56, 94, 670
Communication, user control ID.....	214		

Core dump SysError.....	670	Context menu.....	711
Core dump, SysError.....	41, 56, 94	Customer Feedback.....	12
Create a link axis.....	422	Cycle time exceeded for Motion kernel after updating to 14V22.....	319
Create control.....	113	Cycle times.....	519
Create controller axis.....	399	Cyclic Sercos channel.....	380
Create axis in the Project Explorer.....	399	Cyclic task.....	336
Last step: Summary.....	409	D	
Step 1: General settings.....	400	Delete applications.....	209
Step 2: configuration.....	402	Device category.....	212
Step 3 (central controller): Signal han- dling.....	403	Device data Explorer.....	265
Step 3 (synchronization controller): Axis assignment.....	408	Device dialog	
Step 3 (Sytronix controller): Axis assign- ment.....	408	Applications.....	209
Step 4 (central controller): Signal assign- ment.....	405	Device editor.....	209
Create encoder axis (real master axis).....	427	Applications.....	209
Create axis In the Project Explorer.....	427	Information.....	212
Create function module.....	121	Log.....	210
Create Inline I/Os.....	127	PLC settings.....	211
Create kinematics.....	153	Device name.....	212
Create Onboard I/Os.....	124	Device ordering number.....	212
Create PLC program		Device status.....	234
Compile program.....	322	Device type.....	212
Declare variables.....	321	Device version.....	212
Edit instruction.....	322	Device-specific library.....	323
Load PLC program to control.....	323	Diagnostics	
Open PlcProg object.....	321	Profinet I/O controller.....	188
Create Profibus I/Os.....	134	Diagnostics, error/diagnostic memory	
Create Profinet I/O Controller.....	135	Area control.....	240
Create project.....	107	Area View.....	240
Create real axis.....	370	Context menu.....	241
Create Sercos III I/Os.....	136	Filters.....	239
Create virtual axis (virtual master axis).....	391	Messages.....	238
Creating controls		Diagnostics, Error/diagnostic memory	
Device configuration.....	115	Overview.....	238
Ethernet communication.....	117	Documentation	
Offline parameterization.....	118	Change record.....	1
PLC programming templates.....	118	Documentation structure.....	4
PLC properties.....	117	Drive address, Sercos.....	372, 429
Step 1: General settings.....	115	Drive as PLC device.....	500
Step 2: Hardware/communication.....	115	Drive as PLC device – More field buses.....	511
Step 3: Extended settings.....	117	Drive firmware.....	256
Step 4: Function packages.....	119	Drive firmware management.....	256
Step 5: Interfaces.....	119	Drive password – Change.....	379
Criticism.....	12	E	
Cross communication error messages.....	578	Electronic cams.....	592, 617
Cross communication warning messages.....	588	Cam solutions.....	593
CrossComm Sercos III		Electronic cam.....	595
Configure link and link devices.....	688	FlexProfile, basic functionalities.....	596
Creating and configuring the function module.....	682	FlexProfile, configuration.....	618
Diagnostic messages.....	690	FlexProfile, configuration using Cam- Builder.....	624
Parameters for configuration and diag- nostics.....	689	FlexProfile, configuration using IndraWorks.....	619
Redundancy and error tolerance.....	700	FlexProfile, configuration using PLC func- tion blocks.....	618
CrossComm Sercos III (CFL01.1-R3)			

FlexProfile, event control.....	614	for system axis – Dialog	
FlexProfile, Flex step.....	600	FlexProfile.....	478
FlexProfile, motion laws.....	598	Free-running task.....	336
FlexProfile, profile configuration.....	597	Function module error messages.....	571
FlexProfile, select coordinate system.....	607	Function module warning messages.....	587
FlexProfile, switch and synchronize.....	608	G	
FlexProfile, synchronous operating states.....	597	GAT PlugIn.....	420
FlexProfile, time master.....	598	General information on the Profinet I/O.....	135
