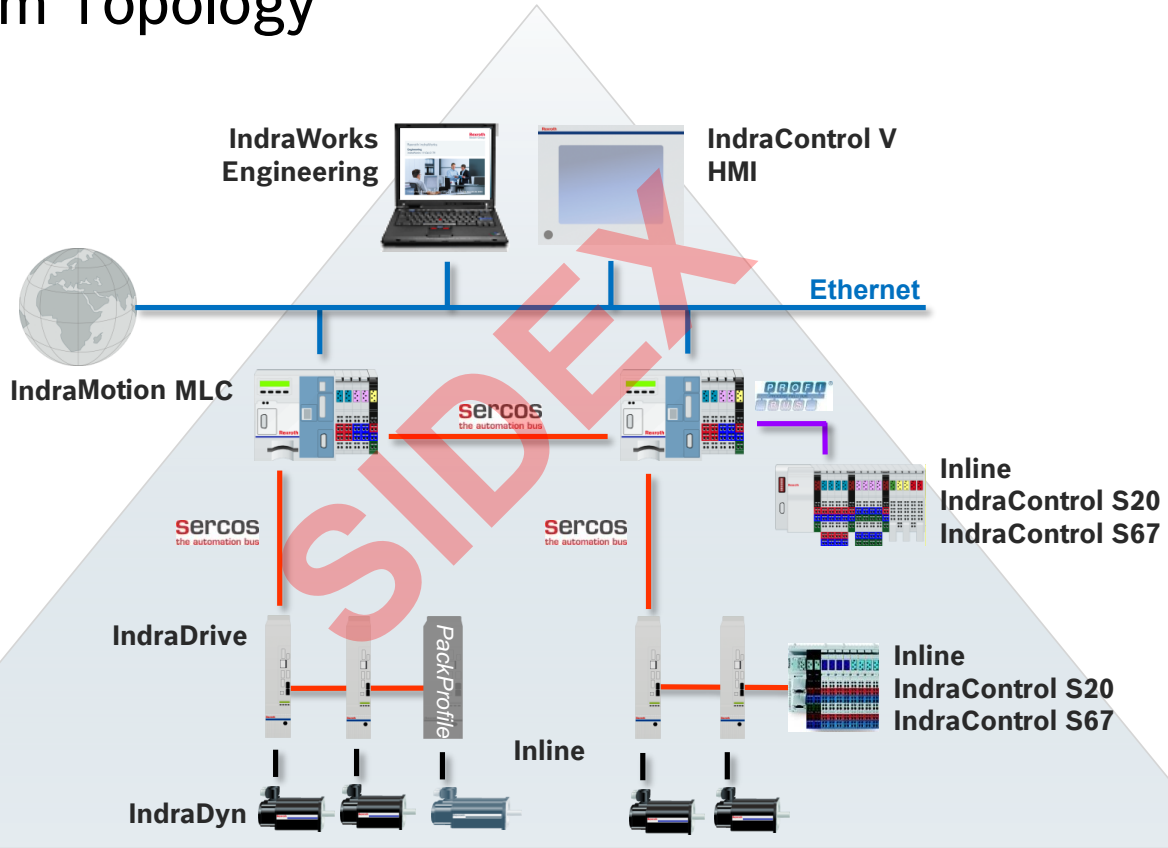# IndraMotion MLC and IndraLogic XLC

1

Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
- Motion Programming Basics
- MLC Diagnosis system
- Sercos – the automation bus
- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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System Topology

Diagram labels: IndraWorks Engineering; IndraControl V HMI; Ethernet; IndraMotion MLC; sercos the automation bus; Inline IndraControl S20 IndraControl S67; IndraDrive; PackProfile; Inline IndraControl S20 IndraControl S67; Inline; IndraDyn; SIDEX

3

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IndraMotion MLC − Hardware platforms

IndraControl L
- Scalable hardware platform L25 − L45 − L65/L75
- Sercos on board
- PROFINET, EtherNet/IP on board
- PROFIBUS on board

IndraControl XM2
- Scalable hardware platform XM21 − XM22
- Sercos on board
- USB Device − Programming interface
- USB Host − Storage
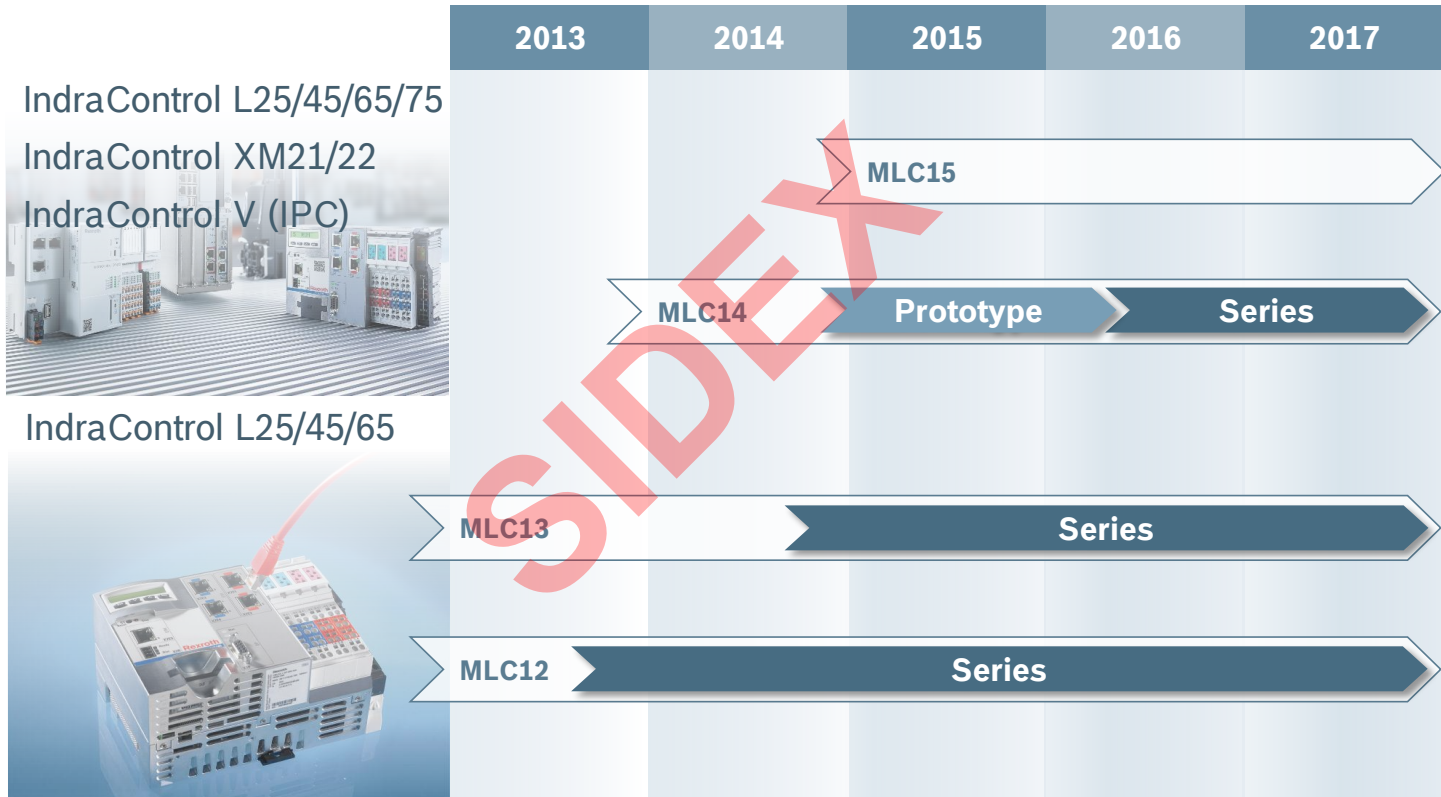- SD card for Backup & Restore

≥ MLC14

IndraControl V
- High-performance IPC platform using Core i7
- Parallel operation of Windows and RTOS VxWorks
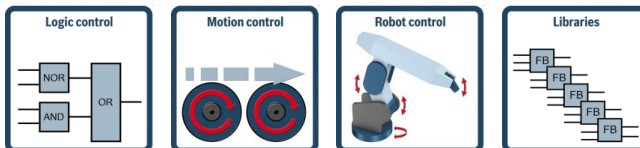- Extension modules for Sercos, PROFINET, EtherNet/IP und PROFIBUS

≥ MLC14

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IndraMotion MLC − Product status

	2013	2014	2015	2016	2017

IndraControl L25/45/65/75
IndraControl XM21/22
IndraControl V (IPC)

MLC15

MLC14 — Prototype — Series

IndraControl L25/45/65

MLC13 — Series

MLC12 — Series

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IndraMotion MLC

- Complete and universal automation system for all Motion Control applications

- Motion Control – efficient Motion kernel for ELS synchronization of up to 64 axes

- Robot Control – Robot kernel for movements in 3D and belt synchronization

- Technology function blocks – toolbox solutions for e.g. packaging, printing and handling

- Motion Control for hydraulic axes

Logic control | Motion control | Robot control | Libraries

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
Functions for Motion Control (selection)

Logic control
according to IEC 61131-3 with extensions

PLCopen
Standardized function blocks for Motion Control

AxisInterface
Easy Motion programming

GAT
Template based programming

Electronic gears

Electronic cams

FlexProfile

Real master axes
Encoder axes

Virtual master axes

Multi-axes synchronization
Electronic Line Shafting

Cross communication
Link axes

Master axes cascading

Positioning

Linear interpolation

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Technology function blocks (selection)

Libraries

Icon	Function
Loop control	**Sag Control**
Tension control	**Tension Control**
Cross cutter	**Cross Cutter**
Handling	**Handling** Interpreter for PTP multi-axes coordination
Temperature control	**Temperature Control**
PLS	**High Speed Cam Switches**
Winder	**Winder Toolbox** Functions for dancer, diameter, tension

Icon	Function
Flying shear	**Flying Shear**
Print mark registration	**Print Mark Registration**
Register control	**Color Register Control**
Adjusting	**Manual Axis Positioning (Jog)** Incremental, continuous
Measuring wheel	**Measuring Wheel**
Touch probe	**Touch Probe**
Two-level control	**Two-point Control**

Icon	Function
PID controller	**PID Control**
Crank kinematics	**Crank Cinematic**
Cross seal	**Cross Sealing**
No Product – No Cycle	**CamLock**
SmartBelt	**Smart Belt**
MagicBelt	**Magic Belt**

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Platform IndraControl L

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Control Portfolio − IndraControl L

Platform	L25	L45	L65	L75
Drive interface	Sercos III	Sercos III	Sercos III	Sercos III
Max. axis number	16	32	64	64
Cycle time	2 ms / 1 ms	1 ms / 1 ms	0.5 / 0.25 ms	0.5 / 0.25 ms
Max. number of function modules	2	4	4	4
Onboard IO	☒	8I/8O	8I/8O	8I/8O
C2C	FM Sercos III	FM Sercos III	FM Sercos III	FM Sercos III
EtherNet/IP Scanner/Adapter	with FM	☑ / ☑	☑ / ☑	☑ / ☑
PROFINET IO Contr./Device	with FM	☑ / ☑	☑ / ☑	☑ / ☑
PROFIBUS Master/Slave	with FM	☑ / ☑	☑ / ☑	☑ / ☑
Robot Control	☑	☑	☑	☑

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IndraControl L25

Display

FM bus for
Function modules

Ethernet interface

Ready contact
with status LED

1 GByte CF
3 Partitions

Sercos
Drives + I/O

Connector for
supply voltage

Local Inline IOs

Up to 16 axes

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IndraControl L45/L65/L75

Display

Option:
8/16 MB SRAM

FM bus for
function modules

Ethernet interface

Ready contact
with status LED

1 GByte CF
3 Partitions

PROFINET IO
EtherNet/IP

Sercos
Drives + I/O

Onboard I/O
8I/8O

Local Inline IOs

Connector for
supply voltage

PROFIBUS DP
Master/Slave

*Up to
32/64 axes*

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IndraControl Lx5 − Display

- 8-digits display with 4 keys

- Display of diagnosis and status information

- Additional information with regards to hardware and installed firmware:

  - Material number

  - Type code

  - Hardware index

  - Serial number

  - Firmware version

  - etc.

- Network Settings

- Load base parameters

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IndraControl Lx5 − Display

Power On

Boot sequence of MLC

BOOT1.01

⋮

BOOT6.xx

Standard display

BB STOP

Axis1

F2004034 …

F50B0002 …

Ethernet Menu

Ethernet		IP Adresse: 192 …		IP 192.
Subnet-Maske:		19;168.
Gateway-Adr.:		16;250.
MAC-Adr.: 00:		25;253
Übernehmen …	Kommando fertig	OK: ?
		Ethernet

Down ⇩   ⇧ Up

Enter ⇨

Esc ⇦

Device Info Menu

Geräte Info		Firmware	CML65s-MLC …
		OHC Lüfter:	0.49 h
		OHC Steuerung:	395.84 h
		Temperatur:	+ 41.0 C
		Seriennummer:	SN: 47114712
		Index:	313
		Type Code:	CML65.1-3P-504 …
		Materialnummer:	R911170899

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IndraControl Lx5 − Display

Ethernet ⇄ IP Address: 192 … ⇄ IP= 192. ⇨

192.168. ⇨

Subnet Mask: … ⇄ 168.250. ⇨

250.253 ⇨

Gateway Addr.: … ⇄ OK: ?

MAC-Addr.: 00: …

Apply … ⇨ Command ready

Ethernet

| Enter ⇨ |
| Esc ⇦ |
| Down ⇩ |
| Up ⇧ |

After modification of the network parameters, the network settings can be validated by the command „Apply IP configuration". As a result the new settings are effective immediately and no restart of the control is required!
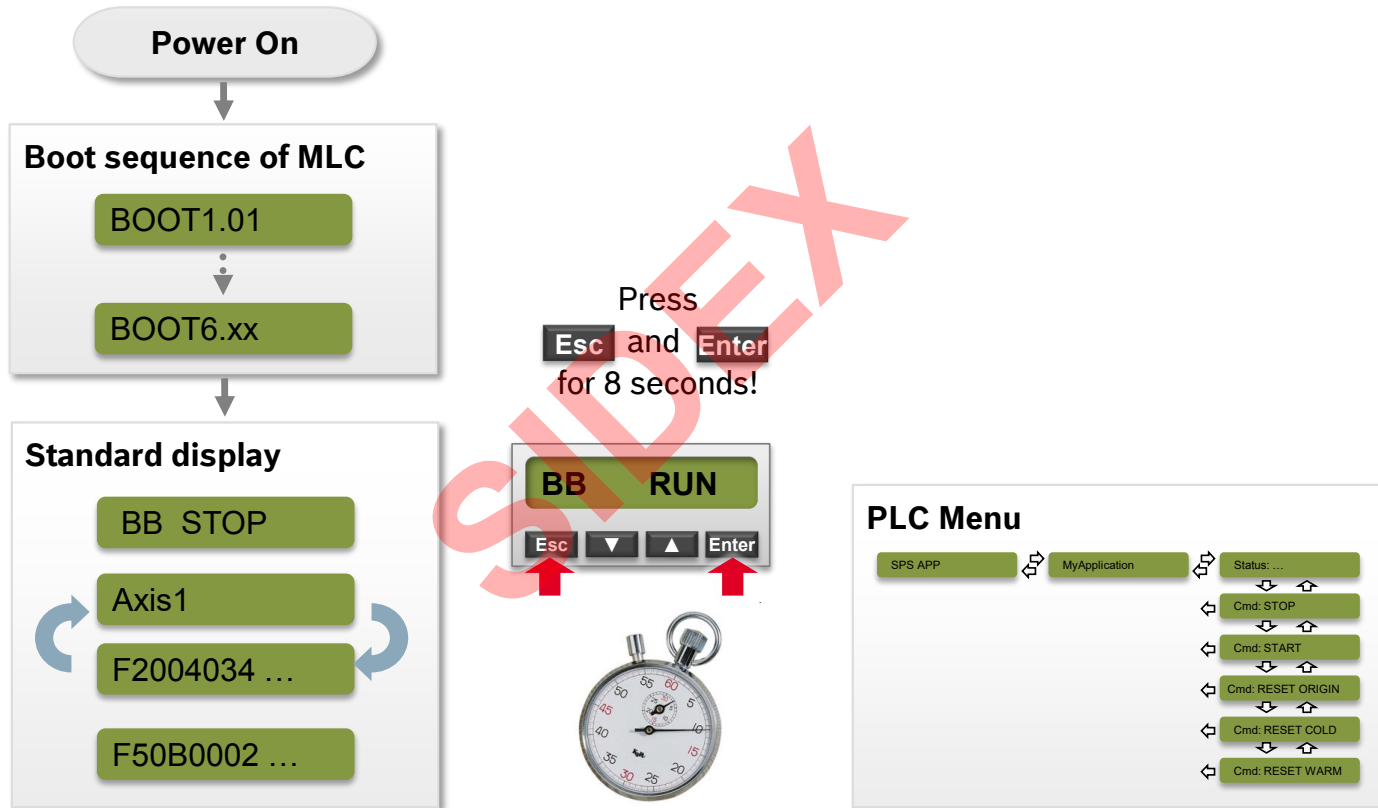
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IndraControl Lx5 − Display

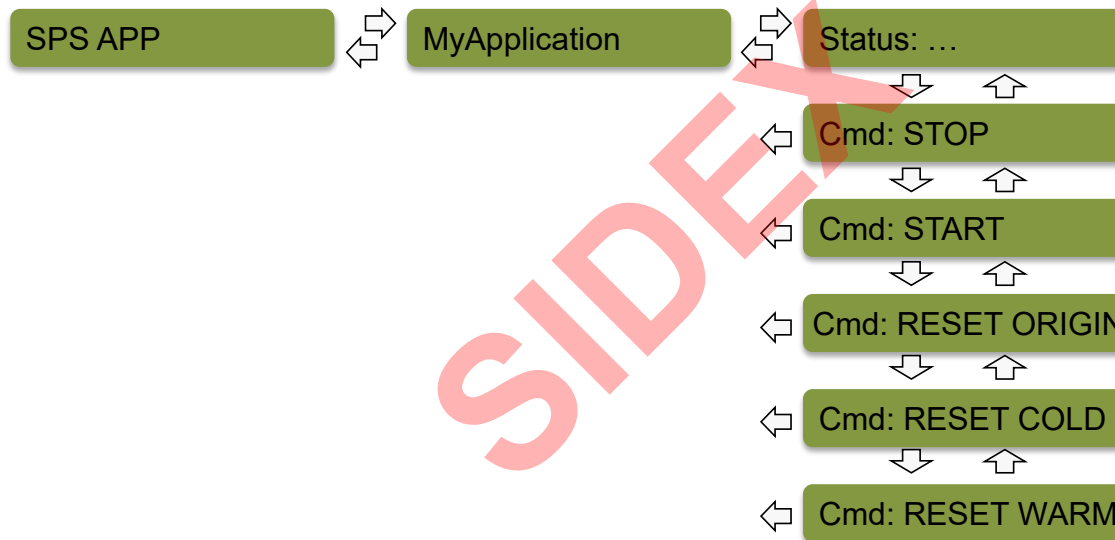| Device Info	⇄	Firmware	CML65s-MLC …
		OHC Fan:	0.49 h
		OHC Control:	395.84 h
		Temperature:	+ 41.0 C
		Serial Number:	SN: 47114712
		Index:	313
		Type Code:	CML65.1-3P-504 …
		Material number:	R911170899

⇨ Enter
⇦ Esc
⇩ Down
⇧ Up

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IndraControl Lx5 − Display

Power On

Boot sequence of MLC

BOOT1.01

BOOT6.xx

Standard display

BB STOP

Axis1

F2004034 …

F50B0002 …

Press
Esc and Enter
for 8 seconds!