Electronic motion laws.....	596	H	
Encoder axis - Context menus		Hazard warnings.....	4
Menu items.....	432	Helpdesk.....	713
Encoder axis - Dialogs		Hidden libraries.....	323
Overview.....	431	Hotline.....	713
Encoder axis - General information.....	427	I	
Error case		I/O.....	352
Core dump.....	41, 56, 94	I/O configuration.....	352
Exception in IEC application.....	667	I/O turn around times	
Spontaneous control reboot.....	670	General information.....	341
SysError.....	669	IndraControl First Touch, firmware management	
Error cases.....	667	Backup system firmware.....	65, 66
Core dump.....	670	IndraDrive.....	465
Error categories.....	667	IndraLogic XLC/IndraMotion MLC – Basic sequences, general information.....	29
Introduction and overview.....	667	IndraLogic XLC/IndraMotion MLC Cross-over connection.....	37
Menu BOOTSTOP.....	37	IndraLogic XLC/IndraMotion MLC display and operating keys.....	34
Procedure in case of SysError.....	40	IndraLogic XLC/IndraMotion MLC L45/L65/L75	
Error reaction of the axis.....	369	Hardware commissioning.....	30
EtherCAT error messages.....	581	IndraLogic XLC/IndraMotion MLC Lxx.....	41
Event.....	336	Add Sercos bus.....	42
Task.....	336	Connections of the control.....	30
Event logging.....	210	Control startup.....	31
Event task.....	336	Delete control memory.....	40
Exception in IEC application		IndraMotion MLC - Response of the ready contact.....	30
Error case.....	667	IP address - Initial setting.....	33
Exchanging firmware.....	253	Lock display keys.....	41
Extension module error messages.....	572	Operate control display.....	31
External event for tasks.....	336	Replace hardware.....	42
External library.....	323	IndraLogic XLC/IndraMotion MLC menu overview to operate display and keyboard.....	35
F		IndraLogic XLC/IndraMotion MLC XM.....	56
F5180005.....	319	IndraMotion MLC VPx.....	94
Feedback.....	12	Back up remanent data.....	101
Find parameters.....	226	BOOTSTOP menu	93
Firmware download		Commissioning steps.....	75
Drives.....	256	Connections, operating elements and LEDs.....	77
Sercos devices.....	203	Error causes and troubleshooting.....	101
Firmware management.....	253	Hardware commissioning.....	75
Firmware update.....	253, 256	Hypervisor.....	80
FlexProfile		IndraControl First Touch.....	83
Centralized and decentralized cam concept.....	596	IndraControl First Touch, core dump.....	89
IndraDrive.....	478		
Use cases.....	596		
FlexProfile editor.....	618		
FlexProfile, assign MotionProfile of an axis.....	617		
for system axis - Dialog			
Jogging (Robot Control V1).....	499		

IndraControl First Touch, file manager....	68, 88	Ports XM42.....	47
IndraControl First Touch, firmware management.....	84	Real-time clock.....	73
IndraControl First Touch, hardware data.....	84	Toggle between the initial firmware and the MLC system firmware.....	44
IndraControl First Touch, network settings....	84	Toggle between the initial firmware and the MLC system firmware (WebAssistant).....	45
IndraControl SysTray.....	90	Toggle between the MLC system firmware and the initial firmware (First Touch).....	44
IndraWorks Engineering.....	69, 97	IndraWorks	
IndraWorks Engineering, firmware download.....	98	Interface.....	106
Initial Connections of the control.....	76	IndraWorks – Startup.....	103
Initial firmware.....	82	Information messages.....	582
Initial firmware, starting and opening the initial firmware.....	82	Information on the device.....	212
IP address - Initial setting XETH2.....	78	Initial values - Real axis.....	462
LEDs operating and error displays.....	78	Install and start IndraWorks.....	103
Network File System (NFS).....	82	Install IndraWorks	
Software tools.....	76	Technical requirements.....	103
IndraMotion MLC XM		Internal library.....	323
Back up and restore.....	59	Interval for task.....	336
Back up remanent data.....	73	IP communication.....	141
Backup and Restore.....	59	Automatic IP address generation.....	149
Behavior in case of fatal exception (SysError).....	54, 101	Basics.....	142
Bootling.....	59	Configure bridge.....	150
BOOTSTOP menu	53	Default setting.....	143
Commissioning steps.....	43	Firewall.....	151
Connect SD card memory media via XG10.....	74	IndraWorks commissioning dialogs.....	147
Connect USB memory media via XF30.....	73	More information on the use.....	152
Connections of the control.....	45	Overview.....	141
Error causes and troubleshooting.....	74	Parameters.....	150
Fallback mode.....	59	Ports.....	151
Firmware download.....	70	TCP.....	151
Hardware commissioning.....	43	UDP.....	151
IndraControl First Touch.....	62	K	
IndraControl First Touch, core dump.....	68	Kinematic commissioning.....	650
IndraControl First Touch, File manager.....	68	Belt configuration.....	655
IndraControl First Touch, firmware management.....	64	Grouping a kinematics.....	652
IndraControl First Touch, general information.....	62	Jogging.....	653
IndraControl First Touch, hardware data.....	63	Overview.....	650
IndraControl First Touch, network settings....	63	PLC configuration.....	657
IndraWorks Engineering.....	69	Positioning.....	654
IndraWorks Engineering via the interface Prog (XF31).....	47	Product coordinates.....	656
Initial firmware.....	56	Safety functions.....	651
Initial firmware, Install backup from external SD card.....	58	Kinematic error messages.....	572
Initial firmware, LED states.....	56	Kinematic warning messages.....	588
Initial firmware, starting and opening the initial firmware.....	57	Kinematics (Robot Control V2).....	647
IP address initial setting XF5.....	47	L	
LEDs on XD1 plug.....	48	Late linking.....	323
Lock operation mode switch.....	55	Library.....	323
Notes on the initial/system firmware.....	43	Library directory.....	323
Operating and display elements.....	48	Library information.....	323
Ports XM21 and XM22.....	46	Library management	
		Convert IndraLogic 1.x libraries.....	328
		Create libraries.....	328
		Install on the system and integrate into a project.....	325

Integrate external code.....	329	PLC, binary PLC inputs in the link/binary status in the link.....	693
Library overview.....	324	PLC, binary PLC outputs in the link/binary link inputs.....	691
Library versions.....	326	PLC, mode of operation for the synchronous link inputs.....	698
Referenced libraries.....	326	Ring topology.....	680, 682
Unique access to library function blocks (namespace).....	327	Synchronous link status.....	696
Library manager.....	323	Link, Sercos III CrossComm Sercos III Line.....	680
Library menu		Load basic parameters	
Container.....	323	General.....	397
Device-specific reference.....	323	IndraDrive.....	378
Documentation.....	323	Log.....	210
External.....	323	Logger in the runtime system.....	210
Hidden.....	323		
Internal.....	323	M	
Namespace.....	323	M-0-0000, Dummy, M-parameter.....	632
Referenced.....	323	M-0-0001, Logic touch probe number.....	632
Target system-specifically.....	323	M-0-0002, Touch probe name.....	632
Unique access.....	323	M-0-0005, Input selection.....	632
Version.....	323	M-0-0006, Signal selection.....	632
Library repository.....	323	M-0-0007, Control word.....	633
Library version.....	323	M-0-0009, Osci: list of all M-parameters that can be oscilloscoped.....	635
License information on the firmware.....	26	M-0-0010, List of all M-parameters.....	635
Link axis - Context menus		M-0-0016, Project identification number.....	635
Menu items.....	425	M-0-0021, Status word.....	635
Link axis – dialogs		M-0-0024, Command: Activation.....	636
Overview.....	425	M-0-0130, Measured value, positive edge.....	637
Link axis – General information.....	421	M-0-0131, Measured value, negative edge.....	637