BB   RUN

Esc ▼ ▲ Enter

PLC Menu

SPS APP → MyApplication → Status: …

Cmd: STOP

Cmd: START

Cmd: RESET ORIGIN

Cmd: RESET COLD

Cmd: RESET WARM

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IndraControl Lx5 − Display

SPS APP	⇄	MyApplication	⇄	Status: …

```
SPS APP  ⇄  MyApplication  ⇄  Status: …
                                 ⬇ ⬆
                              Cmd: STOP
                                 ⬇ ⬆
                              Cmd: START
                                 ⬇ ⬆
                              Cmd: RESET ORIGIN
                                 ⬇ ⬆
                              Cmd: RESET COLD
                                 ⬇ ⬆
                              Cmd: RESET WARM
```

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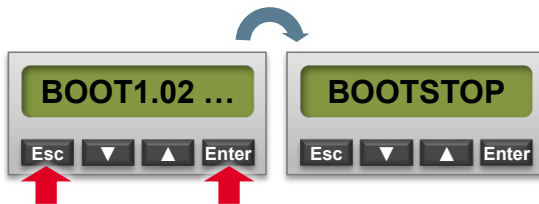Sidex Suministros, S.L: Polígono Industrial El Tiro, s/n. 30100 Murcia. Teléfono: 968 306 000. E-mail: info@sidex.es

IndraControl Lx5 − Load Base Parameters

- During the boot sequence (after display of „BOOT1.01") press the keys `Esc` and `Enter` simultaneously (keep pressed!) until „BOOTSTOP" is displayed:
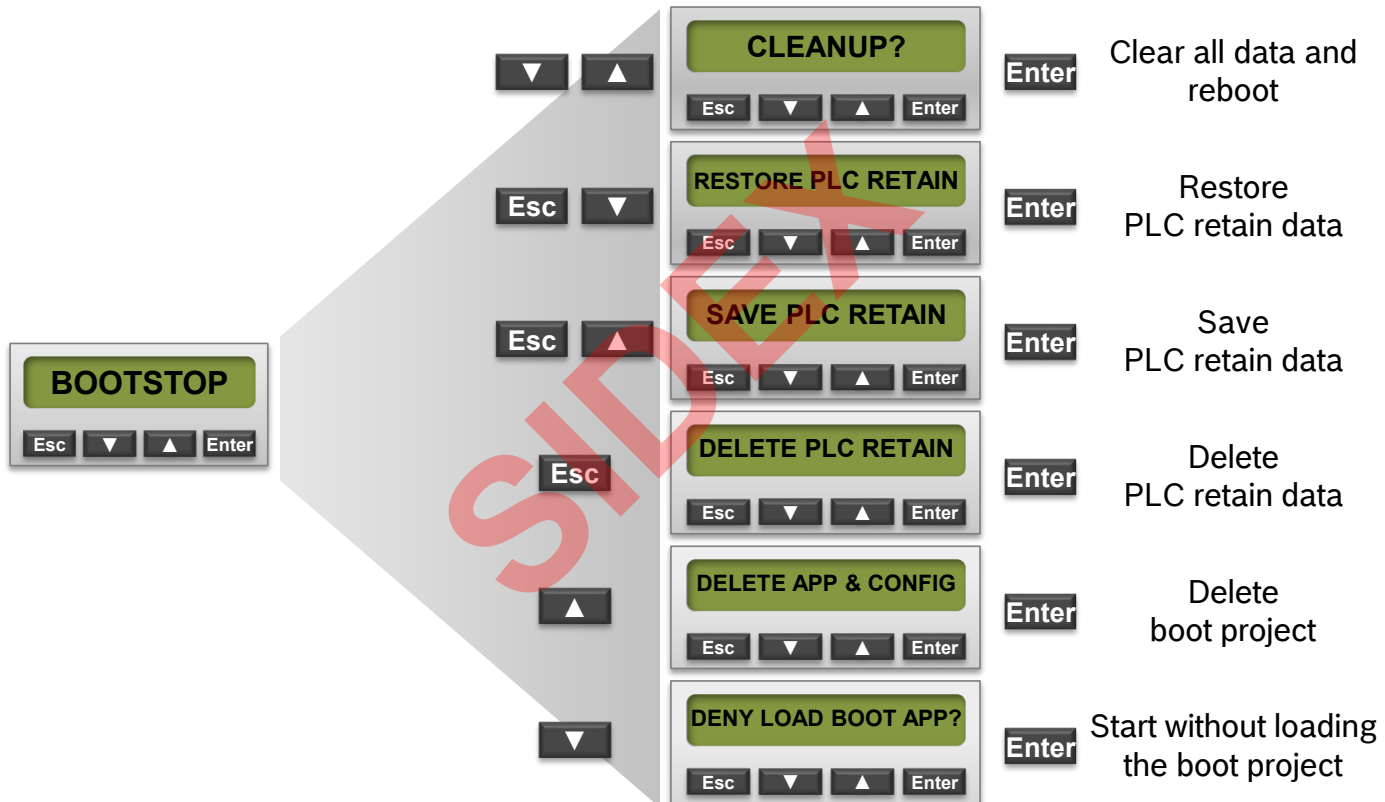
BOOT1.02 …	BOOTSTOP
Esc ▼ ▲ Enter	Esc ▼ ▲ Enter

- Press keys `▼` and `▲` simultaneously and confirm by pressing the key `Enter`

BOOTSTOP	CLEANUP?	CLEANUP	SUCCESS	REBOOT
Esc ▼ ▲ Enter	Esc ▼ ▲ Enter	Esc ▼ ▲ Enter	Esc ▼ ▲ Enter	Esc ▼ ▲ Enter

- As a result all data on the control is cleared and the control reboots!

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IndraControl Lx5 − Bootstop Menu

Menu	Action
CLEANUP? — Esc ▼ ▲ Enter	Enter → Clear all data and reboot
RESTORE PLC RETAIN — Esc ▼ ▲ Enter	Enter → Restore PLC retain data
SAVE PLC RETAIN — Esc ▼ ▲ Enter	Enter → Save PLC retain data
DELETE PLC RETAIN — Esc ▼ ▲ Enter	Enter → Delete PLC retain data
DELETE APP & CONFIG — Esc ▼ ▲ Enter	Enter → Delete boot project
DENY LOAD BOOT APP? — Esc ▼ ▲ Enter	Enter → Start without loading the boot project

BOOTSTOP — Esc ▼ ▲ Enter

Navigation: ▼ ▲ | Esc ▼ | Esc ▲ | Esc | ▲ | ▼

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Platform IndraControl XM

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Control Porfolio − New Platforms

Platform	XM21	XM22	IPC
Drive interface	Sercos III	Sercos III	Sercos III (EM)
Max. axis number	40	32	99
Cycle time	2 ms / 1 ms	1 ms / 0,25 ms	0.5 ms / 0.25 ms
Max. number of function modules	3	3	4
Onboard IO	☒	☒	☒
C2C	EM Sercos III	EM Sercos III	EM Sercos III
EtherNet/IP Scanner/Adapter	with EM	with EM	with EM
PROFINET IO Contr./Device	with EM	with EM	with EM
PROFIBUS Master/Slave	with EM	with EM	with EM
Robot Control	☑	☑	☑

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IndraControl XM2 − Technical data

- Processor:
  - XM21:   E620T 600 MHz
  - XM22:   E660T 1300 MHz

- Main memory: 512 MB RAM

- Flash (internal): 1GB

- Retain memory: 64 kByte (PLC)
                 64 kByte (Motion)

- Performance:
  - XM21:   ≈ CML45
  - XM22:   ≈ CML65

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IndraControl XM2 − Interfaces & operating elements

Sercos
Drive comms, IOs

Ethernet
Engineering, HMI

USB host

Power connector

Reset button
(recessed)

USB device
(Engineering)

Diagnosis LEDs

Mode selector

Slot for SD card

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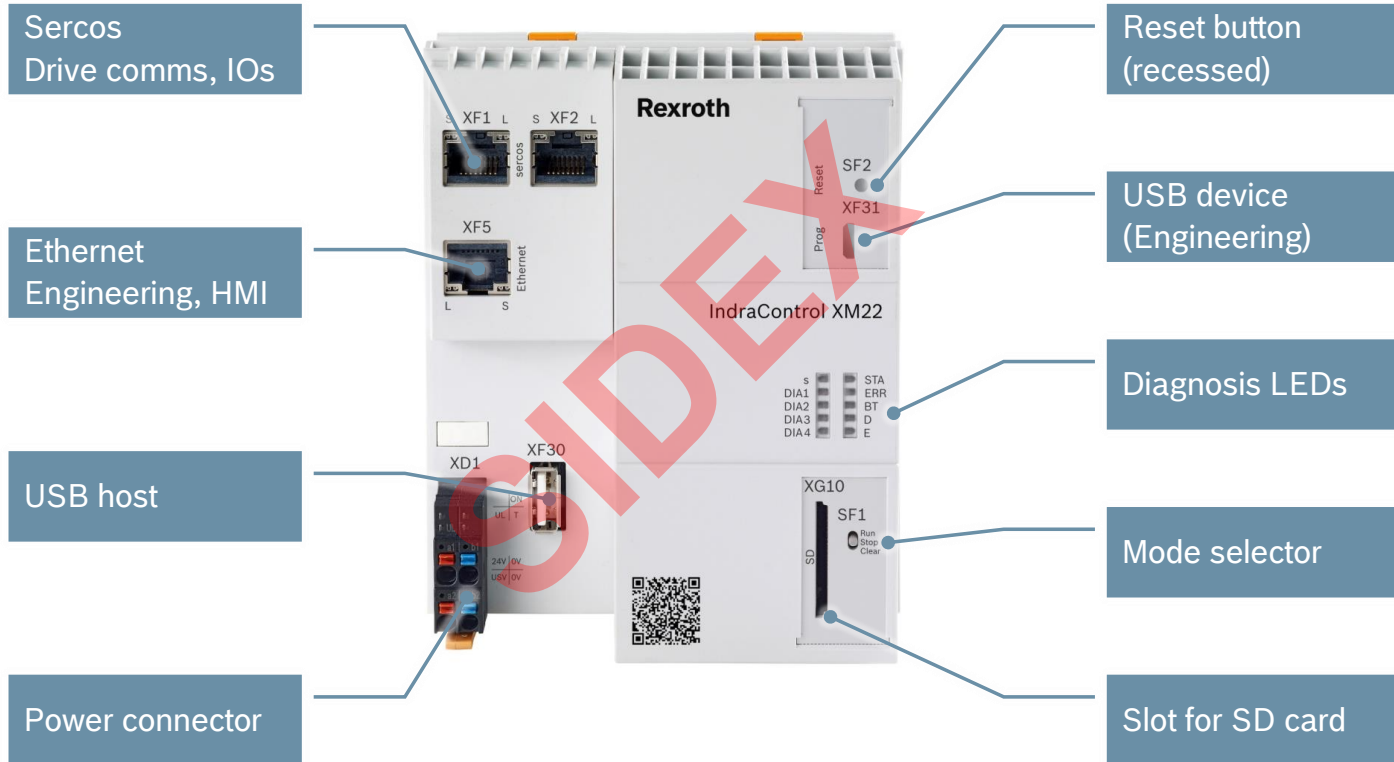
IndraControl XM21/22 − Diagnosis LEDs

Sercos State

Feedback
SF1 switch

System
diagnosis

Currently
booting

s
DIA1
DIA2
DIA3
DIA4

STA
ERR
BT
D
E

RUN / STOP

Warning/
Error

Booting
status

Diagnosis
S20 bus

Warning/Error
S20 modules

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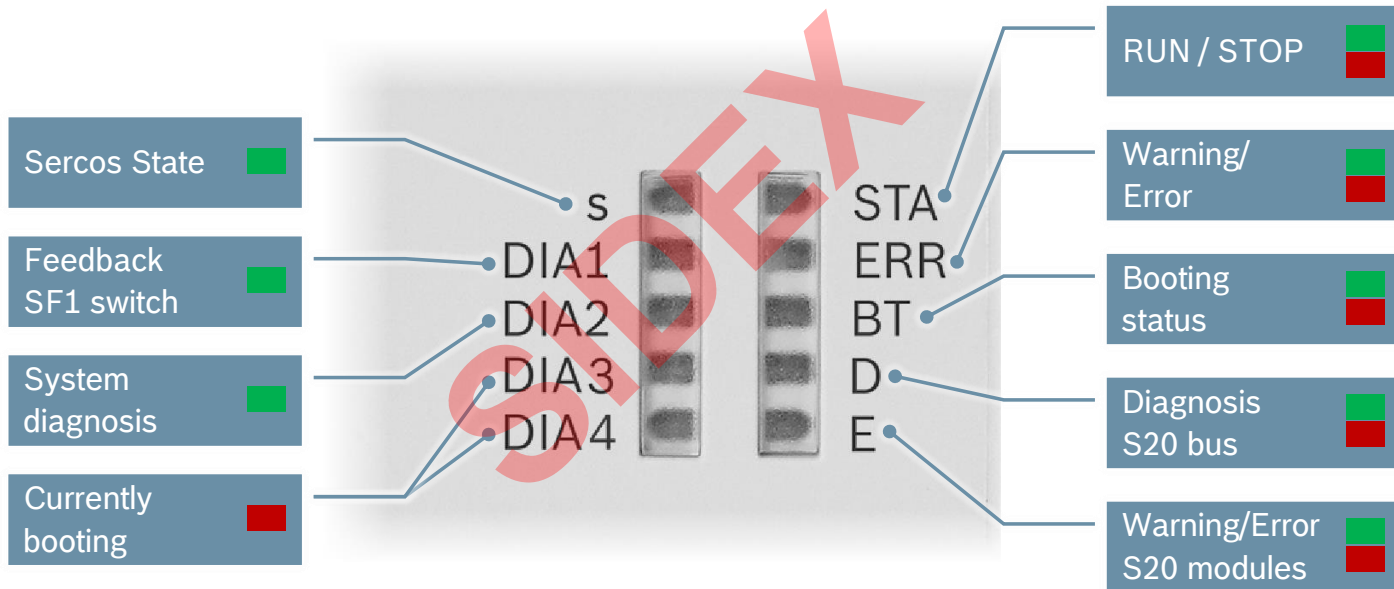
IndraControl XM2 − Delivery status

- Out-of-the-box there is only an **initial firmware** on the control

- The system firmware has to be downloaded to the control during the commissioning

- This can be achieved either with the web-based tool *FirstTouch* or from *IndraWorks*

- Standard IP address: **192.168.1.1**

- Restoration of the delivery status, or recovery of the default network settings can be done via switches SF1 and SF2

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IndraControl XM2 − Delivery status

- LEDs **DIA3** and **DIA4 blinking red** (alternating)
  → Initial firmware is active
- LED **E** permanently **green**
  → Web-Server for FirstTouch is active
- ☞ Use of FirstTouch to adjust the network settings
- ☞ Download of system firmware with FirstTouch
  or from IndraWorks

s   STA
DIA1   ERR
DIA2   BT
DIA3   D
DIA4   E
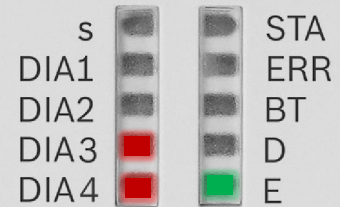
- Press button SF2 > 5 seconds
- LEDs **DIA3** and **DIA4** blinking red (alternating)
  → Initial firmware is active
- LED **E** permanently **red**
  → Menu is active
- ☞ Reset network parameters
- ☞ Reset Username & password
- ☞ Restore delivery status

SF2
XF31
Prog

s   STA
DIA1   ERR
DIA2   BT
DIA3   D
DIA4   E

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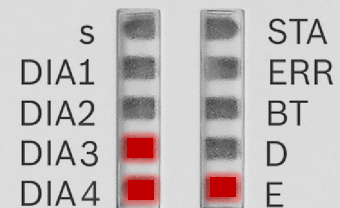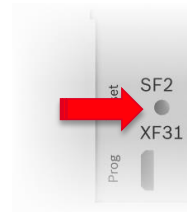
IndraControl XM2 − First Touch

Enter IP address of IndraControl XM

User: boschrexroth
Password:boschrexroth

Login

Enter IP address of IndraControl XM and login with user *boschrexroth* plus password *boschrexroth*!

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IndraControl XM2 − First Touch

Hardware Info

File Transfer

Network Settings

Firmware Management

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IndraControl XM2 – FirstTouch

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IndraControl XM2 − Menu of initial firmware

Press SF2 longer than 5 seconds

Push down SF1 for a short time → Next menu entry

Push down SF1 longer than 3 seconds → activate operation
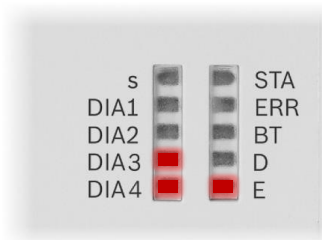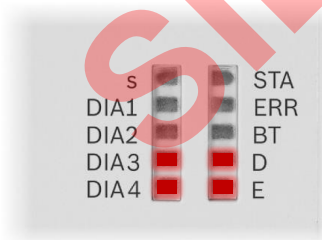
Start FirstTouch   **Restore default network settings**   **Clear username and password**   **Restore factory settings**
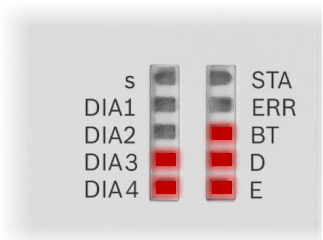
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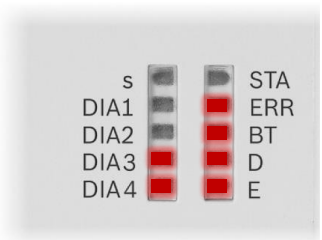
IndraControl XM2 − Restore Factory Settings

Press SF2 at least for 5 seconds

Use switch SF1 in order to select operation "Restore Factory Settings"

Push down SF1 at least for 3 seconds

Confirm operation by switching SF1 to the upper position (Run)

Factory settings are restored

Reboot of IndraControl XM

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IndraControl XM2 − Scalable Firmware

IndraControl L

IndraLogic XLC

| PLC | MOT | OCI | OPC UA |

IndraMotion MLC

| PLC | MOT | OCI | OPC UA |
| TEC | ROCO | HYD | |

Technology Libraries | RCE | RCA | TCE |

Fix range of functions

IndraControl XM

IndraMotion MLC

PLC

MOT

| TEC | ROCO | HYD | OPC UA |
| RCE | RCA | TCE | OCI |

Technology Libraries

Scalable range of functions

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Bosch Group

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IndraControl XM2 − Functional Packages

Functional package	Name	Description	Prerequisites
PLC	Programmable Logic Control	PLC runtime system compliant to IEC 61131 (IndraLogic 2G)	-
MOT	Motion	Single axis movements and synchronized operation motion of several axes	PLC
TEC	Technology	PLC function blocks for multiple technology functions	PLC, MOT
ROCO	Robot Control	Kinematics (Scara, Delta, Cartesian, ...) and axis transformation for robot control	PLC, MOT
HYD	Hydraulics	Centralized control for hydraulic axes	PLC, MOT
OPC UA	OPC UA	OPC UA server in IndraMotion MLC	PLC
OCI	Open Core Interface	API for high level language programming	PLC

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Bosch Group

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IndraControl XM2 − Functional Packages

R911345728 – XM2100.01-01-31-31-001-NN-108N3NN *

1 x IndraControl XM + 1 x suitable bus socket module + 1 x License sheet for ordered Functional packages

Rexroth
Made in Germany

TYP: XM2100.01-01-31-31-001-NN-108N3NN (7261)
MNR: R911345728 A1
FD: 13W08 IP20
I-V-C-B-T-V
Uɴ DC 24 V
Iɴ 0,6 A

XF5 MAC: 00.60.34.01.D6.CF

Bosch Rexroth AG, 97816 Lohr, Germany

SN: 7260007123456789BC

C UL US LISTED
IND.CONT.EQ 17YB

Fig.: Type code

Configurable features

▪ **CPU variety**
  ○ XM21 or XM22

▪ **Extensibility with extension modules**
  ○ Bus socket module

▪ **Range of firmware functions**
  ○ Functional packages

Each configuration has a unique material number and type code

* Example for a feasible configuration

35

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IndraControl XM2 − License sheet

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Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
- Motion Programming Basics
- MLC Diagnosis system
- Sercos – the automation bus
- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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IndraWorks − Supported operation systems

Rexroth
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Agenda

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Engineering Workflow

```
Create empty project
        ↓
Add MLC or XLC to project
        ↓
Scan Sercos bus configuration
        ↓
Add virtual axes
        ↓
Setup control parameters
(e.g. adjust time, select language)
        ↓
Configure axes
(Scaling, Motion limit values etc.)
        ↓
Create IO configuration
        ↓
Programming
```

Alternative: offline configuration

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Engineering with IndraWorks

Selection of devices by drag & drop
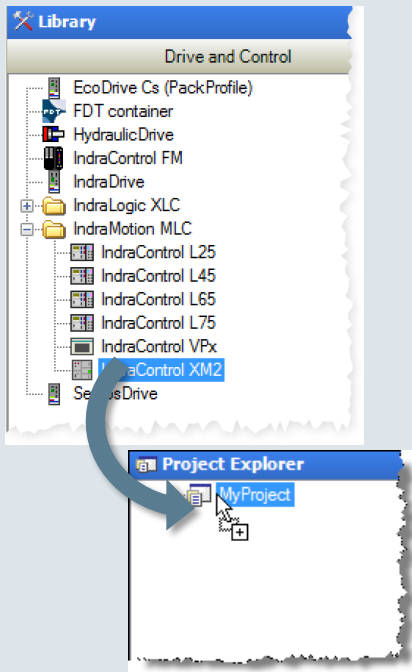
Parameterization through wizards
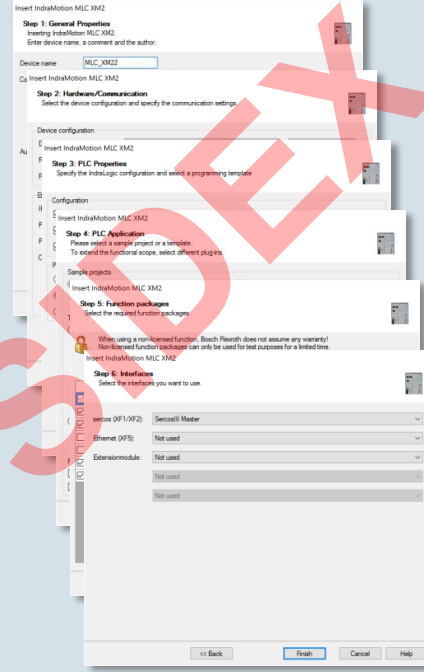
Automatic generation of program data

Control parameters

Drive parameters

IndraLogic elements

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Parameterization through wizards

Insert IndraMotion MLC XM2

Step 1: General Properties
Inserting IndraMotion MLC XM2.
Enter device name, a comment and the author.

Device name   MLC_XM22

Comment   <Please enter your comment here!>

Author   Joachim

Select Template...

Next >>   Cancel   Help

Enter device name

Comment
(tooltip in project explorer)

User name can be modified

Push "Next" button

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Parameterization through wizards

Insert IndraMotion MLC XM2

Step 2: Hardware/Communication
Select the device configuration and specify the communication settings.

Device configuration

Device type:	IndraMotion MLC XM2	XM2s00.01-01
Firmware version:	MLC14VRS	
Firmware release:	FWA-XM2sss-MLC-14V10	

Ethernet communication

IP address: 192.168.1.1

PLC gateway: localhost

PLC communication: ○ TCP   ○ UDP

Connection test:
Communication test to control successful:
  Firmware: XM2sss-MLC-14V10.0467.005
  Device name: Control name
  Author: --

PLC communication successful:
  Address: 192.168.1.1

Execute

<< Back   Next >>   Cancel   Help

- Select appropriate firmware version
- Enter IP address
- Execute Connection Test
- Connection Test OK!
- Push "Next" button

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Parameterization through wizards

Insert IndraMotion MLC XM2

Step 3: PLC Properties
Specify the IndraLogic configuration and select a programming template

Configuration
- ☑ Secure online mode
- ☑ Check array accesses
- ☑ Transmit PLC sources together with the boot application

PLC programming templates
- ○ Standard   Programming language: ST
- ◉ GAT Wizard
- ○ Empty

[<< Back] [Next >>]   [Cancel] [Help]

Activate or deactivate Secure online mode

Check of array indexes at runtime of PLC program

Download PLC sources (for Online compare)

Select favorite IEC language

GAT Wizard offers different templates

Push "Next" button

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Parameterization through wizards

Sample projects
AxisInterface or GAT^{compact}

Template
GAT^{central} or GAT^{decentral}

User-defined GAT or
OMAC PackML

Select appropriate
Plugins

Push "Next" button

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Parameterization through wizards

Insert IndraMotion MLC XM2

Step 5: Function packages
Select the required function packages.

When using a non-licensed function, Bosch Rexroth does not assume any warranty!
Non-licensed function packages can only be used for test purposes for a limited time.
Purchase a full license (see Function Description) in case of permanent use of the function package!

Order the license of the function packages at Bosch Rexroth.

	Function package
☑	Programmable Logic Control
☑	Motion
☑	Technology
☐	Robot Control
☐	Hydraulics
☑	OPC UA
☑	Open Core Interface

Material number	Type Code
R911342837	FWS-XM2100-MLC-NNVRS-NN-PLC-00
R911344243	FWS-XM2200-MLC-NNVRS-NN-PLC-00

Description:
PLC runtime according to IEC 61131-3 3rd Edition

<< Back | Next >> | Cancel | Help

Select appropriate Function package

Required license for selected Function package

Description of selected Function package

Push "Next" button

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Parameterization through wizards

Insert IndraMotion MLC XM2

Step 6: Interfaces
Select the interfaces you want to use.

sercos (XF1/XF2): SercosIII Master

Ethernet (XF5): Not used

Extensionmodule: Not used

Not used

Not used

[<< Back] [Finish] [Cancel] [Help]
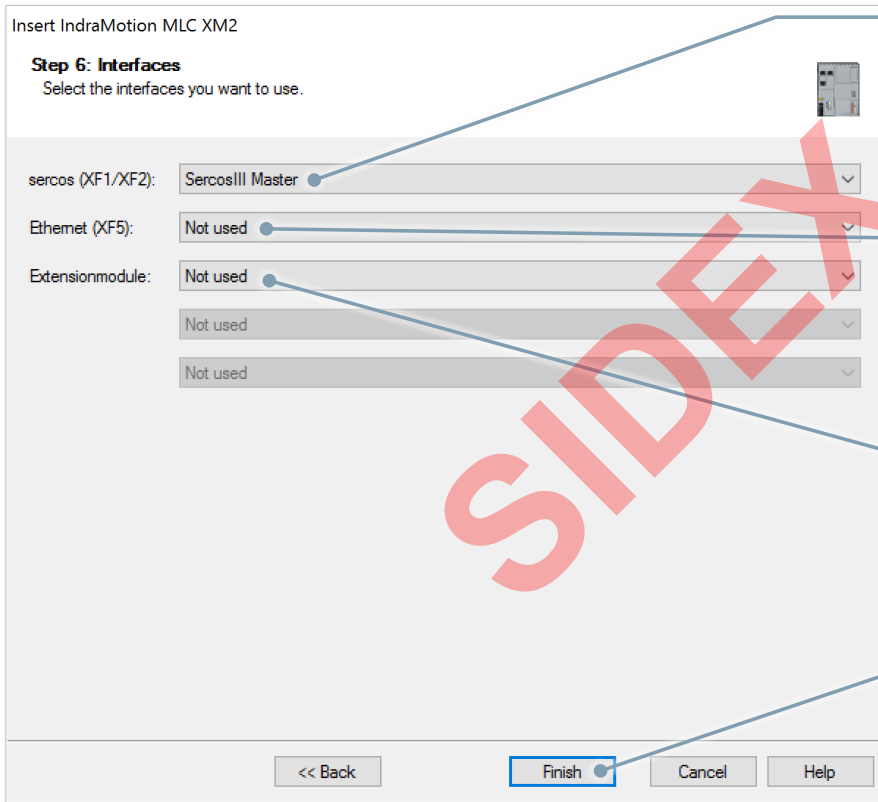
Enable or disable Sercos

Enable or disable
EtherNet/IP adapter

Up to 3
Extension modules

Press "Finish" button to
add MLC to project

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MLC Firmware Management

Firmware files are located in the folder
C:\Program Files (x86)
…\Rexroth\IndraWorks\MLC\Firmware

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MLC Firmware Management

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MLC Firmware Management

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MLC Firmware Management

Press "Download"

Progress indicator

Download complete!

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Scanning of Sercos Devices

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Scanning of Sercos Devices

Sercos devices in project

Detected Sercos devices

With "Add Devices" all selected devices will be added to the project

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Scanning of Sercos Devices

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Scanning of Sercos Devices

„Identify device visually" results in a flashing at the IndraDrive or the IO node

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Remote Address Assignment

Modified Sercos address

Address assignment

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Scanning of Sercos Devices
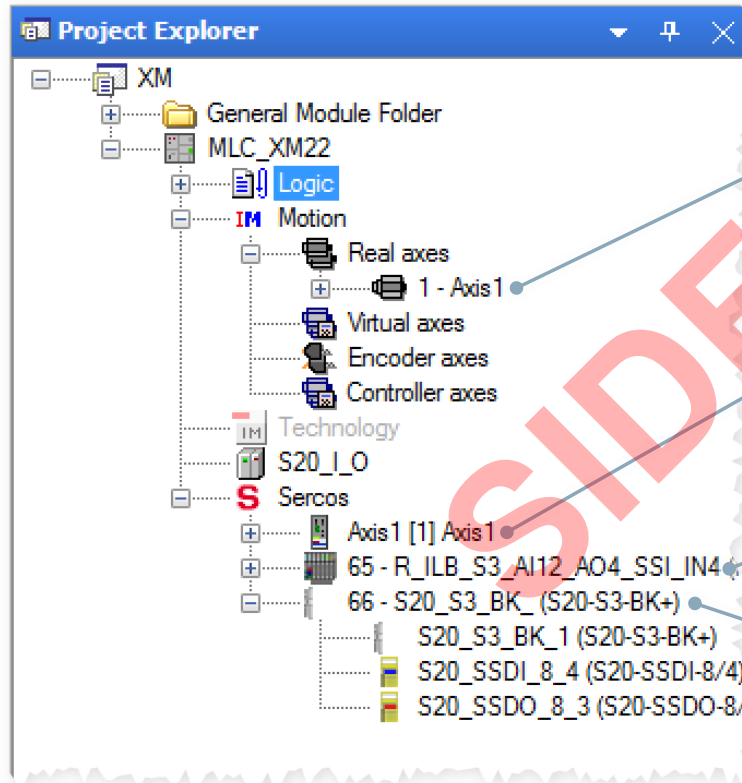
Drives are added to the Real Axes folder (logical view)

Drives are added to the Sercos folder (physical view)

Sercos IOs also are added to the Sercos folder

Modular Sercos slaves are added including additional modules

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Remote address assignment

- Why?
  - Address assignment for devices without address switch (e.g. Sercos IO modules)
  - Better usability by centralized assignment from IndraWorks

- The topology address corresponds to the position in the ring
- Visualization of all devices in ascending order in a table form
- The Sercos address can be modified

Topology Address	1	2	3	4	5
Sercos Address	1	3	2	4	20

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Remote address assignment

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Remote address assignment

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Remote address assignment

New setting is effective!

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Sercos Configuration

New handling of Sercos Configuration with MLC14

- Motion devices are applied to the control while downloading the Motion configuration

- PLC devices are applied to the control upon login

- If the control detects a misconfiguration, it is reported via the error/diagnostic memory

- In addition, the dialog "Sercos Configuration" displays, whether the configuration matches the connected devices as well as the differences

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IndraWorks – Tool Bars

Switch Online/Offline,
Create archive or Restore archive
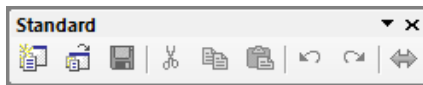
Create/Open/Close/Save project,
Undo etc.

MLC Device Status/Warnings/Errors,
Clear Errors

IndraLogic Login / Logoff, Start / Stopp etc.
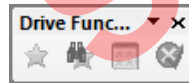
Parameter Editor, Parameter Groups,
IDN search

Switch Sercos Phase

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IndraWorks – Tool Bars

XLC/MLC-Info

192.168.250.253

Clear Errors

Show Errors

Show Warnings

Show Device Status

Open Parameter Editor

Switch MLC/XLC Offline

Compare Motion Configuration

Download Motion Configuration

Switch MLC/XLC Online

IP address of MLC

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IndraWorks – Add virtual axis

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IndraWorks – Edit, Duplicate, Add, Remove axis

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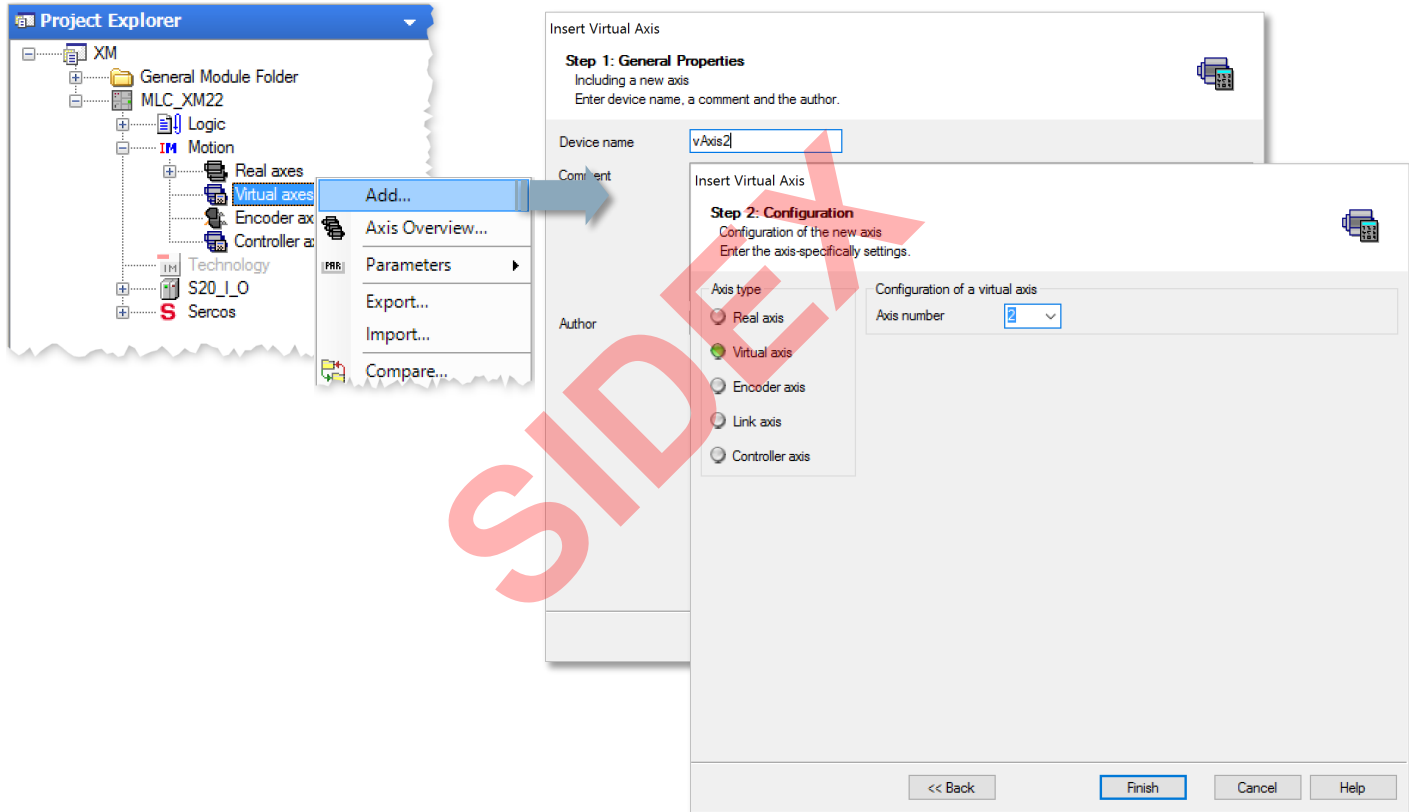
IndraWorks − Edit, Duplicate, Add, Remove axis

- Axis Overview displays all axes of the system
- Axis characteristics can be modified
- Axis can be duplicated, added or removed

Add, duplicate or remove an axis

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IndraWorks − Project Explorer

IndraLogic Programming

Motion Configuration
(real, virtual axes etc.)

Local S20 IOs

Sercos bus configuration

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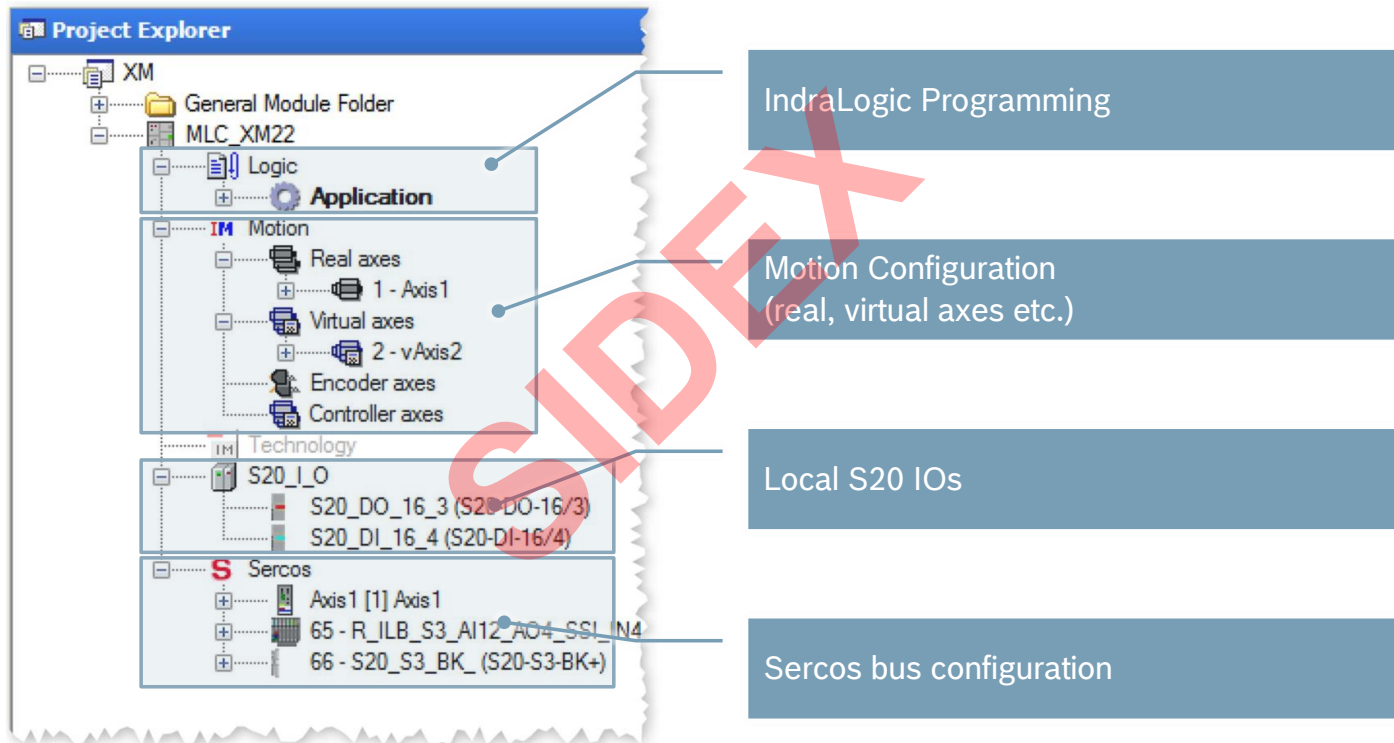
IndraWorks − Registers in Project Explorer

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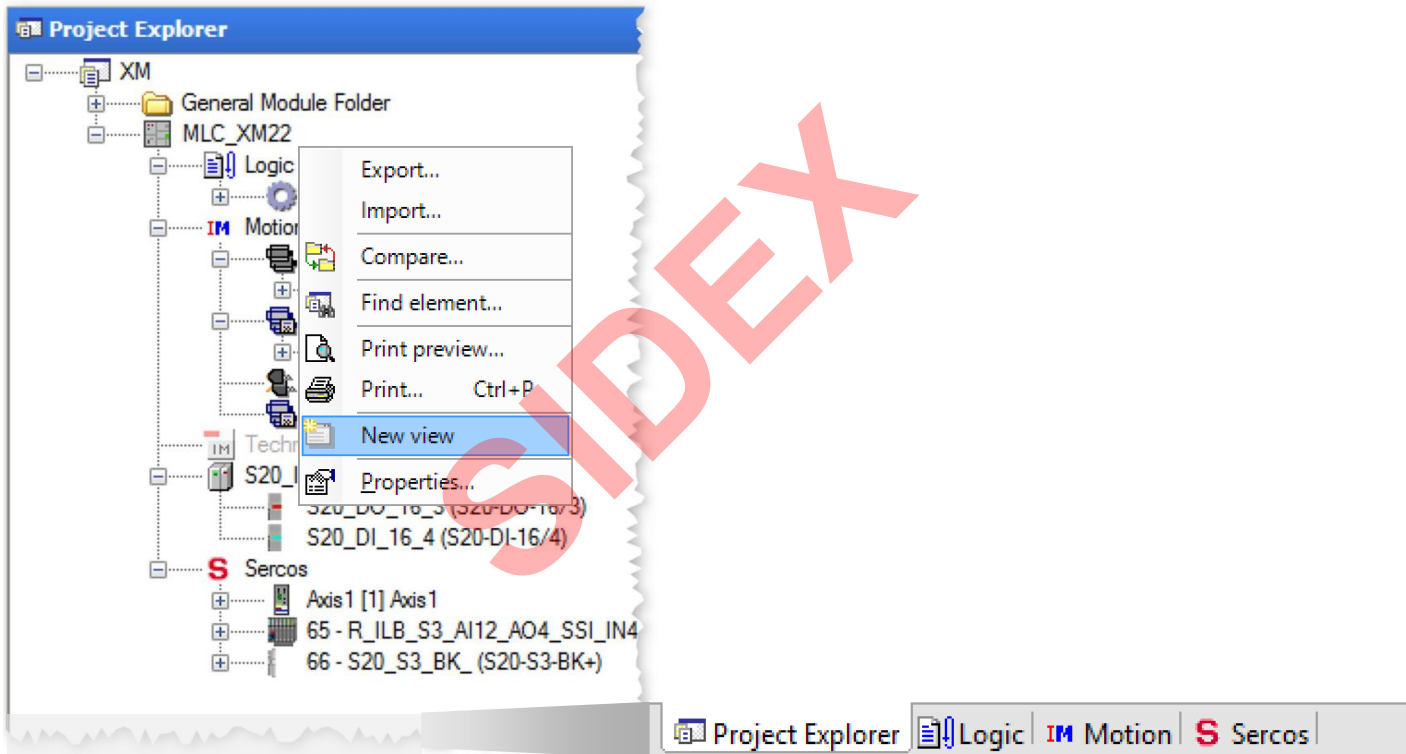
IndraWorks − Switching Online
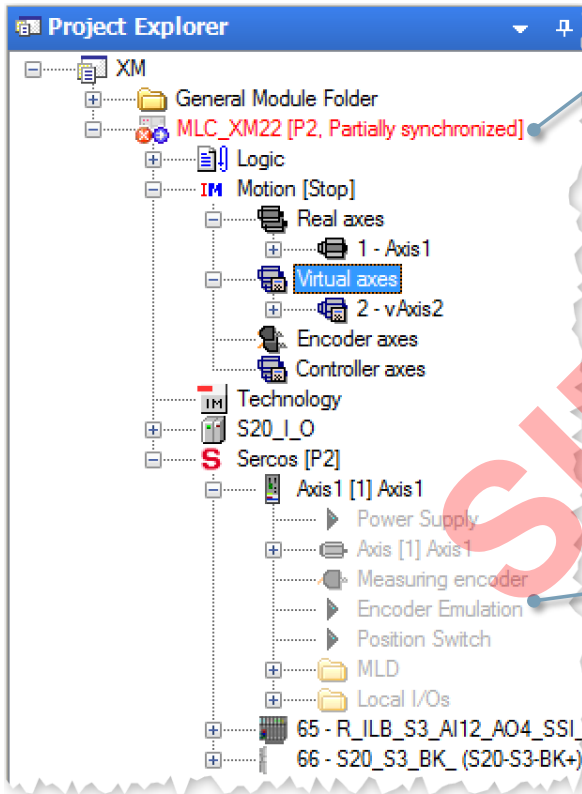
A comment "Partially synchronized" is displayed at the control. This indicates that the project configuration differs from the configuration inside the control!

As long as the configuration doesn't match no access to the drive dialogues is possible!

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IndraWorks − Download of Motion Configuration
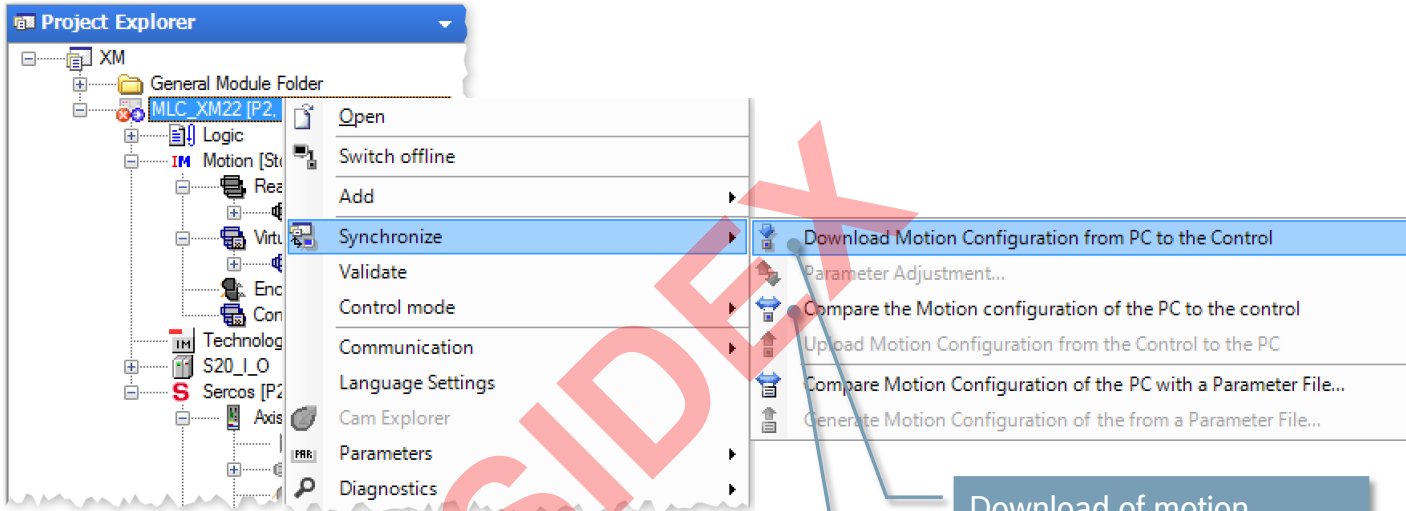
Download of motion configuration

Comparison of motion configuration is always possible!