Link, CrossComm Sercos III		M-0-0132, Difference value.....	638
Compatibility of different MLC versions.....	680	M-0-0133, Time difference.....	638
Configuration examples.....	702	M-0-0140, Time stamp, positive edge.....	639
Configuration examples, modularly-structured system.....	702	M-0-0141, Time stamp, negative edge.....	639
Configuration examples, rotary printing with two outputs.....	703	M-0-0200, Dead-time compensation, positive edge.....	639
CrossComm Sercos III - Adjusting the acyclically transmitted parameters.....	695	M-0-0201, Dead-time compensation, negative edge.....	639
CrossComm Sercos III - Hot-plug active.....	695	M-0-0202, Starting position of the expectation window, positive edge.....	639
CrossComm Sercos III - Hot-plug canceled during running link.....	695	M-0-0203, End position of the expectation window, positive edge.....	640
CrossComm Sercos III - Hot-plug error.....	695	M-0-0204, Starting position of the expectation window, negative edge.....	640
CrossComm Sercos III - Hot-plug error rbits 0...2.....	695	M-0-0205, End position of the expectation window, negative edge.....	640
CrossComm Sercos III - Link master active.....	695	M-0-0206, Maximum number of marker failures.....	641
CrossComm Sercos III - Phase switching active in link.....	695	M-0-0224, Number of marker failures, positive edge.....	641
CrossComm Sercos III - PLL engaged.....	695	M-0-0225, Number of marker failures, negative edge.....	641
Data of remote axes.....	699	M-0-0401, Input status.....	642
Error Port 1.....	694	M-0-0405, Enabling.....	642
Error Port 2.....	695	M-0-0409, Counter of measured values, positive edge.....	643
Line topology.....	681		
Line topology or ring topology.....	681		
Link device n data valid.....	695		
Link master.....	685		
Link redundancy loss.....	695		
Link slave.....	685		
PLC components.....	691		

M-0-0410, Counter of measured values, negative edge.....	643	MLs-E0C0106.....	569
M-0-0411, Counter of difference values.....	643	MLs-E0C0108.....	569
M-0-1000, Command: Load basic touch probe parameters.....	643	MLs-E0C0110.....	569
M-0-2100, List of all backup operation M-parameters.....	644	MLs-E0C0111.....	569
Max. number of tasks.....	338	MLs-E0C0112.....	570
Memory alignment.....	354	MLs-E0C0113.....	570
Memory organization.....	354	MLs-E0E0002.....	572
ML_AXISDATA_SM.....	381, 383, 385	MLs-E0E0010.....	572
ML_TechInterface.library.....	26	MLs-E0E0011.....	572
ML_TechMotion.library.....	27	MLs-E0E0020.....	572
ML_TechMotionBase.library.....	27	MLs-E0E0021.....	572
MLC XM		MLs-E0F0010.....	571
Create a backup using FirstTouch.....	58	MLs-E0F0011.....	571
Restore a backup using FirstTouch.....	58	MLs-E0F0012.....	571
MLPI connections.....	243	MLs-E0F0013.....	571
MLs-E0A0001.....	562	MLs-E0F0020.....	571
MLs-E0A0002.....	562	MLs-E0F0021.....	571
MLs-E0A0004.....	562	MLs-E0K0001.....	572
MLs-E0A0005.....	562	MLs-E0K0002.....	572
MLs-E0A0010.....	562	MLs-E0K0005.....	573
MLs-E0A0012.....	562	MLs-E0K0006.....	573
MLs-E0A0013.....	563	MLs-E0K0010.....	573
MLs-E0A0014.....	563	MLs-E0K0012.....	573
MLs-E0A0015.....	563	MLs-E0K0013.....	573
MLs-E0A0020.....	563	MLs-E0K0020.....	573
MLs-E0A0021.....	563	MLs-E0K0021.....	573
MLs-E0A0022.....	563	MLs-E0K0022.....	574
MLs-E0A0024.....	563	MLs-E0K0023.....	574
MLs-E0A0030.....	564	MLs-E0K0024.....	574
MLs-E0A0100.....	564	MLs-E0K0025.....	574
MLs-E0A0500.....	564	MLs-E0K0027.....	574
MLs-E0A0501.....	564	MLs-E0K0028.....	574
MLs-E0A0502.....	565	MLs-E0K0029.....	574
MLs-E0A0504.....	565	MLs-E0K0030.....	575
MLs-E0A0505.....	565	MLs-E0K0031.....	575
MLs-E0A0511.....	565	MLs-E0K0032.....	575
MLs-E0A0520.....	565	MLs-E0K0033.....	575
MLs-E0A0521.....	565	MLs-E0K0034.....	575
MLs-E0A0590.....	566	MLs-E0K0035.....	575
MLs-E0A0591.....	566	MLs-E0K0037.....	576