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IndraWorks − Motion Configuration

Motion Configuration in project

Motion Configuration on control

x mismatch between project and Motion Configuration on control

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Using the IP channel in Sercos (1)

- IP communication with devices in the Sercos link

- Required parameters
  - IP settings Engineering port
  - SERCOS addresses of drives and IO

- Automatic setting of all IP addresses for all IndraDrives

- ... and further network settings of IndraDrives

Bridge
IP = 172.31.**254**.254

sercos
the automation bus

IndraDrive
IP = 172.31.**254**.<Sercos Addr.>

IndraDrives

IOs

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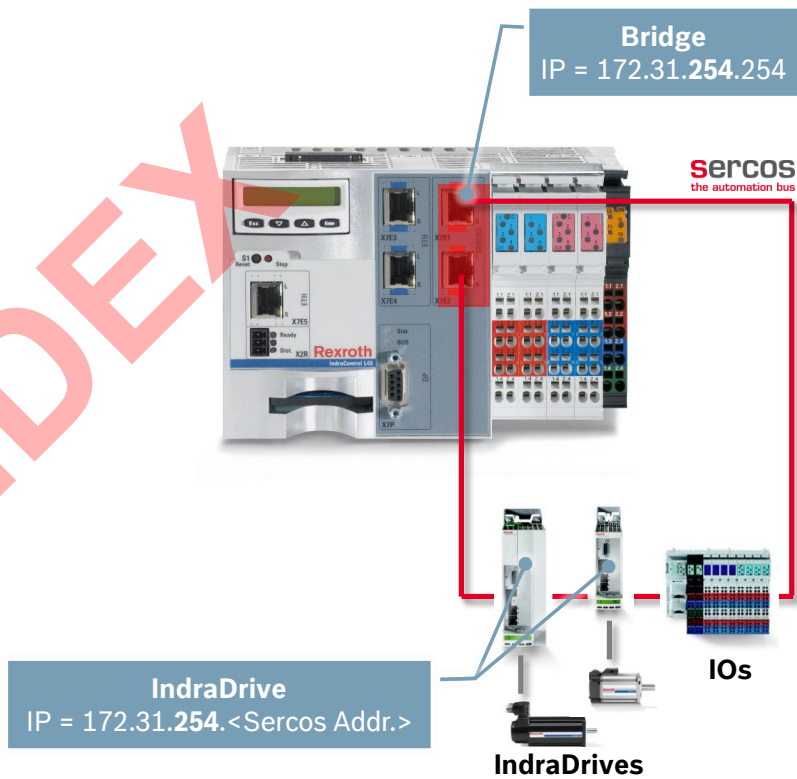
Using the IP channel in Sercos (2)

- Sercos interfaces of MLC are "bridged"

- Bridging means that different physical networks are combined into one logical network

- Common IP address range for all Sercos interfaces of MLC

- All drives and IOs in the Sercos drive link are accessible via Engineering port

- ... and also remote MLCs in the Sercos C2C link

Bridge
IP = 172.31.<C-0-0031>.254

Sercos address
C-0-0031

IndraDrive
IP = 172.31.<C-0-0031>.<Sercos Addr>

IOs

IndraDrives

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Using the IP channel in Sercos (3)

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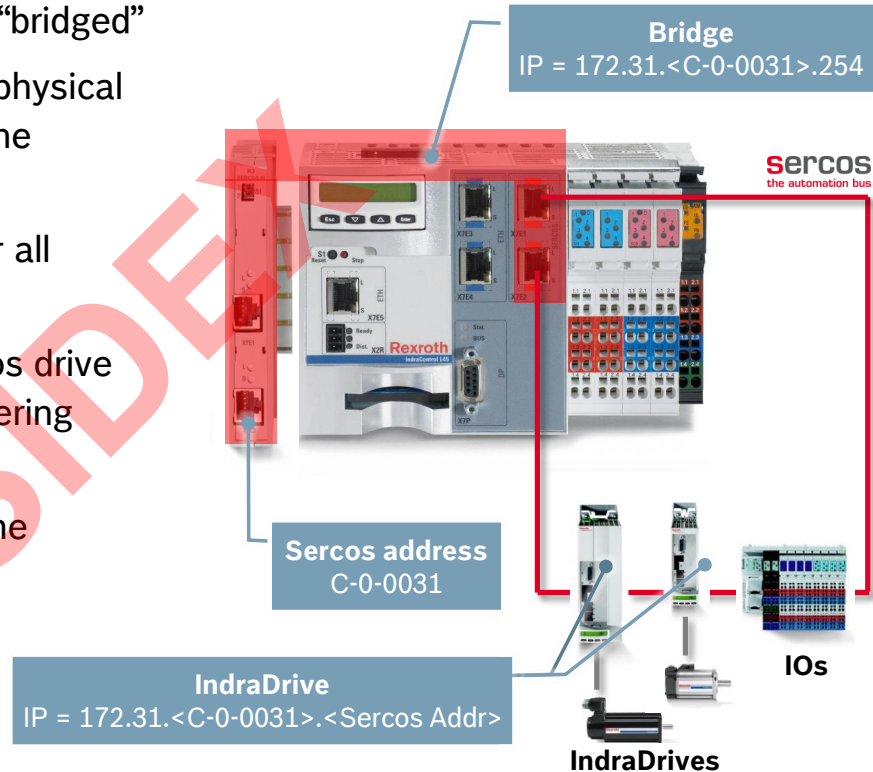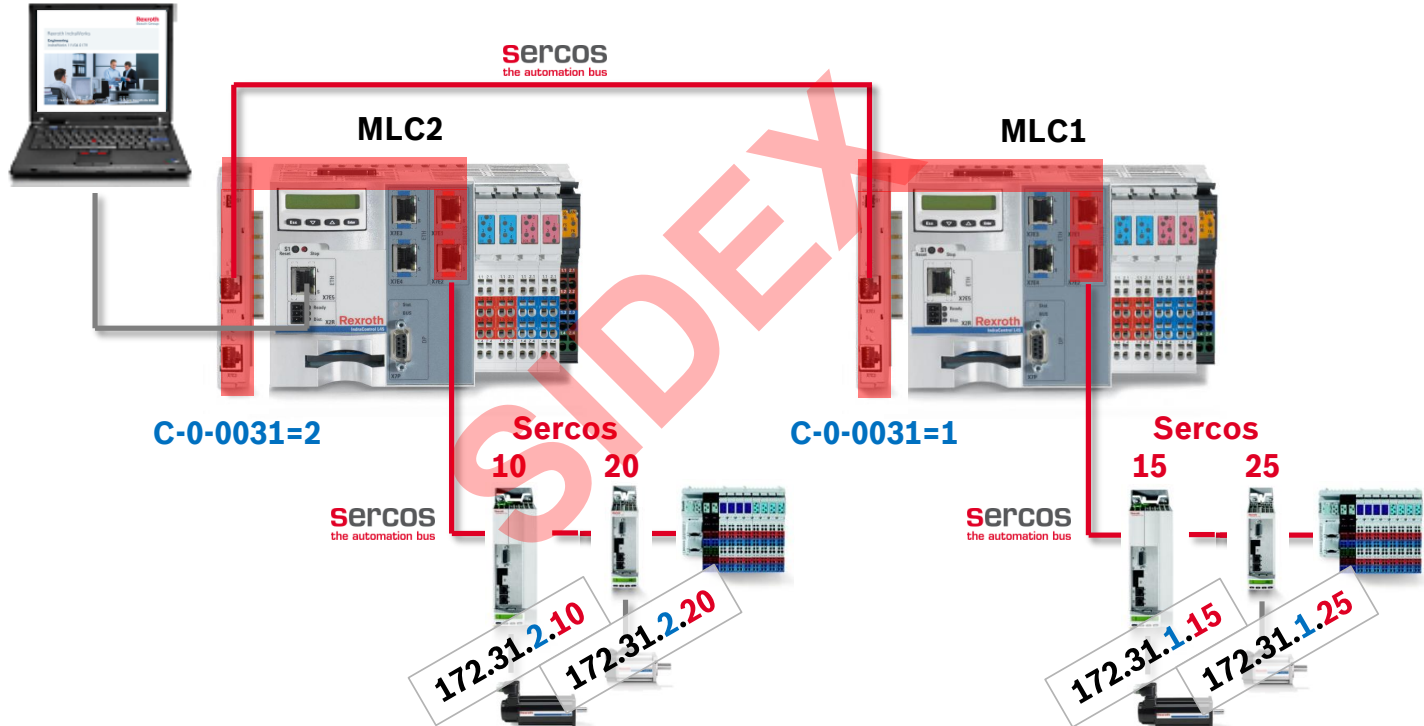
IndraWorks –Initial commissioning assistant
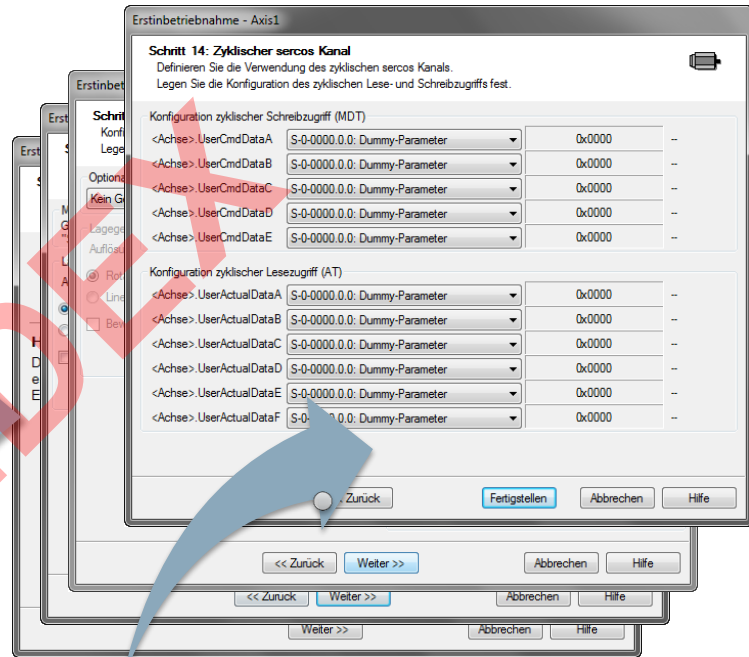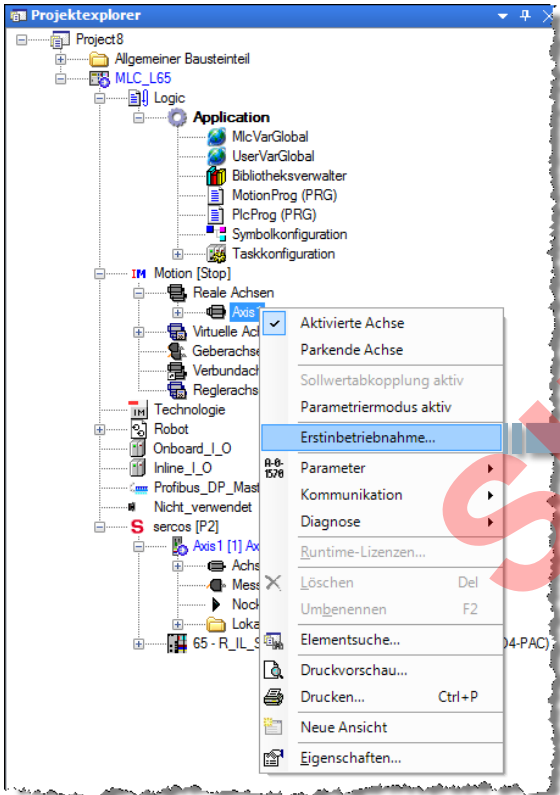
Guided axis commissioning in 14 steps!

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Axes commissioning without PLC

Rexroth
Bosch Group

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Axes commissioning without PLC

💡 Axes can be moved in any operating mode independent of the PLC program!

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Consistent IO configuration

Onboard IO

Local Inline IO

PROFIBUS IO

sercos
the automation bus

Sercos IO

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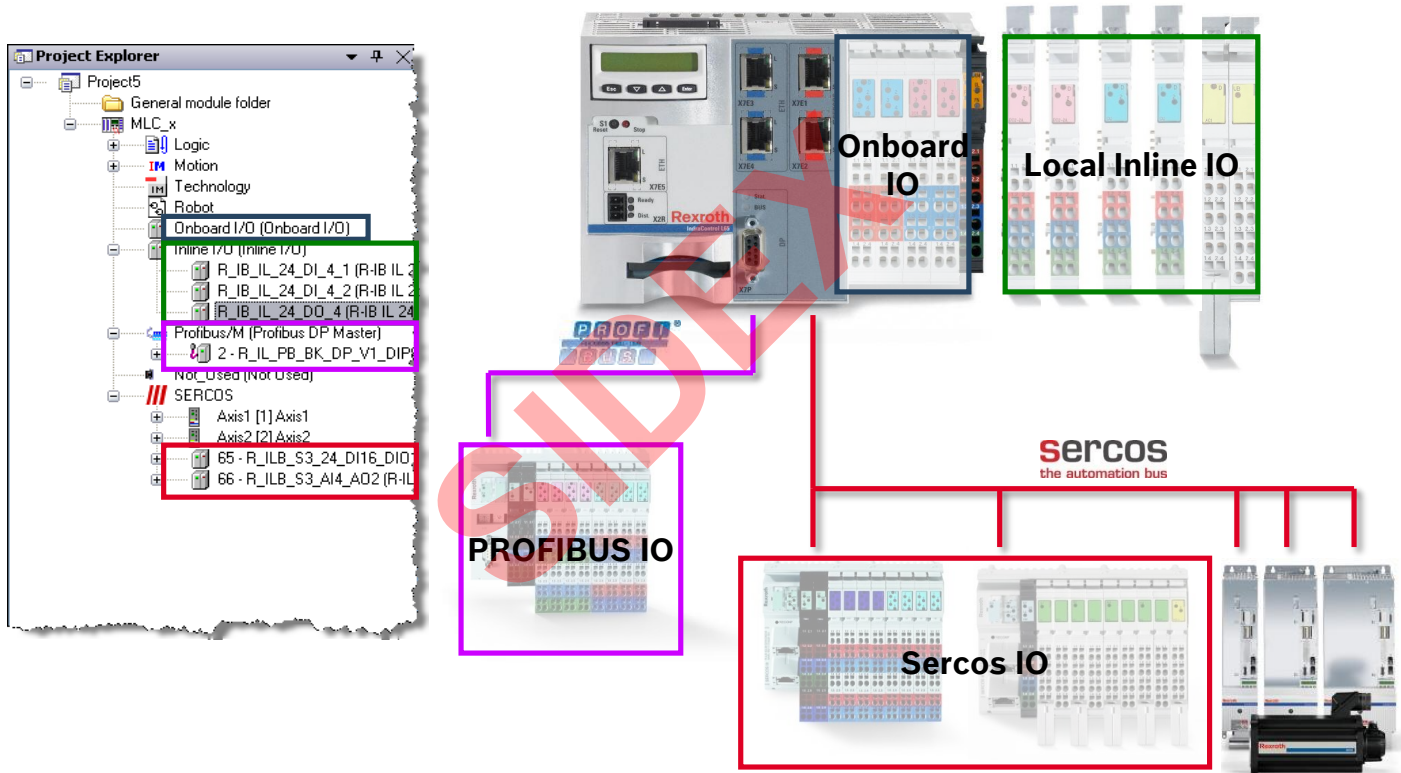
IO configuration − Inline IOs
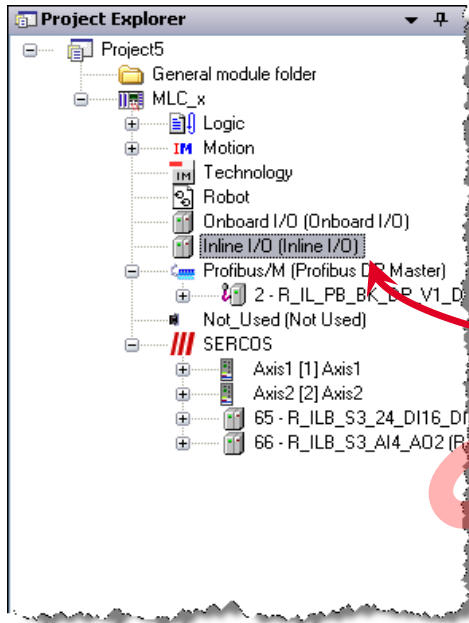
Add appropriate Inline modules to the node Inline IO

Drag & Drop
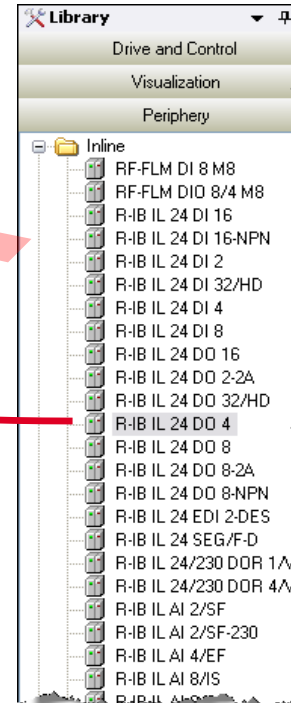
The IO configuration in IndraWorks is uniform. The configuration of PROFIBUS IOs and Sercos IOs follows the same philosophy.

Open **Periphery** in Device Library
Select category **Inline**

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IO configuration − PLC Addresses

- PLC addresses are assigned automatically when periphery devices are added
- The syntax according to IEC 61131 is as follows:

| % | Memory Area Prefix | Size Prefix | Number | . | Number |

Byte offset   Bit offset

X	Single bit
none	Single bit
B	Byte (8 bits)
W	Word (16 bits)
D	Double word (32 bits)
L	Long word (64 bits)

I	Input → "sensor"
Q	Output → "actuators"
M	Marker → "flags"

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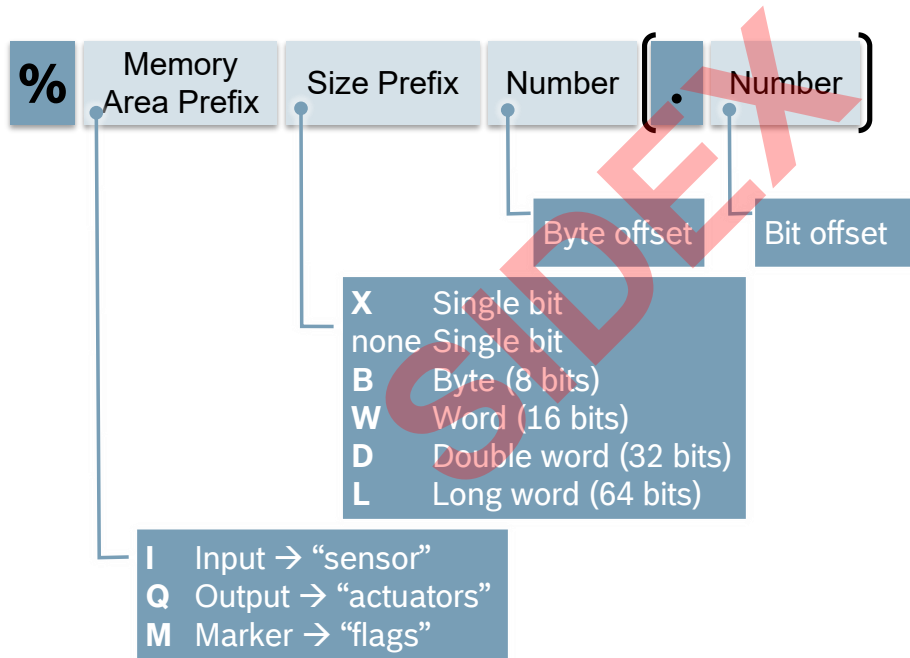
IO configuration − PLC Addresses

- Examples:

%	Memory Area Prefix	Size Prefix	Number	.	Number
%	I	X	100	.	3
%	Q	X	110	.	7
%	I	B	5		
%	M	W	810		
%	M	W	812		
%	Q	D	200		

Input bit 100.3	
Output bit 110.7	
Input byte 5	
Marker word 810	
Marker word 812	
Output double word 200	

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IO configuration − Address assignment & Mapping

PLC addresses are
assigned
automatically to new
elements

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IO configuration − Address assignment & Mapping

Mapping to an existing variable

Create a new variable

Enter variable name

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IO configuration − Symbolic access to the IOs

```
 1   VAR_GLOBAL
 2       // Bitadressen
 3       bSwitch_0   AT      %IX4.0  :   BOOL    ;   // Switch 0
 4       bSwitch_1   AT      %IX4.1  :   BOOL    ;   // Switch 1
 5       bSwitch_2   AT      %IX4.2  :   BOOL    ;   // Switch 2
 6       bSwitch_3   AT      %IX4.3  :   BOOL    ;   // Switch 3
 7       bSwitch_4   AT      %IX4.4  :   BOOL    ;   // Switch 4
 8       bSwitch_5   AT      %IX4.5  :   BOOL    ;   // Switch 5
 9       bSwitch_6   AT      %IX4.6  :   BOOL    ;   // Switch 6
10       bSwitch_7   AT      %IX4.7  :   BOOL    ;   // Switch 7
11
12       bSwitch_8   AT      %IX5.0  :   BOOL    ;   // Switch 8
13       bSwitch_9   AT      %IX5.1  :   BOOL    ;   // Switch 9
14       bSwitch_10  AT      %IX5.2  :   BOOL    ;   // Switch 10
15       bSwitch_11  AT      %IX5.3  :   BOOL    ;   // Switch 11
16       bSwitch_12  AT      %IX5.4  :   BOOL    ;   // Switch 12
17       bSwitch_13  AT      %IX5.5  :   BOOL    ;   // Switch 13
18       bSwitch_14  AT      %IX5.6  :   BOOL    ;   //
19       bSwitch_15  AT      %IX5.7  :   BOOL    ;   //
20
21       // Byte addresses
22       byS0_S7     AT      %IB4    :   BYTE    ;   //
23       byS8_S15    AT      %IB5    :   BYTE    ;   //
24
25       // Word addresses
26       wS0_S15     AT      %IW4    :   WORD    ;   //
27
28       // Double word addresses
29       dwS0_S31    AT      %ID4    :   DWORD   ;   //
30
31       // Long word addresses
32       dwS0_S63    AT      %IL4    :   LWORD   ;   //
33   END_VAR
```

```
VAR_GLOBAL
    // Single comment line

(* Bit addresses *)
    bValve_0    AT      %QX4.0  :   BOOL    ;   // Valve 0
    bValve_1    AT      %QX4.1  :   BOOL    ;   // Valve 1
    bValve_2    AT      %QX4.2  :   BOOL    ;   // Valve 2
    bValve_3    AT      %QX4.3  :   BOOL    ;   // Valve 3
    bValve_4    AT      %QX4.4  :   BOOL    ;   // Valve 4
    bValve_5    AT      %QX4.5  :   BOOL    ;   // Valve 5
    bValve_6    AT      %QX4.6  :   BOOL    ;   // Valve 6
    bValve_7    AT      %QX4.7  :   BOOL    ;   // Valve 7)

    bValve_8    AT      %QX5.0  :   BOOL    ;   // Valve 8
```

Variables can be mapped to IOs in IndraLogic using the keyword AT followed by the PLC address

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MLC Parameter System

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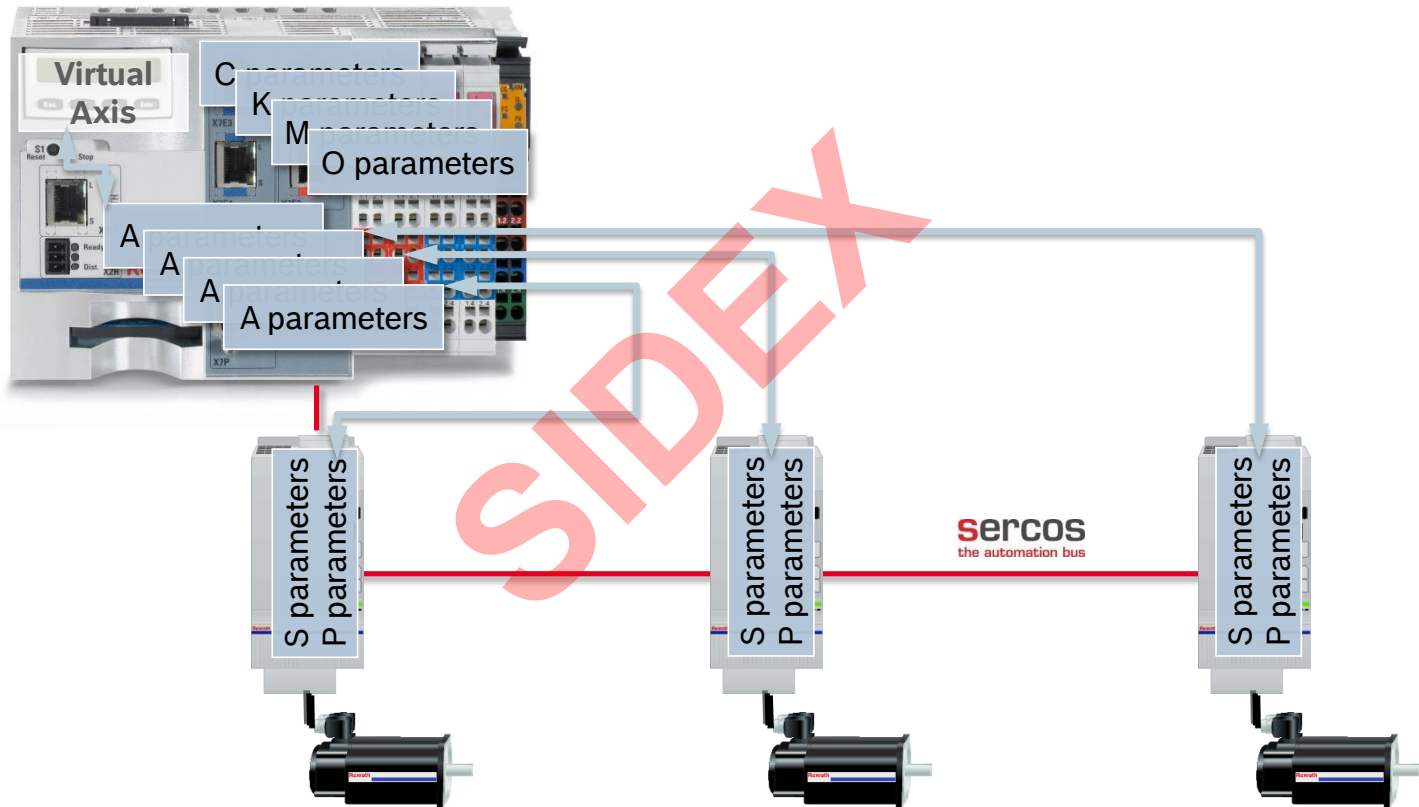
MLC Parameter System
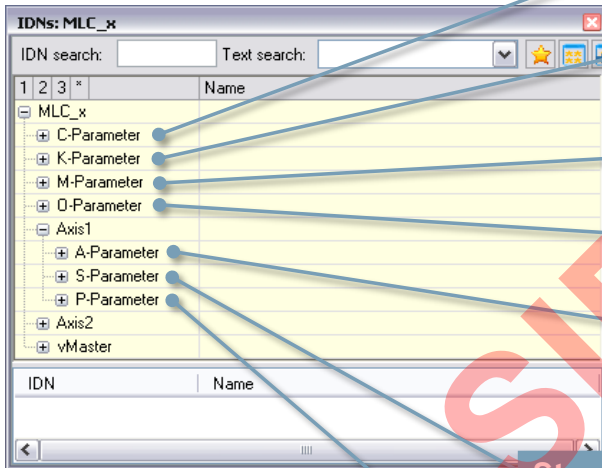
Control parameters
Configuration data of the control (or information)
One set of C parameters per IndraMotion MLC

Kinematics parameters
Configuration data for Robot Control
One set of K parameters per Kinematics

Probe parameters
Configuration data for probes (M001 – M100)

Oscilloscope parameters
Configuration data for the oscilloscope

Axis parameters
Configuration data of the axes (or information)
Stored on the control

Standard parameters defined in the Sercos standard
Configuration data of the drive (or information)
Stored in the IndraDrive (Flash/MMC/drive display)

Proprietary parameters in terms of the Sercos standard
Configuration data of the drive (or information)
Stored in the IndraDrive (Flash/MMC/drive display)

IDNs: MLC_x

IDN search: | Text search:

1 2 3 * | Name
MLC_x
  C-Parameter
  K-Parameter
  M-Parameter
  O-Parameter
  Axis1
    A-Parameter
    S-Parameter
    P-Parameter
  Axis2
  vMaster

IDN | Name

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MLC Parameter System

MLC/MLP-Parameter 10VRS
A/C Parameters Cover S/P Parameters

IndraDrive: A/C Parameter
SercosDrive: A/C Parame
HNC Devices: A/C Parame

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MLC/MLP-Parameter 10VRS
IndraDrive: A/C Parameters Cover S/P Parameters

The following table provides an overview for IndraDrive on how the information of A or C parameters of the MLC are transferred to the S or P parameters:

☞ The calculation of the motion is carried out on the IndraDrive.

If the calculation is carried out on the control, see SercosDrive: A/C Parameters cover S/P Parameters.

- Ident_IDV means that the copy is identical,
- Used_IDV means that at least one bit is influenced.

IDN	Parameter name	Ident_IDV	Used_IDV
A-0-0002	Axis name	S-0-0142	S-0-0142
A-0-0007			-0033, S-0035, S-0-5, S-0-7
A-0-0021	Axis st...		...iguration
A-0-0022	Extended axis status		AT configuration
A-0-0023	Axis diagnostic number		S-0-0390
A-0-0024	Axis condition		S-0-0139
A-0-0028	Travel range limit switch	P-0-0090	P-0-0090
A-0-0029	Position polarities	S-0-0055	S-0-0055
A-0-0030	Positive position limit value	S-0-0049	S-0-0049
A-0-0031	Negative position limit value	S-0-0050	S-0-0050
A-0-0032	Positive velocity limit value	S-0-0038, S-0-0091	S-0-0038, S-0-0091
A-0-0033	Negative velocity limit value	S-0-0039, S-0-0091	S-0-0039, S-0-0091
A-0-0034	Bipolar acceleration limit value	S-0-0138	S-0-0138
A-0-0036	Bipolar jerk limit value	S-0-0349	S-0-0349

During Sercos startup (transition from P2 to BB) the information of A or C parameters is sent to the drives. As a result some S or P parameters are overlapped by A and C parameters!

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MLC Parameter System − Parameter Editor

Multiple instances of the Parameter Editor can be opened. Provides direct access to the parameter system of MLC and the drives.

Invoke the Online Help directly from the Parameter Editor

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MLC Parameter System − Parameter Editor

With IDN search you get all the control and drive parameters in a tree structure and you can browse the parameter system

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MLC Parameter System − Parameter Groups

Use Parameter groups to group all parameters relating to a specific MLC function, e.g. FlexProfile, MotionProfile, Phase synchronous operation etc.

The axis for which the parameters are displayed can easily be switched!
For only one entry as shown above ...

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MLC Parameter System − Parameter Groups
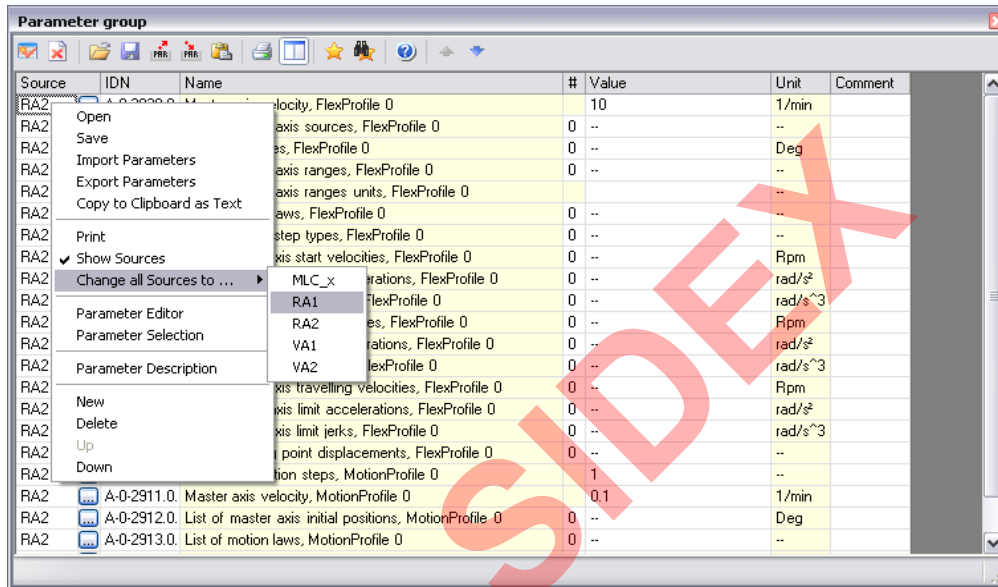
... or for all group entries simultaneously!

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MLC Parameter System − Parameter Groups

Parameter group with all parameters relating to *FlexProfile*

Source	IDN	Name	#	Value	Unit	Comment
RA2	A-0-3020.0.	Master axis velocity, FlexProfile 0		10	1/min	
RA2	A-0-3021.0.	List of master axis sources, FlexProfile 0	0	--	--	
RA2	A-0-3022.0.	List of distances, FlexProfile 0	0	--	Deg	
RA2	A-0-3023.0.	List of master axis ranges, FlexProfile 0	0	--	--	
RA2	A-0-3024.0.	List of master axis ranges units, FlexProfile 0		--	--	
RA2	A-0-3025.0.	List of motion laws, FlexProfile 0				
RA2	A-0-3026.0.	List of motion step types, FlexProfile 0				
RA2	A-0-3027.0.	List of slave axis start velocities, FlexProfile				
RA2	A-0-3028.0.	List of slave axis start accelerations, FlexPro				
RA2	A-0-3029.0.	List of slave axis start jerks, FlexProfile 0				
RA2	A-0-3030.0.	List of slave axis end velocities, FlexProfile 0				
RA2	A-0-3031.0.	List of slave axis end accelerations, FlexProfile				
RA2	A-0-3032.0.	List of slave axis end jerks, FlexProfile 0				
RA2	A-0-3033.0.	List of slave axis travelling velocities, FlexPro				
RA2	A-0-3034.0.	List of slave axis limit accelerations, FlexPro				
RA2	A-0-3035.0.	List of slave axis limit jerks, FlexProfile 0				
RA2	A-0-3036.0.	List of turning point displacements, FlexProf				
RA2	A-0-2910.0.	Number of motion steps, MotionProfile 0		1	--	
RA2	A-0-2911.0.	Master axis velocity, MotionProfile 0		0.1	1/min	
RA2	A-0-2912.0.	List of master axis initial positions, MotionProfile 0	0	--	Deg	
RA2	A-0-2913.0.	List of motion laws, MotionProfile 0	0	--		

Group for operation of IndraDrive with *110 Volts*

Source	IDN	Name	#	Value
RA1 [1]	P-0-0114.0.	Undervoltage threshold		0
RA1 [1]	P-0-0810.0.	Minimum mains crest value		226
RA1 [1]	P-0-0118.0.	Power supply, configuration		0b0000
RA1 [1]	P-0-0860.0.	Converter configuration		0b0000
RA1 [1]	P-0-0300.0.	Digital I/Os, assignment list	0	P-0-08
RA1 [1]	P-0-0301.0.	Digital I/Os, bit numbers	0	9

Import/Export as well as Load/Save of parameter groups is supported!

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Activate/Deactivate

- The real axis is created in the IndraMotion MLC project
- The "deactivated" status can be assigned via the context menu and is then marked with ⊘ in the Project Explorer
- The A parameters can be accessed. The drive must not exist physically
- The drive is always in P0, even if the sercos ring is in P4 (applies for sercos 2)
- Virtual axes and encoder axes cannot be "deactivated"
- If the drive electronics is taken away from the encoder axis by "deactivating" a real axis, it is also marked as "deactivated"

Usage:

- During the commissioning, only certain drives should be moved. The other drives are configured and also programmed in the PLC program, but they do not yet exist physically.

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Parking Axis

P

- The real axis is created in the IndraMotion MLC project
- The "parking" property can be assigned via its context menu and is then marked with P in the Project Explorer.
- The drive must exist physically. The motor does not need to exist. The drive command "Parking Axis" is used
- The A parameters as well as S/P parameters are accessible
- The drive follows the sercos phase. No error messages are generated by the drive
- Virtual axes and encoder axes cannot be "parked"

Usage:

- Prevent drive from generating an error with the transition to P4 without a connected motor

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Command value decoupling

- Available for real axes with interpolation on the control
- Enabled via context menu and marked with ⬛
- The axis is subject to the regular PLCopen state machine in case of an active command value decoupling.
- This means that the MC_Power has to be executed before executing a motion command. This does not cause the drive to be switched to **AF**. The **AB** mode in the drive is not required for the execution of the FB.
- In case of an active command value decoupling, the position command value calculated by the control will still be written cyclically into the parameter S-0-0047. Since the drive is not in **AF**, the command values are not processed.
- The calculated command value of the axis is reflected by parameter A-0-0151 „Interpolated position of the control".

Usage:
- Test motion program without axis movements

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Command value decoupling

- The command value decoupling allows the execution of traveling commands without a motion carried out in the drive.
- The command value decoupling is activated via A-0-0024, „Axis state".
- The previous states
  - 0 - axis activated
  - 1 - axis parked
  - 2 - axis deactivated
- ... were extended by the following states
  - 4 - axis is activated without command value processing in the drive
  - 5 - axis is activated with command value calculation. Drive is parked
  - 6 - axis activated with command value calculation. Drive not conneted

Axis status	Without command value decoupling	Command value decoupling activated
Activated		↗
Parked	🅿	🅿↗
Deactivated	⊘	ₛ⊘↗

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IEC 61131 − What is it?

- The international standard IEC 61131 was created as a basis for uniform PLC programming, where modern software technology designs are considered

- The standard comprises 7 parts:
  - IEC 61131-1 General overview, definitions
  - IEC 61131-2 Hardware
  - IEC 61131-3 Programming languages
  - IEC 61131-4 User guidelines
  - IEC 61131-5 Messaging service specification
  - IEC 61131-7 Fuzzy logic
  - IEC 61131-8 Technical report

- MLC is a IEC 61131 compliant system, i.e. Motion programming is based on this standard

- All IEC programming languages are supported

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IEC 61131 − Programming languages

LD Ladder diagram


```
i1      i3      q1
─┤├─────┤├─────( )─
i2
─┤├─
```

graphical
Programming languages

Sequential function chart


```
Init ──┤N        Action_1
   ┼Trans1
Step2 ─┤N        Action_1
   ┼Trans0
   ▷
Init
```

IL Instruction list

LD   i1
OR   i2
AND   i3
ST   q1

Function block design


```
        OR          AND
i1 ─┐
i2 ─┘ ──── i3 ────
```

ST Structured text

q1 := i3 AND (i1 OR i2);

textual
Programming languages

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Relation IndraWorks ↔ IndraLogic

- For every axis in IndraWorks a corresponding global variable with the same name is created, which is used as "key" to designate a specific axis
- Consistent use of axis names in IndraWorks and in the motion program

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Relation IndraWorks ↔ IndraLogic

Two tasks are created automatically:

Motion Task:
- Handling of axes with special requirements, e.g. Winder, Register control, ELS.
- Handling of fast IOs
- Fast error reaction

PlcTask:
- Operational sequences of machine
- Operation modes
- Standard IOs

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Relation IndraWorks ↔ IndraLogic

Properties of both tasks

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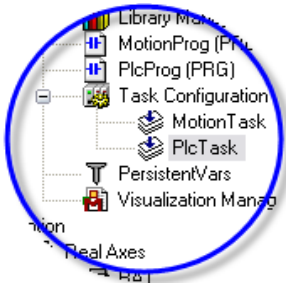
What is PLCopen?
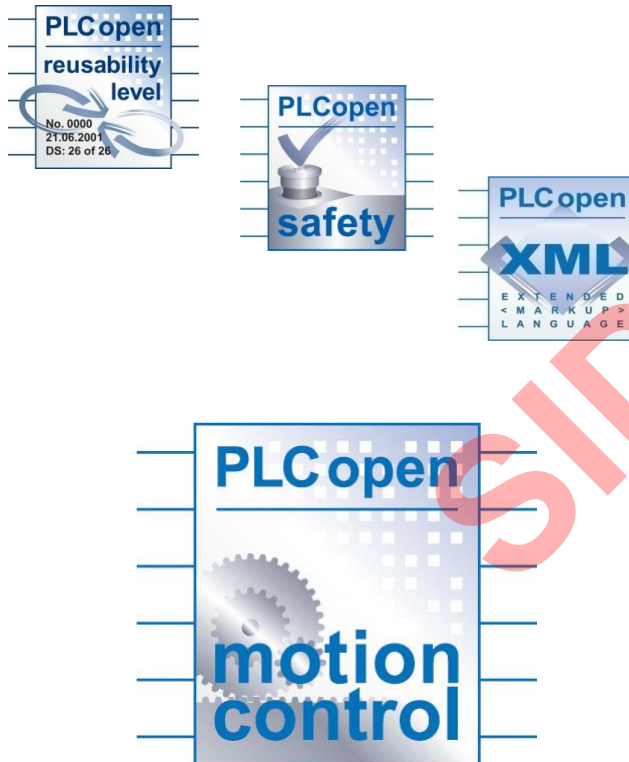
- Interest group, independent of controller manufacturers and users

- founded in 1992

- Ambition:
  promotion, development and use of IEC 61131-3 compatible software

- Advantages:
  cost reduction e. g. for

  - Training,

  - Development,

  - or Service

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PLCopen and Motion Control

- First Library for standardized motion control functions specified in November 2001

- Main subjects：

  - State Machine

  - Function Blocks

  - Directives for use of Function Blocks

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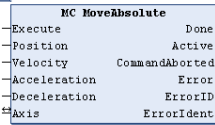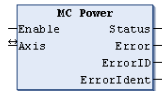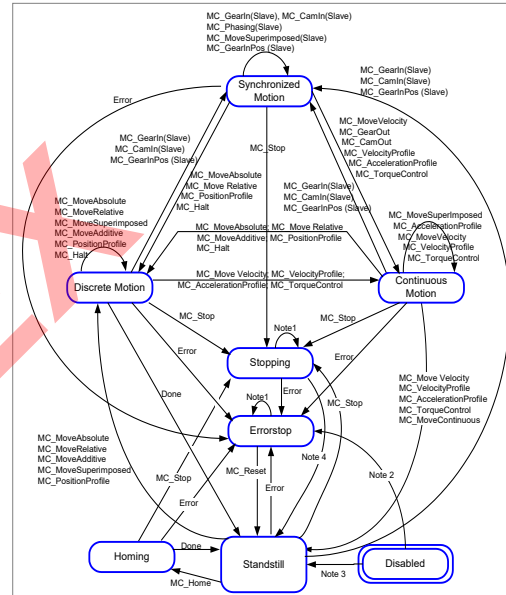
State Diagram – simplified