MLs-E0C0001.....	566	MLs-E0K0038.....	576
MLs-E0C0002.....	566	MLs-E0K0039.....	576
MLs-E0C0003.....	566	MLs-E0K0040.....	576
MLs-E0C0004.....	566	MLs-E0K0041.....	576
MLs-E0C0005.....	566	MLs-E0K0042.....	576
MLs-E0C0006.....	567	MLs-E0K0047.....	576
MLs-E0C0007.....	567	MLs-E0K0048.....	577
MLs-E0C0008.....	567	MLs-E0K0049.....	577
MLs-E0C0010.....	567	MLs-E0K0050.....	577
MLs-E0C0014.....	567	MLs-E0K0053.....	577
MLs-E0C0101.....	568	MLs-E0K0054.....	577
MLs-E0C0102.....	568	MLs-E0K0055.....	577
MLs-E0C0103.....	568	MLs-E0L0012.....	578
MLs-E0C0104.....	568	MLs-E0L0020.....	578
MLs-E0C0105.....	569	MLs-E0L0021.....	578
		MLs-E0L0022.....	578
		MLs-E0L0023.....	578
		MLs-E0S0010.....	578

MLs-E0S0012.....	579	MLs-W0S0020.....	590
MLs-E0S0013.....	579	MLs-W0S0021.....	590
MLs-E0S0014.....	579	MLs-W0S0023.....	590
MLs-E0S0015.....	579	MLs-W0S0024.....	591
MLs-E0S0022.....	579	MLs-W0S0200.....	591
MLs-E0S0023.....	580	MLs-W0S0201.....	591
MLs-E0T0001.....	581	MLs-W0S0202.....	591
MLs-E0Y0010.....	580	MLs-W0S0203.....	591
MLs-E0Y0011.....	580	MLs-W0Y0010.....	592
MLs-E0Y0012.....	580	MLs-W0Y0011.....	592
MLs-E0Y0013.....	580	MLs-W0Y0012.....	592
MLs-E0Y0014.....	580	Modes for project editing.....	523
MLs-E0Y0015.....	581	Modes for project editing.....	526
MLs-E0Y0100.....	581	Transition between modes, mode switch- ing.....	526
MLs-E0Y0101.....	581	Monitor task.....	329
MLs-E0Y0102.....	581	Motion configuration validation	
MLs-E0Y0103.....	581	Error messages.....	561
MLs-IOX0001.....	582	Motion functionality.....	519
MLs-IOX0002.....	582	Cycle times.....	519
MLs-W0A0020.....	582	General information.....	519
MLs-W0A0021.....	582	Parameterization level.....	522
MLs-W0A0022.....	583	Parameters.....	520
MLs-W0A0200.....	583	Programmable limit switch.....	644
MLs-W0A0201.....	583	Motion limit values	
MLs-W0A0202.....	583	Virtual axis.....	460
MLs-W0A0203.....	583	Motion tasks according to VDI2143.....	598
MLs-W0A0501.....	584	MotionProfile	
MLs-W0A0502.....	584	IndraDrive.....	471
MLs-W0A0503.....	584	Multi-device.....	244
MLs-W0A0504.....	584	Brief description of the multi-device table....	246
MLs-W0A0510.....	584	Configuration file to disable field bus slaves.....	252
MLs-W0A0511.....	585	Introduction.....	244
MLs-W0A0520.....	585	Multi-device functionality in detail.....	247
MLs-W0A0521.....	585	Multi-device functionality with SafeLogic.....	245
MLs-W0A0522.....	585	Multi-tasking.....	329
MLs-W0A1001.....	585	I/O turn-around times.....	341
MLs-W0A1000.....	585	Task configuration.....	332
MLs-W0C0020.....	586	Task configuration, configuration exam- ples.....	333
MLs-W0C0021.....	586	Task editor.....	335
MLs-W0C0022.....	586	Task list/configuration.....	338
MLs-W0C0023.....	586	Task Viewer.....	340
MLs-W0C0024.....	587	Multicore.....	318
MLs-W0C0109.....	587	Configuration.....	318
MLs-W0C0114.....	587	Control configuration.....	318
MLs-W0C0200.....	587	CPU load.....	318
MLs-W0F0020.....	587	Known problems.....	319
MLs-W0F0021.....	588	Prerequisites.....	318
MLs-W0F0022.....	588	TaskExecutionViewer.....	318
MLs-W0K0001.....	588	Multilingualism IndraLogic XLC/IndraMotion MLC	
MLs-W0K0002.....	588	File management.....	671
MLs-W0K0003.....	588	File structure.....	671
MLs-W0L0020.....	588	Multilingualism XLC/MLCIndraLogic XLC/ IndraMotion MLC.....	671
MLs-W0L0022.....	589	MultilingualismIndraLogic XLC/IndraMotion MLC	
MLs-W0L0023.....	589	Function.....	672
MLs-W0L0024.....	589		
MLs-W0L0026.....	589		
MLs-W0L0027.....	590		
MLs-W0S0013.....	590		

Node names for menu texts	675	Open from task editor.....	336
Node names for Units.....	674	POUs for task.....	336
N		Power supply as PLC device.....	511
Names.....	12	Power supply as PLC device – Configure cyclic data.....	513
Names and abbreviations.....	12	Power supply as PLC device – Parameterization.....	512