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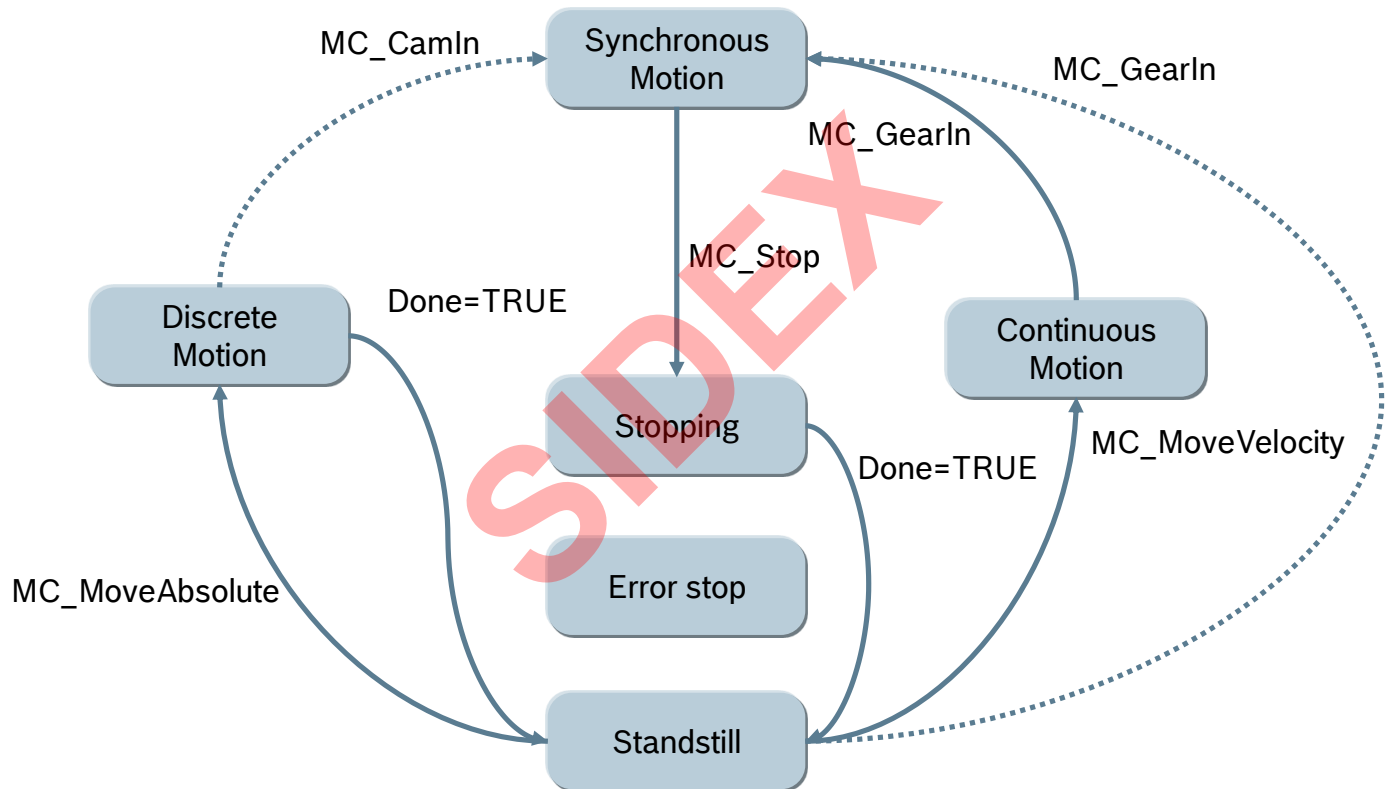
Example of a PLCopen Function block
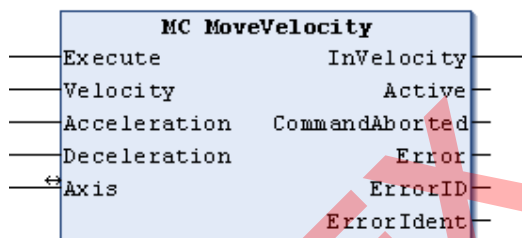
	Name	Type	Comment [1]
VAR_IN_OUT	Axis	AXIS_REF	Contains information regarding the actual axis
VAR_INPUT	Execute	BOOL	Starts the motion if there is a rising edge
	Velocity	REAL	Maximum velocity value (does not necessarily have to be reached).
	Acceleration	REAL	Acceleration (always +).
	Deceleration	REAL	Deceleration (always +).
VAR_OUTPUT	InVelocity	BOOL	Velocity reached (for the first time)
	Active	BOOL	Processing of data runs after preprocessing is completed
	CommandAborted	BOOL	Command aborted by the following command.
	Error	BOOL	Indicates that an error has occurred in the FB instance.
	ErrorID	ERROR_CODE	Brief indication of the cause for error
	ErrorIdent	ERROR_STRUCT	Detailed information regarding the error

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PLCopen − AXIS_REF

```
                 MC MoveVelocity
   ──── Execute            InVelocity ──
   ──── Velocity               Active ──
   ──── Acceleration   CommandAborted ──
   ──── Deceleration            Error ──
   ──↔── Axis                 ErrorID ──
                          ErrorIdent ──
```
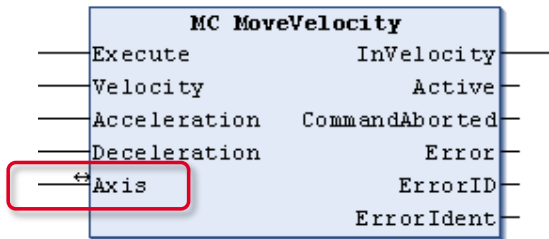
```
(* Structure of PLCopen element AXIS_REF. The AXIS_REF is a structure that contains *)
(* information on the corresponding object.                                          *)
(* It is used as a VAR_IN_OUT in all Motion Control Function Blocks.                 *)
TYPE AXIS_REF :
STRUCT
    CntrlNo: CONTROLS := LOCAL_CNTRL;   (* Control number init: local control        *)
    AxisNo:  OBJECTS  := NO_OBJECT;     (* Axis reference number, init: no object     *)
END_STRUCT
END_TYPE
```

AXIS_REF

- ... is used as a "key" to designate a specific axis
- ... unique reference to an axis of the system
- VAR_IN_OUT of all PLCopen Function blocks
- Definition is manufacturer-specific

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Function Blocks according to PLCopen

Parameter access	Single axis commands	Multi axes commands	Robot Control
MC_ReadActualPosition	MC_Power	MC_CamIn	MC_AddAxisToGroup
MC_ReadStatus	MC_MoveAbsolute	MC_CamOut	MC_RemAxisFromGroup
MC_ReadAxisError	MC_MoveRelative	MC_GearIn	MC_GroupReset
MB_Command	MC_MoveAdditive	MC_GearOut	MB_GroupReadListParameter
MB_ReadLintParameter	MC_MoveVelocity	MB_GearInPos	MB_GroupReadParameter
MB_ReadListParameter	MB_Home	MB_Phasing	MB_GroupRealRealParameter
MB_ReadLrealParameter	MC_Stop	MB_PhasingSlave	MB_GroupReadSercosAttribute
MB_ReadLrealListParameter	MC_Reset	MB_PhasingSlave	MB_GroupReadSercosDataStatus
MB_ReadParameter	MC_TorqueControl		MB_GroupReadStringParameter
MB_ReadRealParameter	MB_ChangeCamData	MB_MotionProfile	MB_GroupWriteListParameter
MB_ReadSercosAttribute	ML_OpenCyclicPositionChannel	ML_FlexProfile	MB_GroupWriteParameter
MB_ReadSercosDataStatus	ML_OpenCyclicAnalogChannel	MB_ChangeCamData	MB_GroupWriteRealParameter
MB_ReadStringParameter	ML_OpenCyclicTorqueChannel	MB_ChangeFlexEventSet	MB_GroupWriteStringParam.
MB_WriteLintParameter	ML_OpenCyclicVelocityChannel	MB_ChangeFlexProfileSet	MB_IRDProgSelect
MB_WriteListParameter	ML_WriteCyclicPosition	MB_ChangeProfileSet	MB_IRDProgStart
MB_WriteLrealParameter	ML_WriteCyclicAnalogl	MB_ChangeProfileStep	MB_IRDProgStop
MB_WriteParameter	ML_WriteCyclicTorquel		
MB_WriteRealParameter	ML_WriteCyclicVelocity		
MB_WriteStringParameter			

MC_xxx specified according to PLCopen   **MB_xxx** Bosch Rexroth standard   **ML_xxx** MLC specific

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Standard and System-specific FBs, Portability

	Scope	Präfix	Beispiel
Standard	PLCopen	**MC_**	MC_MoveVelocity
	Rexroth Standard	**MB_**	MB_ReadParameter
System-spezifisch	MLC	**ML_**	ML_FlexProfile
	MLC + H	**MH_**	MH_HydrControl
	MLD	**MX_**	MX_SetDeviceMode
	Visual Motion	**MV_**	MV_Hysteresis
	Synax	**MS_**	MS_ReadSingleParameter
	MTX	**MT_**	MT_CplData
	IndraLogic	**IL_**	IL_ParameterChannel
	Synax und VisualMotion	**MSV_**	MSV_ReadMaxValue

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AxisInterface − Why?

- AxisInterface bundles all functions which are available with PLCopen to a concise and simple data interface

- Bidirectional communication

    - arAxisCtrl_gb − Command interface

    - arAxisStatus_gb − State information

- Less PLCopen knowledge required

- Faster program development and clean code thanks to automatic code generation

- Good usability due to "Intellisense"

- Ready-to-use IndraLogic visualization for easy commissioning

- Complete documentation available

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AxisInterface − Data structure arAxisCtrl_gb

```
[−] 🌐 arAxisCtrl_gb
   [−] 🌐 arAxisCtrl_gb[1]
      [+] ◈ Admin
      [+] ◈ PosMode
      [+] ◈ VelMode
      [+] ◈ SyncMode
      [+] ◈ SetupMode
```

Administration
- Select operating mode
  (e.g. positioning, velocity, Cam, ...)
- Axis reference ...

Command values in positioning mode
- target position
- velocity
- acceleration ...

Command values in velocity control mode
- velocity
- acceleration ...

Command values in synchronous mode
- dynamic synchronization
- select master axis
- gear ratio
- select Cam profile ...

Command values for Jogging / Homing
- Jog directrion
- velocity
- acceleration ...

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AxisInterface – Cyclic and non-cyclic scanning
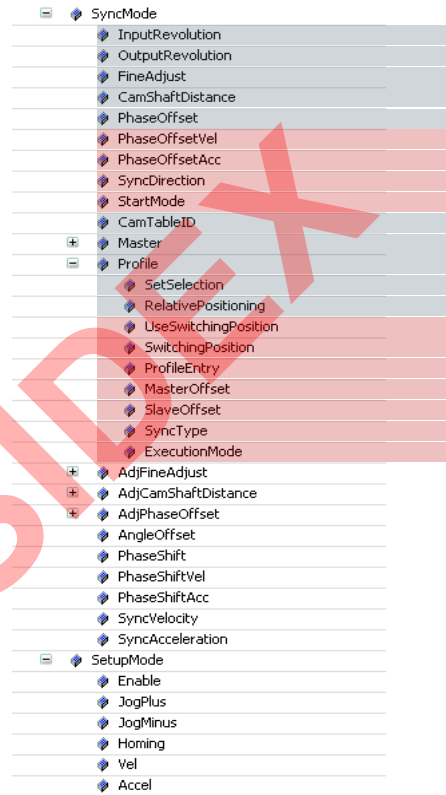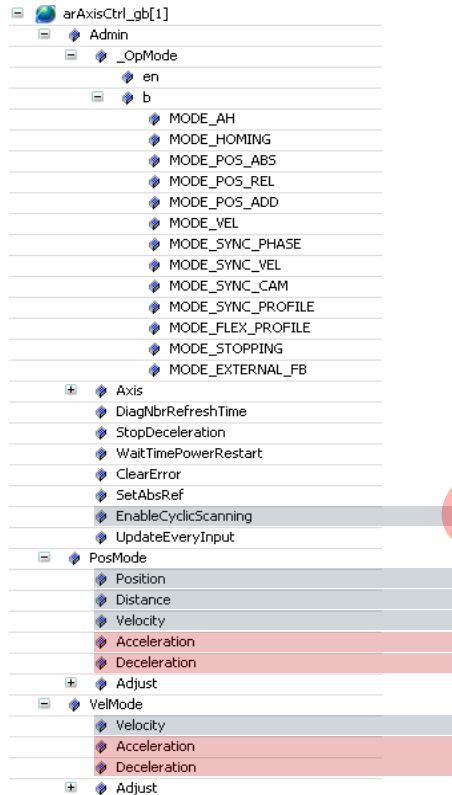
Cyclic scanning

Non-cyclic scanning

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AxisInterface − Data structure arAxisStatus_gb

Tree structure	Description
arAxisStatus_gb	
arAxisStatus_gb[1]	
PtrAxisData	**Pointer to AxisData entry**
Admin	**Administration / Axis state** • Actual operating mode
Diag	**Axis diagnostics** • Warning • Error • Error codes • ...
PosMode	**Status in positioning mode**
VelMode	**Status in velocity control mode**
SyncMode	**Status for synchronous mode**
SetupMode	**Status for Jogging / Homing**

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AxisInterface − Application example
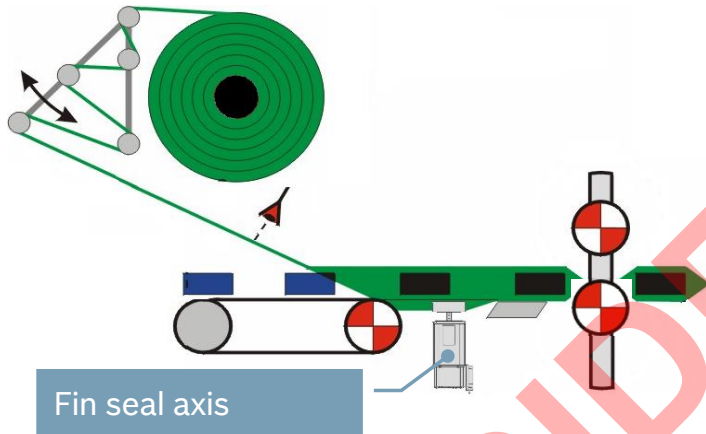
Fin seal axis

- Phase synchronization of the Fin seal axis
  - Master: virtualAxis1
  - Ratio 3:2
  - absolute synchronization
  - dynamic synchronization only in positive direction

Sample program:

```
arAxisCtrl_gb[SealAxis.AxisNo].SyncMode.Master := virtualAxis1;
arAxisCtrl_gb[SealAxis.AxisNo].SyncMode.InputRev := 3;
arAxisCtrl_gb[SealAxis.AxisNo].SyncMode.OutputRev := 2;
arAxisCtrl_gb[SealAxis.AxisNo].SyncMode.StartMode := ABSOLUTE;
arAxisCtrl_gb[SealAxis.AxisNo].SyncMode.SyncDirection := POS_DIRECTION;
arAxisCtrl_gb[SealAxis.AxisNo].Admin._OpMode.en := ModePhaseSync;
```

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AxisInterface − Automated Code creation

```
//-------------------------------------------------------
//------------------ Call all required programs --> Imc a
//-------------------------------------------------------
TE_AxisInterfaceType01Prog();
MB_ImcInterface();

IF TE_AxisInterfaceType01Prog.InitDone=
    RETURN;
END_IF
```

Context menu:
- Cut
- Copy
- Paste
- Delete
- Select All
- Advanced ▶
- Input Assistant...
- ST Code Templates...
- **Command Axis...**
- Show POU Description...
- Export POU as template to database...
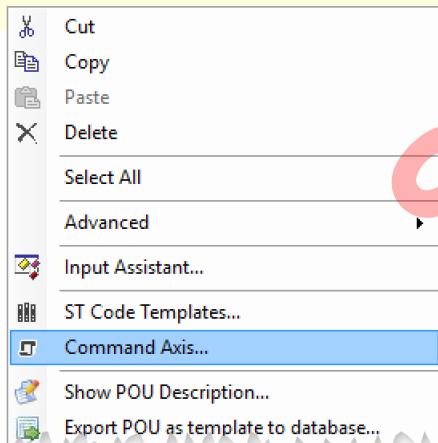
- A input form comes up in which the axis and the operating mode can be selected
- Additionally the command values for the selected operating mode are entered
- Based on these inputs, ST code is created, which translates the input data into program code for the AxisInterface
- As an option acknowledgement code can be created, to check if the operation is successful

☑ *Saving of time + less error-prone!*

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AxisInterface − Automated Code creation

Set operating mode

Select axis

Enter command values (concrete values or variables)

Acknowledgement code as an option

With „Finish" the code will be created

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AxisInterface − Automated Code creation

```
//-----------------------------------------------------------------------------
//-------------------- Call all required programs --> Imc and Axis Interface Update  ---------
//-----------------------------------------------------------------------------
TE_AxisInterfaceType01Prog();
MB_ImcInterface();

IF TE_AxisInterfaceType01Prog.InitDone=FALSE THEN
  RETURN;
END_IF

arAxisCtrl_gb[Axis1.AxisNo].PosMode.Position := rPosition_Axis1;
arAxisCtrl_gb[Axis1.AxisNo].PosMode.Velocity := rVelocity_Axis1;
arAxisCtrl_gb[Axis1.AxisNo].PosMode.Acceleration := rAcceleration_Axis1;
arAxisCtrl_gb[Axis1.AxisNo].PosMode.Deceleration := rDeceleration_Axis1;
arAxisCtrl_gb[Axis1.AxisNo].Admin._OpMode.en := ModePosAbs;
(* Code example to check if the commanded operation mode is acknowledged
IF ((arAxisStatus_gb[Axis1.AxisNo].Admin._OpModeAck = ModePosAbs) AND (arAxisStatus_gb[Axis1.A:
  // commanded operation mode is acknowledged
  ;
END_IF
*)
```

Generated code

The commented code can be used to check if the command was successful

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AxisInterface − Online Help

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AxisInterface − Function Blocks

MB_AxisInitType01	**MB_AxisInterfaceType01**

```
        MB_AxisInitType01
─Execute                      Done─
─ReadModuloValue            Active─
─EnableCyclicScanning        Error─
⇆AdminCtrl                 ErrorID─
⇆PosModeCtrl             ErrorIdent─
⇆VelModeCtrl
⇆SyncModeCtrl
⇆AxisDataPtrStatus
⇆AdminStatus
⇆DiagStatus
⇆Axis
```

```
        MB_AxisInterfaceType01
─AdminCtrl
─PosModeCtrl
─VelModeCtrl
─SyncModeCtrl
─AdminStatus
─DiagStatus
─PosStatus
─VelStatus
─SyncModeStatus
```

Initializes the AxisInterface for one axis

Cyclic call for each axis

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AxisInterface − Cyclic call of system code

```
PlcProg[MLC_L65: Logic: Application]
1    PROGRAM PlcProg
2    VAR
3
4    END_VAR
```

Inside TE_AxisInterfaceType01Prog the function blocks of the AxisInterface are called!

```
1    //-------------------------------------------------------------
2    //-------------------- Call all required programs --> Imc and Axis Interface Update -------------
3    //
4    TE_AxisInterfaceType01Prog();
5    MB_ImcInterface();
6
7    IF TE_AxisInterfaceType01Prog.InitDone=FALSE THEN
8        RETURN;
9    END_IF
10
```

No commands can be issued during the initialization of the AxisInterface! The RETURN statement ensures that the following statements are not executed!

Don't modify these statements, otherwise the AxisInterface will not work properly!

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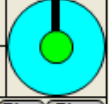
AxisInterface − IndraLogic Visualization

- IndraLogic Visualization is part of the AxisInterface
- After adjustment of the visualization to the correct axis configuration the axis can be commanded immediately without any coding!

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ImcInterface – ImcCtrl and ImcStatus

ImcCtrl
- Admin
  - _OpMode
  - ClearError
  - RetriggerOpMode

Switch of the Sercos phase

Clear errors

ImcStatus
- InOperation
- Admin
  - _OpModeAck
  - ModeStatus_P0
  - ModeStatus_P1
  - ModeStatus_P2
  - ModeStatus_P3
  - ModeStatus_BB
  - PwrUpModeAck
  - PhaseSwitchActive
- Diag
  - Error
  - Warning
  - ErrorID
  - ErrorIdent
  - ClearErrorAck
  - ErrSeverity
  - Number
  - Message
- PassiveMode

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AxisInterface − How to get the Axis Interface?

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Programming Guidelines for IndraLogic

- A cross-system working group has elaborated IndraLogic programming guidelines

- Aim: unify all functions, function blocks etc. across systems

- Definitions and recommendations for different subjects:

  - Standardized headers for function blocks

  - History

  - Type identifiers

  - Variable identifiers

  - Constant identifiers

  - Interfaces of function blocks

  - Error handling

  - Names of libraries

  - Versioning of libraries

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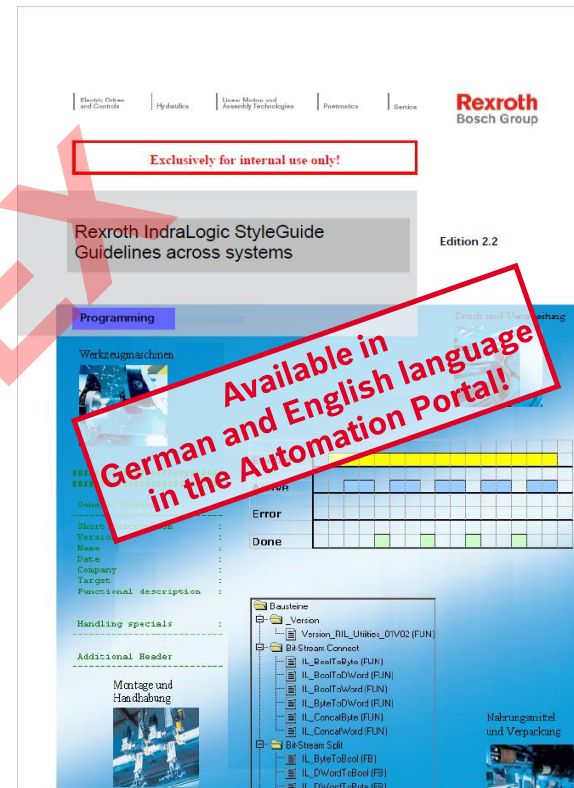
IL Guidelines − Standardized header

```
(*############################################################################################*)
(*############################################################################################*)

(* General Header *)
(*------------------------------------------------------------------------------------*)
(* Shortdescription     : This function block provide the communication between device xyz *)
(*                        via Profibus and the programmable logic controller *)
(* Version              : 1.3 *)
(* Name                 : Max Mustermann *)
(* Date                 : 2004-02-02 *)
(* Company              : Bosch Rexroth AG *)
(* Target               : SYNAX200-MotionLogic; VisualMotion *)
(* Functional description : A communication with device xyz is only possible over a special *)
(*                          multiplex process. The function block decodes and encodes the *)
(*                          telegram and makes sure that ... *)
(* Handling specials    : Attend the following points: *)
(*                        - It's essential that the device xyz is connected with the *)
(*                          control unit. *)
(*                        - Connect the device to the Profibus and provide that the bus is *)
(*                          running without any error. *)
(*------------------------------------------------------------------------------------*)

(* Additional Header *)
(*------------------------------------------------------------------------------------*)
(* Customer             : Koenig & Bauer AG *)
(* Machine              : FA0815STX *)
(*------------------------------------------------------------------------------------*)

(*############################################################################################*)
(*############################################################################################*)
PROGRAM ZZMainProgram
VAR
```

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IL Guidelines − Prefix for type & variable identifiers

Data type	Prefix	Instance example	Type example
Function block	fb	fbJogAxisX1	MT_Jogging
Structure	st	stDeviceCommunication	MX_COM_DATA
Array	ar	arStateControlUnit	MV_STATE_INFO
Enumerator	en	enDeviceDiagnosis	ML_DIAG_DATA

Data type	Prefix	Example	Memory allocation	Data type designation	Data type description
BOOL	b	bVar	1 Bit	Boole	Bit oriented boolean format
BYTE	by	byVar	8 Bit	Byte	Bit oriented Byte format
WORD	w	wVar	16 Bit	Word	Bit oriented format with simple word length
DWORD	dw	dwVar	32 Bit	Double Word	Bit oriented format with double word length
LWORD	lw	lwVar	64 Bit	Long Word	Bit oriented format with fourfold word length
SINT	si	siVar	8 Bit	Short Integer	integer signed format with shortened length
INT	i	iVar	16 Bit	Integer	integer signed format with simple length
DINT	di	diVar	32 Bit	Double Integer	integer signed format with double length
LINT	li	liVar	64 Bit	Long Integer	integer signed format with fourfold length
USINT	usi	usiVar	8 Bit	UnsignedShort Integer	integer unsigned format with shortened length
UINT	ui	uiVar	16 Bit	Unsigned Integer	integer unsigned format with simple length
UDINT	udi	udiVar	32 Bit	Unsigned Double Integer	integer unsigned format with double length
ULINT	uli	uliVar	64 Bit	Unsigned Long Integer	integer unsigned format with fourfold length
REAL	r	rVar	32 Bit	Real	real number with simple length

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IL Guidelines − Prefix for type & variable identifiers

LREAL	lr	lrVar	64 Bit	Long Real	real number with double length
STRING	str	strVar	8 Bit per character	String	string of 1-255 characters (ANSI code possible)
WSTRING	wstr	wstrVar	16 Bit per character	Wide String	string of 1-65535 characters (UNI code possible)
TIME	t	tVar	32 Bit	Time	Time format
DATE	d	dVar	32 Bit	Date	Date format
TIME_OF_DAY	tod	todVar	32 Bit	Time Of Day	Time of day format
DATE_AND_TIME	dat	datVar	32 Bit	Date And Time	Date and time format
POINTER TO ???	p???	p???Var	32 Bit	Pointer To ???	Pointer / address of a variable with special data type
POINTER TO DWORD	pdw	pdwVar	32 Bit	Pointer To Double Word	Example: Pointer to a double word variable

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Libraries

- IndraWorks has a two-stage library management:
  Libraries are first installed into the repository before adding them to a project

- The **Library Repository** holds all libraries which have been installed on the local system, in order that they can be bound to an IndraLogic project. In the Library Repository is a link to the folder where the library is located.

- In the **Library Manager** the libraries which are available in the repository can be added to a project. Consequently the functions, function blocks or other elements of the library (e.g. data types) can be used in the project.

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Libraries for IndraMotion MLC

ML_Base_...	Data types and variables which are particular for the systems IndraMotion MLC and IndraLogic XLC. Functions, function blocks and methods to access the concrete control hardware.
ML_PLCopen	PLCopen function blocks for the programming of real axes (sercos-based), virtual axes etc. Functions for read and write access to control and axis parameters.
ML_TechInterface	IMC Interface and Axis Interface for programming of real and virtual axes etc.
RMB_PLCopenFieldBus	PLCopen function blocks for the programming of field bus-based axes
ML_Robot	Data types, functions and function blocks for robot applications

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Libraries for IndraMotion MLC

RIL_CheckRtv	Implicit check of division by 0, access to array elements, pointer access, etc.
RIL_CommonTypes	Data types for PLCopen function blocks
RIL_Utilities	Common IL functions and function blocks
RIL_ProfibusDP_Util	Archiving and restoring of DP/V1 parameters of ProfibusDP/V1 devices; functions for drives connected via PROFIBUS (PROFIdrive)
RIL_ModbusTCP	Diagnosis and Communication services for Modbus/TCP
RIL_SocketComm	Basic functions for TCP/IP and UDP communication
RIL_LoopControl	Basic elements and controllers
RIL_NetXLoad	Only for internal use
RIL_HMI_Utilities	Functions to access M-Keys on a HMI
RIH_CMLx	Hardware information of CML25/L45/L65 (OHC, temperature, elektronic typeplates, display of messages)

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Libraries for IndraMotion MLC

ML_TechBase	
ML_TechMotion	
ML_TechReg	
ML_TechCrank	
ML_TechTensionAdvanced	
RMB_TechWinder	
RMB_CrosscutCrossseal	
RMB_TechCam	
RIL_ParameterChannel	

Technology function blocks

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Global Data as interface to the motion kernel (axis)

Write access	Read access

AxisInterface

arAxisCtrl_gb[3]
arAxisCtrl_gb[2]
arAxisCtrl_gb[1]

arAxisStatus_gb[3]
arAxisStatus_gb[2]
arAxisStatus_gb[1]

ML_Base

"Shared Memory" for read access to axis status information

AxisData[3]
AxisData[2]
AxisData[1]

ML_Base

DV_Axis[3]
DV_Axis[2]
DV_Axis[1]

"Direct variables" for read access (and write access) to A parameters

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Global Data as interface to the motion kernel (MLC)

Write access	Read access
ImcInterface	
ImcCtrl	ImcStatus
ML_Base	Read access to status information
	ControlData[...]
	ControlData[LOCAL_CNTRL]
ML_Base	
DV_Control[...]	"Direct variables" for read access (and write access) to C parameters
DV_Control[LOCAL_CNTRL]	

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Global Data related to axes

- AxisData is an array with elements of type ML_AXISDATA_SM
  - This axis-specific structure holds „per axis" information like:
    - **Axis state information, e.g.**
      ```
      AxisData[1].Axis_InVelocity
      ```
    - **Actual values for Position, Velocity and Force/Torque, e.g.**
      ```
      AxisData[1].rActualPosition_i
      AxisData[1].rActualVelocity_i
      ```
    - **Container for customized command values and actual values**
      ```
      AxisData[1].dwUserCmdDataA_q
      AxisData[1].dwUserActualDataC_i
      ```
- DV_Axis is an array with elements of type ML_DirectVarAxis
  - **Access to A-Parameters**
    ```
    DV_Axis[1].A_0_0100                    // actual position
    DV_Axis[1].A_0_0102                    // actual velocity
    ```
- arAxisStatus_gb is an array with elements of type TE_STATUS_DATA
  - **Access to axis state information, e.g.**
    ```
    arAxisStatus_gb[1].Admin.OpModeAck     // operating mode
    arAxisStatus_gb[1].Admin.CmdDone       // cmd acknowledgement
    ```

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Global Data related to control

▪ ControlData is an array with elements of type ML_CONTROLDATA_SM

  ▪ It holds information on Sercos etc, e.g.

  - **Redundancy warning active**

    `ControlData[LOCAL_CNTRL].arSercos[ML_LOCAL_SERCOS_IFC].ERROR_RED`

  - **Flag to recover Sercos ring**

    `ControlData[LOCAL_CNTRL].arSercos[ML_LOCAL_SERCOS_IFC].RBUILD_RING`

  - **Sercos cross communication**

    `ControlData[LOCAL_CNTRL].arLinkSyncBits_i[…]. …`

▪ DV_Control is an array with elements of type ML_DirectVarControl

  ▪ **Access to C-Parameters**

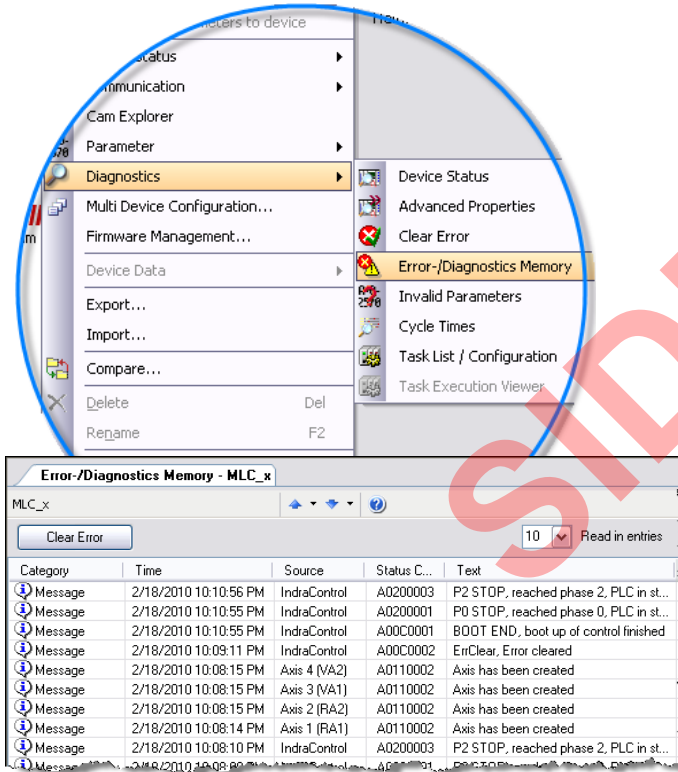   `DV_Control[LOCAL_CNTRL].C_0_0023`   `// system status`
    `DV_Control[LOCAL_CNTRL].C_0_0070`   `// control termperature`

▪ ImcStatus is an array with elements of type MB_IMC_STATUS_TYPE01

  ▪ **Access to control state information**

    `ImcStatus[LOCAL_CNTRL].Admin._OpModeAck`   `// Sercos phase`
    `ImcStatus[LOCAL_CNTRL].Diag.Error`   `// error pending`

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Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
- Motion Programming Basics
- MLC Diagnosis system
- Sercos – the automation bus
- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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System Diagnosis

- Display of **device status**

- Function for **clearing errors**

- **Diagnosis / error memory**
  for the entire system (max. 1000
  entries)

- List of invalid parameters

- Overview on task configuration

- Monitoring of the task execution

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Diagnosis / Error memory

- Message categories

Categories	Note
ⓘ Message	Status information of message type
⊗ Error	Error reaches, the error reaction is triggered, the error is active
⊙ Error	Error passive, the error cause still exists, but the error was reset
Ⓡ Error	Error leaves, the error cause does not exist any longer **and** the error was reset
⚠ Warning	Warning reached, the warning reaction is triggered, the warning is active
⚠ Warning	Warning passive, the warning cause still exists, the warning was reset
Ⓡ Warning	Warning leaves, the warning cause does not exist any longer **and** the warning was reset

- Display of messages

Error/Diagnostic Logbook - MLC...

Clear Error   max. 10 ▼ most recent entries

Category	Time	Source	Status Code	Text
ⓘ Message	4/11/2007 5:23:01 PM	IndraControl	A0200003	P2 STOP, reached phase 2, PLC in stop
⊗ Error	4/11/2007 5:23:00 PM	IndraControl	F0160021	RTOS error (Real Time Operating System)
ⓘ Message	4/11/2007 5:22:59 PM	IndraControl	A00C0001	BOOT END, boot up of control finished
ⓘ Message	4/11/2007 5:22:59 PM	IndraControl	A0200001	P0 STOP, reached phase 0, PLC in stop
ⓘ Message	4/11/2007 4:09:39 PM	IndraControl	A0200003	P2 STOP, reached phase 2, PLC in stop
ⓘ Message	4/11/2007 4:09:39 PM	IndraControl	A0200001	P0 STOP, reached phase 0, PLC in stop
ⓘ Message	4/11/2007 4:09:38 PM	IndraControl	A0200005	BB STOP, Motion ready, PLC in stop
⊗ Error	4/11/2007 4:09:38 PM	IndraControl	F0160021	RTOS error (Real Time Operating System)
ⓘ Message	4/11/2007 4:09:37 PM	IndraControl	A0200004	P3 STOP, reached phase 3, PLC in stop
ⓘ Message	4/11/2007 4:09:37 PM	IndraControl	A0200003	P2 STOP, reached phase 2, PLC in stop

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Axis Diagnosis

- Display of axis status and drive status

- Function Clear errors

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Display of pending errors, warnings, and infos

`192.168.250.253`

Colored icon
indicates pending error / warning

By pushing the button the internal **diagnosis / error memory** is displayed.
It holds diagnostic information of the overall system (max. 1000 entries)

Error-/Diagnostics Memory - MLC_x

MLC_x

| Clear Error | | | | 10 | Read in entries |

Category	Time	Source	Status C...	Text
Message	2/18/2010 10:10:56 PM	IndraControl	A0200003	P2 STOP, reached phase 2, PLC in st...
Message	2/18/2010 10:10:55 PM	IndraControl	A0200001	P0 STOP, reached phase 0, PLC in st...
Message	2/18/2010 10:10:55 PM	IndraControl	A00C0001	BOOT END, boot up of control finished
Message	2/18/2010 10:09:11 PM	IndraControl	A00C0002	ErrClear, Error cleared
Message	2/18/2010 10:08:15 PM	Axis 4 (Va 2)	A0110002	Axis has been created
Message	2/18/2010 10:08:15 PM	Axis 3 (V)	A0110002	Axis has been created
Message	2/18/2010 10:08:15 PM	Axis 2 (F 2)	A0110002	Axis has been created
Message	2/18/2010 10:08:14 PM	Axis 1 (F)	A0110002	Axis has been created
Message	2/18/2010 10:08:10 PM	IndraCo ol	A0200003	P2 STOP, reached phase 2, PLC in st...

After a double click on an entry the Online Help opens   and you get more information on
the occurred error or warning!

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Diagnosis concept

- MLC has a consistent diagnostic system

- Every MLC diagnosis info has a 8-digit diagnosis code as a unique identifier

- The 8-digit diagnosis code is displayed as well as a plain text message in German or English language (for MLC)

- The IndraDrive has some more languages available ...

- Diagnosis infos are displayed

  - in IndraWorks (Device status, Axis-/Drive status)

  - in the MLC-internal diagnosis memory (in chronological order)

  - on the display of IndraControl L25/45/65/75

  - Error output of PLCopen function blocks, technology function blocks etc.
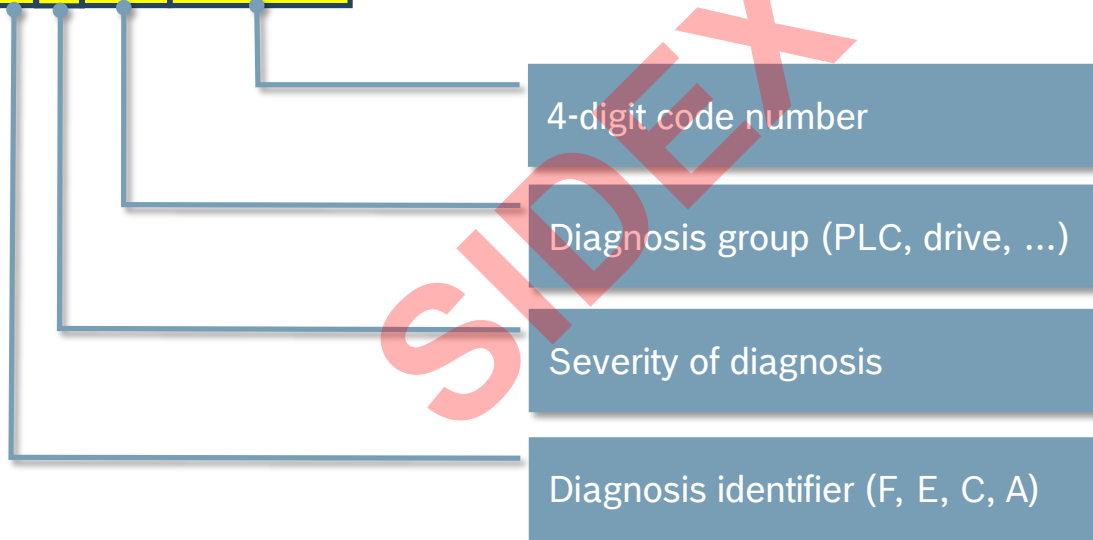
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Diagnosis codes

8-digit diagnosis code   plain text message

| **F50B0002** |

SERCOS ring interrupted

4-digit code number

Diagnosis group (PLC, drive, ...)

Severity of diagnosis

Diagnosis identifier (F, E, C, A)

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Diagnosis codes − Identifier & Severity

Diagnostic identifier

- Currently, 4 different categories are supported:
    - F - Error
    - C - Command error
    - E - Warning
    - A - Message
- Priority is defined as follows: F > C > E > A

Severity of the diagnostic

- Currently ten degrees of severity are supported for the MLC:
- F9 > ... >F1 >F0 ; C9 > ... >C1 >C0 ; E0 ; A0.

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Diagnosis codes – Severity

Severity	Description /Designation	Error reaction
0	Non-fatal error	Logbook entry is generated, message is shown on the display, no error reaction.
1	Axis group error	Logbook entry is generated, message is shown on the display, If an axis belonging to a group activates an error of severity F2, Disengage the axis, then this axis is currently lost to the group and the group reacts with an F1 error, disengaging **all** axes in the group.
2	Axis error	A logbook entry is generated, a message is shown on the display, Axis (or drive) is disengaged as best as possible, all other axes are unaffected by this.
3/4	Reserved	–
5	Controller error	A logbook entry is generated, a message is shown on the display, **All** axes are disengaged as best as possible.
6	Reserved	–
7	Reserved	–
8	Fatal controller error	A logbook entry is generated, a message is shown on the display, **All** axes are disengaged as best as possible.
9	Fatal system error Exception, undefined system status	A logbook entry is generated, a message is shown on the display, Firmware no longer working, request for FatalSystemErrorHandler (), no error reaction to the drive, torque disable.

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Diagnosis codes − Group

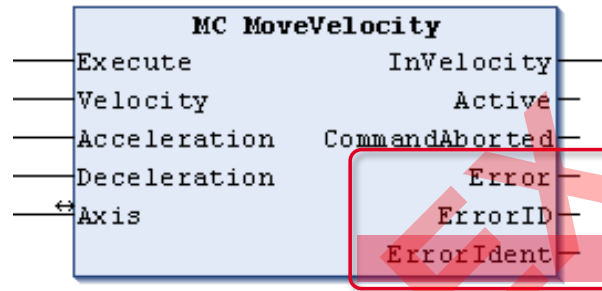**Diagnosis group**

- … indicates which component has caused an error etc.