Namespace for library.....	323	Power supply as PLC device – PLC programming.....	516
Network settings via the configuration file.....	37	PowerSupply.....	511
Non-object-related information messages.....	582	Priority.....	336
Notes on how to use deactivated and parking axes.....	536	Task.....	336
O		Procedure to convert a cross link of Sercos III MLC 04VRS to Sercos III ≥ MLC 10VRS.....	710
OEM partition.....	24	Procedure to convert cross link Sercos II to cross link Sercos III	
Offline mode.....	523	General information.....	704
Offline parameterization		Remove link axes.....	705
Enable offline parameterization.....	111	Replace function modules.....	706
General information.....	110	Procedure to convert the cross link Sercos II to the cross link Sercos III.....	704
Parameterization via parameter file.....	113	Adapt PLC program.....	709
Settings.....	112	Processing types.....	613
Use cases.....	111	Product phases.....	3
Online mode.....	524	Program call.....	336
Operating strategy.....	110	ProjectData.....	24
Operation mode settings		ProjectData/bundles.....	25
Real axis.....	437	ProjectData/CertificateStore.....	25
Operation mode switches SF1 and LEDs.....	49	ProjectData/PAR.....	25
Oscilloscope connection.....	665	ProjectData/PLC.....	25
Overview on bus addresses.....	196	ProjectData/TMP.....	25
P		ProjectData/Protected.....	24
Parameter adjustment.....	226	Properties.....	277, 361, 389
Adjust.....	227	Purpose of this documentation.....	3
Dialog elements and shortcuts.....	229	R	
General information.....	226	Real axes, HydraulicDrive	
Prerequisites.....	226	Firmware.....	366
Response when disabling offline parameterization.....	228	Real axes, IndraDrive	
Parameter editor.....	222	Firmware.....	365, 366
Parameter editor toolbar.....	223	Function package.....	365, 366
Parameter group.....	224	Real axis - dialogs	
Parameter group toolbar.....	225	Overview.....	373
Parameter overview.....	521	Real axis - general information.....	364
Parameterization level.....	522	Real axis – Context menu	
Parameters - Export.....	231	Menu items.....	376
Parameters - import.....	232	Real axis (IndraDrive).....	364
Parameters – Save parameters in drives.....	230	Real axis (IndraDrive) - Context menu	
Placeholder for library.....	323	Parameters, Load basic parameters.....	378
PLC log.....	210	Parameters, save mode.....	380
PLC logger.....	210	Parameters, save parameters in the drive.....	380
PLC program		Real axis (IndraDrive) - Dialog	
Create.....	321	Dimensional reference - Motor encoder.....	455
PLC programming		Real axis (IndraDrive) – context menu	
General information.....	321	Communication, cyclic Sercos channel.....	380
Pointer addressing.....	355	Real axis (IndraDrive) – Context menu	
Pointer programming.....	354		
POU			
Assign to task.....	336		

Parameter, drive password – Change password.....	379	Save mode.....	380
Reference		Save parameters in drive.....	380
Applications.....	209	Save project.....	110
Referenced libraries.....	323	Scan bus configuration.....	197, 530
Remote support.....	677	Sensitivity	
Connect via internet.....	677	Task watchdog.....	336
Definition of terms and introduction.....	677	Sercos device error messages.....	578
Related documentation.....	677	Sercos device warning messages.....	590
Repository.....	323	Sercos diagnostics.....	192
Response time		Sercos III as PLC device – Configure cyclic data.....	504
Inline I/O.....	127	Sercos III drive as PLC device.....	501
Onboard I/O.....	124	Sercos III drive as PLC device – Parameterization.....	502
Restore.....	59	Sercos III drive as PLC device – PLC parameterization.....	508
Restore device data.....	263	Service hotline.....	713
Restore SYSTEM/OEM/USER (update/install system firmware).....	66	Signal alert symbol.....	5
Rights category		Signal control word.....	384
Access protection.....	303	Signal status word.....	382
Communication protocols.....	300	Signal words.....	5
ContainerLib (for MLPI SDK developers).....	303	Signatures	
E/A.....	302	Applications.....	209
EtherCAT.....	302	Single axis operating modes	
Logic].....	301	Overview.....	539
MLPI / MLPIS connections.....	301	Single axis operation modes	
Motion.....	301	Operation modes.....	540
Network security settings.....	300	Singleton event.....	336
Parameters.....	302	Special motion laws.....	599, 600
Robotics.....	302	Spontaneous control reboot	
System settings.....	300	Error case.....	670
TaskLib (for MLPI SDK developer).....	303	Status information	
TraceLib (for MLPI SDK developer).....	304	Based on command values.....	439
WatchdogLib (for MLPI SDK developer).....	304	based on command values and actual values.....	439
Robot Control		Structure of a project.....	161
Menu structure: Kinematics.....	647	Suggestions.....	12
Robot Control V1 kinematics in compatibility mode.....	155	Support.....	713
Robot Control V2		switch online.....	530
Folder "Robot" – Dialog: Coordinate Off-set.....	662	Symbols.....	6
Folder "Robot" – dialog: Scaling/Units.....	660	Synchronous operating states.....	597
Folder "Robot" – Kinematic dialogs.....	660	SysError	
General information.....	647	Error case.....	669
Robot folder– Axis lengths and couplings dialog.....	660	System overview.....	15
Robot folder– Motion limit values dialog.....	661	Firmware.....	23
Robot-Control		Hardware.....	15
Kinematics – Context menu: Diagnostics.....	658	Software.....	26
Kinematics – Context menu: Initial commissioning.....	658	SYSTEM partition.....	24
Robot-Control V2			
Kinematics – Context menu.....	658	T	
S		Target groups.....	3
Safety error messages.....	580	Target system-specific library.....	323
Safety instructions.....	4	Task configuration	
Safety warning messages.....	592	General information.....	332
		Max. number of tasks.....	338
		Properties.....	338
		Task configuration properties.....	338

Task editor		
Assign POU.....	336	
Configuration dialog.....	336	
General information.....	335	
Max. number.....	338	
Order.....	336	
Task list.....	336	
Task list/configuration.....	242	
Task list/Task Viewer.....	242	
Task monitoring		
General information.....	329	
Task name.....	336	
Task properties.....	336	
Task system.....	329	
CPU load of the control.....	350	
System tasks.....	345	
Template		
Create.....	119	
Toolbar of the control.....	162	
Touch probe.....	496, 624	
Accuracy.....	627	
Data acquisition.....	627	
Expectation window.....	631	
Features.....	625	
Function blocks.....	644	
Functional description.....	625	
Introduction.....	624	
Overview on M-parameters.....	632	
Turn around times		
Profibus, Profinet and Inline I/Os.....	343	
Turn-around times		
Onboard and Fast I/Os.....	344	
Sercos III I/Os.....	343	
U		
Update		
Applications list.....	209	
Update options.....	26	
Update XM backup file after online change.....	61	
User control ID.....	214	
User management on the control.....	281	
USER partition.....	24	
V		
Validate Motion configuration.....	560	
Vendor name.....	212	
Verbund, CrossComm Sercos III		
CrossComm Sercos III - Hot-plug can- celed during running link.....	695	
Version control.....	247	
Version control of control		
PLC connection with version-controlled project.....	309	
Using multi-device configurations.....	309	
Version control of the control.....	308	
Introduction.....	308	
Project management.....	308	
Special features.....	308	
Using controls.....	309	
Version of a library.....	323	
Virtual axis - Dialogs		
Overview.....	394	
Virtual axis – Context menu		
Menu items.....	395	
Virtual axis – General information.....	391	
W		
Warning messages.....	582	
Warnings.....	4	
Watchdog for tasks.....	336	
X		
XM control		
Create backup.....	59	
Restore.....	59	

Notes

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