Group	Cause / Error Table
00	IndraDrive drive/ INDRV_TABLE (see IndraDrive Drive Errors, IndraDrive Drive Warning)
01…A9	MLC firmware, e.g. a virtual axis error Virtual Axis, Error Message
2D	SERCOS error/ SERCOS_TABLE SERCOS error message
2E	Generic axis / generic drive Generic Axis/SercosDrive, Error Message
AE	User program (to be provided by the user)

- Drive errors are translated as follows:
  - IndraDrive error ***F4034 Emergency-Stop***
  - Expansion to 8 digits → ***F2004034***
  - Severity 2, no other axis is affected
  - Diagnosis group 00 → IndraDrive
  - **S-0-0390** F4034
  - **A-0-0020** "Drive Error"
  - **A-0-0023** F2004034
  - Lx5 display: "**Axis1 F2004034 Drive error**"

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Error information in the motion program


```
(* Structure to implement the diagnostics of the function block *)
TYPE ERROR_STRUCT :
STRUCT
    Table      : ERROR_TABLE;   (* Additional diagnosis table        *)
    Additional1 : DWORD;        (* Contains the error number diagnostics *)
                                (* corresponding to the table.       *)
    Additional2 : DWORD;        (* eventually supplements to Additional1 *)
END_STRUCT
END_TYPE
```

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Error information in the motion program

```
(* Enumeration of valid tables in additional information *)
TYPE ERROR_TABLE:
(
  NO_TABLE_USED       := 16#0000, (* reserved      *)
  SERCOS_TABLE        := 16#0010, (* sercos : Addtitional1 = sercos code *)
  MLD_TABLE           := 16#0020, (* Drive-based Motion – Logic   *)
  MLC_TABLE           := 16#0030, (* Controller-based Motion Logic       *)
  MTX_TABLE           := 16#0040, (* CNC  *)
  MLP_TABLE           := 16#0050, (* PC-based Motion Logic        *)
  PLC_TABLE           := 16#0060, (* PLC  *)
  INDRV_TABLE         := 16#0070, (* IndraDrive   *)
  …       (* DIAX, EcoDrive, Profibus, DeviceNet, *)
          (* Ethernet, EtherNet/IP, Interbus,      *)
          (* function related, CAN        *)
  INLINEIO_TABLE      := 16#0190, (* Inline IO bus       *)
  USER1_TABLE         := 16#1000, (* free User Table     *)
                                  (* ... *)
  USER10_TABLE        := 16#1009  (* free User Table     *)
);
END_TYPE
```

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Error information in the motion program

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Agenda

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- Motion Programming Basics
- MLC Diagnosis system
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- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
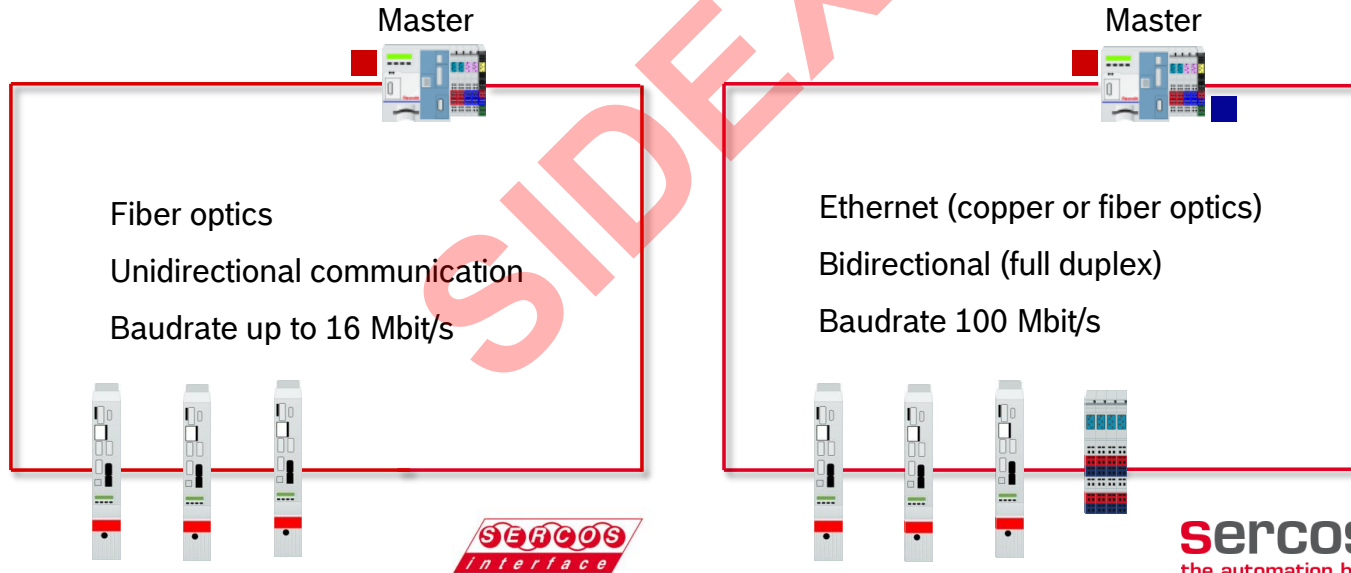- Additional sources of information

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Sercos − What does it mean?

serial

realtime

communication

system

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Sercos – Sercos 2 and Sercos III

Sercos 2

Sercos III

Master

Master

Fiber optics

Unidirectional communication

Baudrate up to 16 Mbit/s

Ethernet (copper or fiber optics)

Bidirectional (full duplex)

Baudrate 100 Mbit/s

sercos
interface

sercos
the automation bus

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Sercos − Features

Master
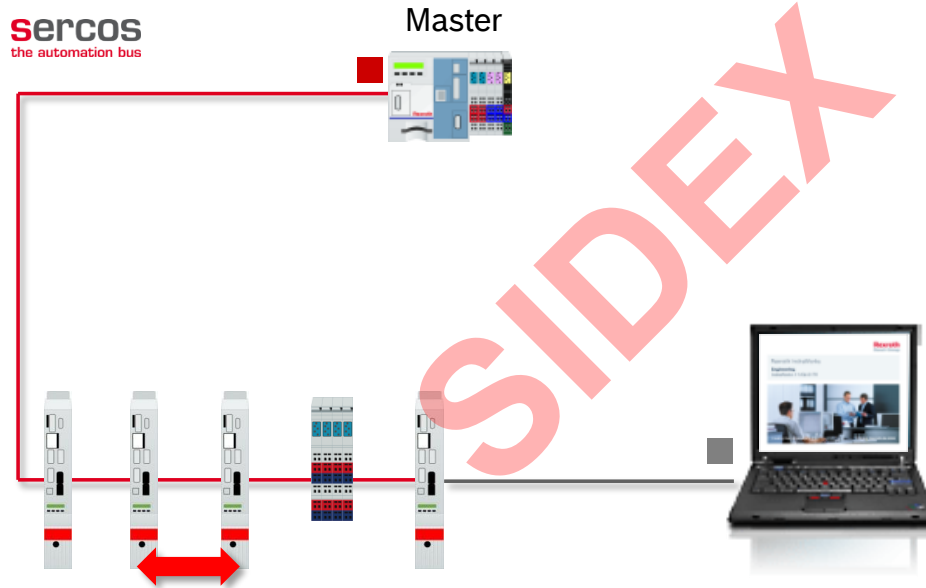
Cyclic
real-time traffic

Cross communication
(CC)

Standard
Ethernet traffic

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Sercos − Features

Master
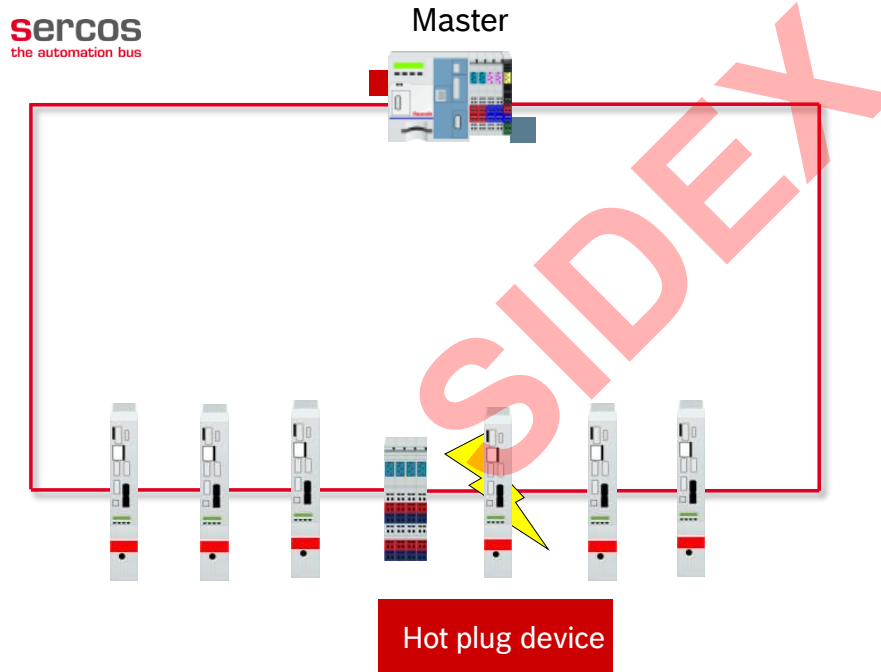
Redundancy
(as of MLC13)

Hot Plug
(not supported
by MLC)

Hot plug device

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Sercos − Communication phases

Phase	Description
NRT Non real-time phase	Standard Ethernet communication possible
CP0 Start phase	The master checks the Sercos ring by sending synchronization telegrams. During CP0 , communication between master and slave is not possible yet.
CP1 Configuration phase	When the ring is closed, the master changes to CP1 and scans the slaves. In addition it checks the configuration of the ring.
CP2 Parameterizing phase	In CP2, the complete drive parameterization can be done. The master transmits communication parameters and device parameters. Subsequently a command is issued to check the parameters inside the slaves.
CP3 Ext. parameterizing phase	Further parameters can be modified in this phase. At the end of CP3 another command is sent to all slaves which triggers a check inside all devices to verify if all required parameters for CP4 are valid.
CP4 Operating Phase	The initialization is complete, normal operation.

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Sercos – IndraDrive Display

Sercos address

Sercos phase

Ab

Esc ▽ △ Enter

Keys for more functions

1	NRT
1	P0
1	P1
1	P2
1	P3
1	bb
1	Ab

Switch power on

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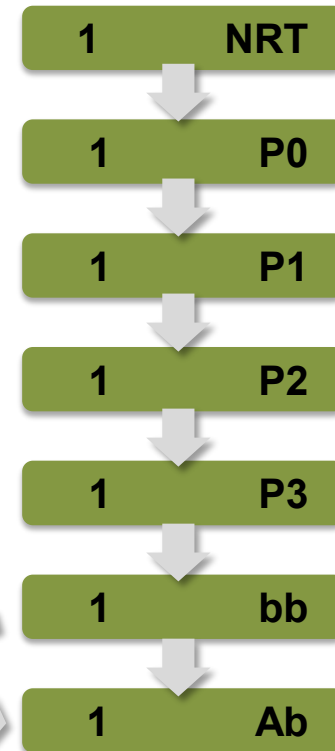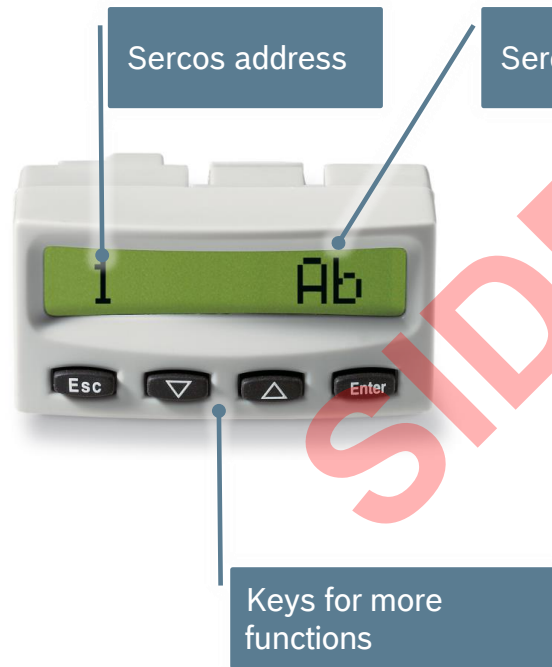
Sercos − Redundancy

- Redundancy is supported for ring topology

- After a break at an arbitrary position the ring is decomposed into a double line

- All Sercos devices remain accessible, there is no interruption of communication

- After reestablishing the connection at the defective position

- … and executing the command "Restore redundancy" the double line is converted back to a ring

IndraMotion MLC

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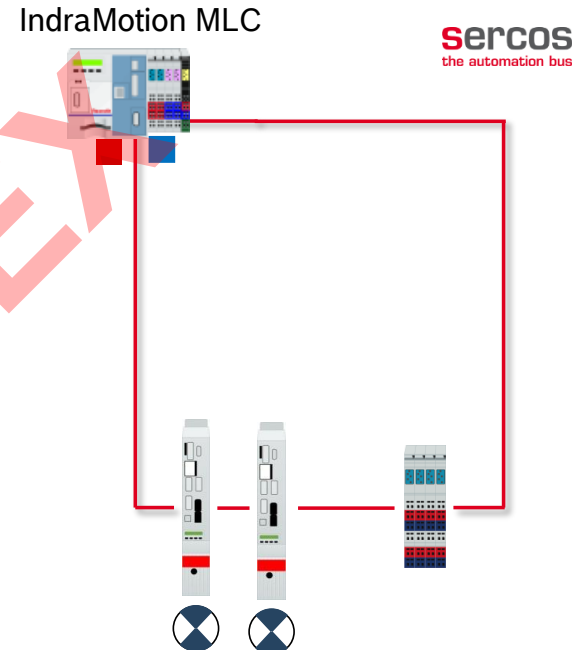
Sercos − Redundancy

sercos Eigenschaften - MLC_L65

MLC_L65

Busdiagnose | E/A-Diagnose | Einstellungen

Allgemein

Erlaubte Telegrammausfälle   2

Redundanz

Redundanzerkennung   Redundanzerkennung ein

Keine Redundanzerkennung
Redundanzerkennung ein
Redundanzerkennung mit Ringwiederherstellung

No detection of redundancy loss (for line topology)

Detection of redundancy loss (automatic recovery)

Detection of redundancy loss ("manual" recovery")

If line topology is used detection of redundancy loss has to be disabled (C-0-0-0506), otherwise the warning "E00B0179 Sercos III: Redundancy error" is displayed permanently!

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Archiving IndraWorks projects

For which purpose you need an archived IndraWorks project?

- Service
  For diagnosis purposes, drive replacement, and other service tasks a valid
  IndraWorks project is required

- Support
  A qualified support can be done based on the complete IndraWorks project.
  For this purpose the exchange of a complete IndraWorks archive is very
  useful

- Serial machines
  The IndraWorks project is required to duplicate machines

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Archiving IndraWorks projects

Engineering PC

IndraWorks project
- Control, axis & IO configuration
- Offline parameters
- IndraLogic project (sources)
- CAMs
- FlexProfiles
- ...

MLC

CF

System partition
- Firmware

OEM partition
- PLC boot project
- IndraWorks project

User partition
- ... (other)

unpartioned area
- C parameters
- A parameters
- K, M, O parameters
- remanent PLC data

IndraDrive

Flash / MMC Display / µSD
- Firmware
- S parameters
- P parameters

IndraWorks archive (on HDD and/or on CF of MLC)

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Archiving IndraWorks projects

- Invoke the Archiving function via menu or toolbar
- … IndraWorks is in online mode
☞ Switch Sercos to CP2 and stop the PLC!
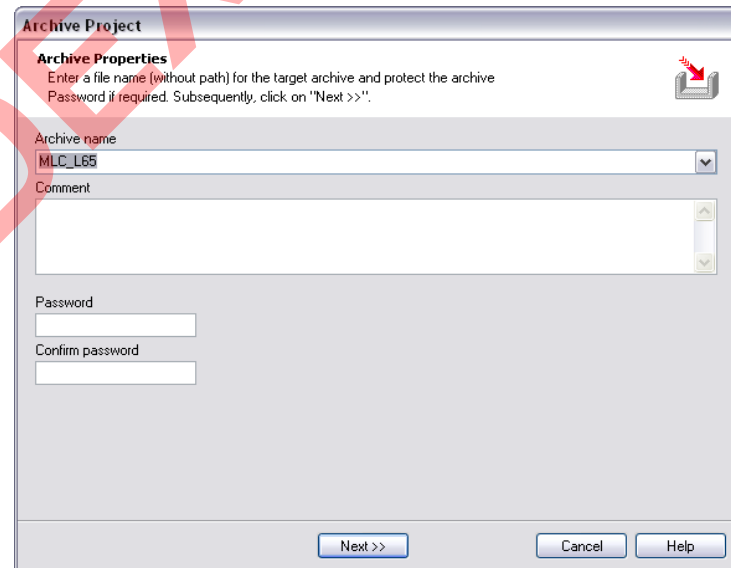
- Enter an archive name
- Optionally you can protect the archive by a password

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Archiving IndraWorks projects
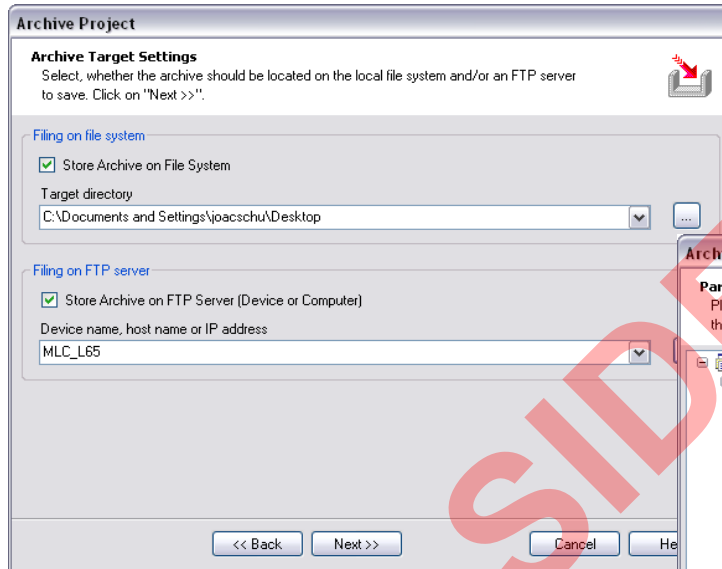
- Specify the target directory and/or
- the device name or IP address of the MLC
- (storage on a FTP server is also supported)
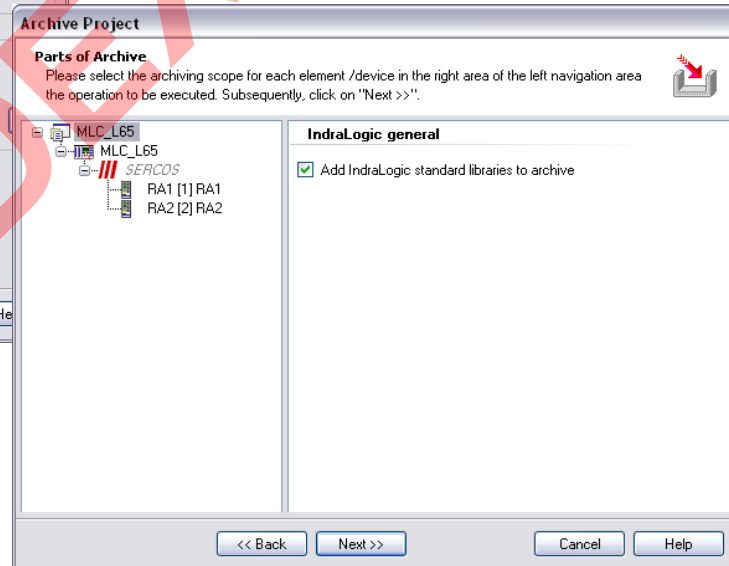
- Add IndraLogic libraries to archive

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Archiving IndraWorks projects
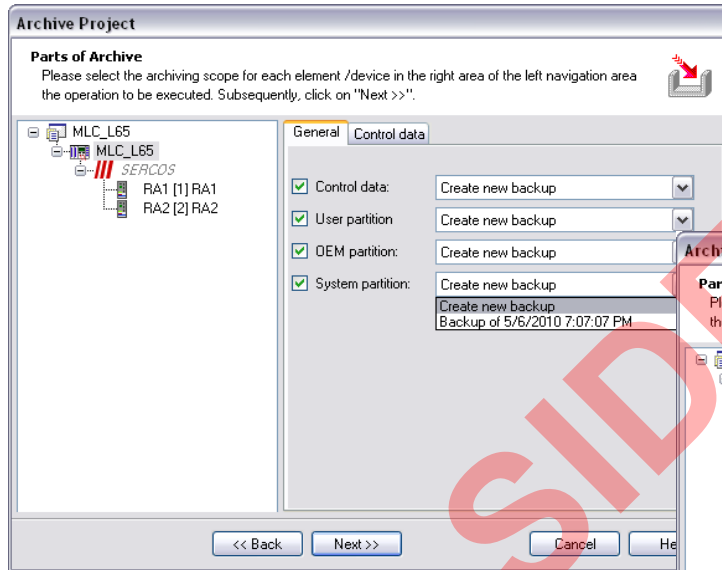
- **Tab "General":**
- Select control data (includes drive data)
- Select User and OEM partition
- Select new backup or an existing backup, which is still up-to-date
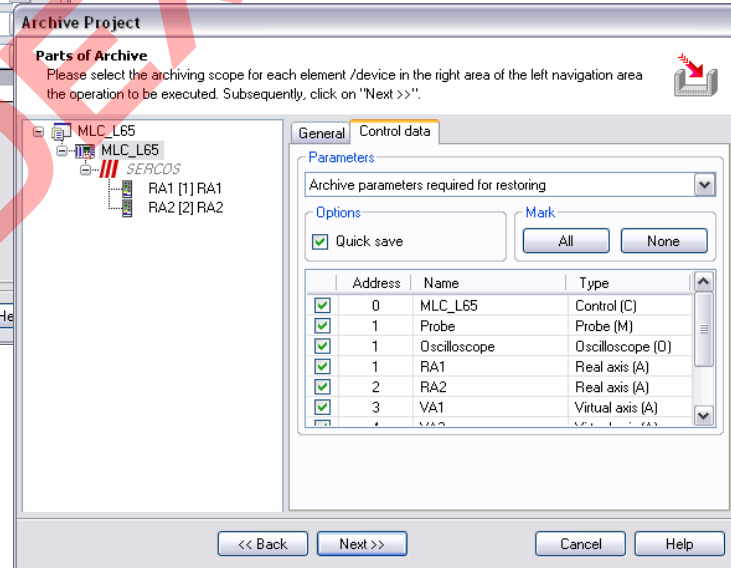
- **Tab "Control data":**
- Mark all parameters
- Select option
  "Archive parameters required for restoring"

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Archiving IndraWorks projects

Archive Project

Create Archive
This operation may last several minutes. The opened project is closed during archiving.
Click on "Stop" for stopping or canceling the operation.

MLC_L65: Archiving of System-partition - Current file: SYI.o.

8%

[Stop]

[<< Back] [Next >>]   [Cancel] [Help]

Name ▲	Größe	Typ	Geändert am
CF_OEM.zip	105 KB	zip Archive	06.05.2010 19:06
CF_System.zip	6.506 KB	zip Archive	06.05.2010 19:07
CF_User.zip	14.010 KB	zip Archive	06.05.2010 19:06
DeviceData.meta	1 KB	META-Datei	06.05.2010 19:07
Params.par	344 KB	PAR-Datei	06.05.2010 19:06

- During the archive operation the selected data is transferred to the engineering PC
- ... and stored in a subfolder of the current IndraWorks project

- Subfolder "ArchivedData" in current IndraWorks project

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Archiving IndraWorks projects

- Finally the complete IndraWorks project is zipped and stored as an archive in the specified target directory
- … and/or on the CF card of the MLC (partition OEM)
- The successful result is displayed:

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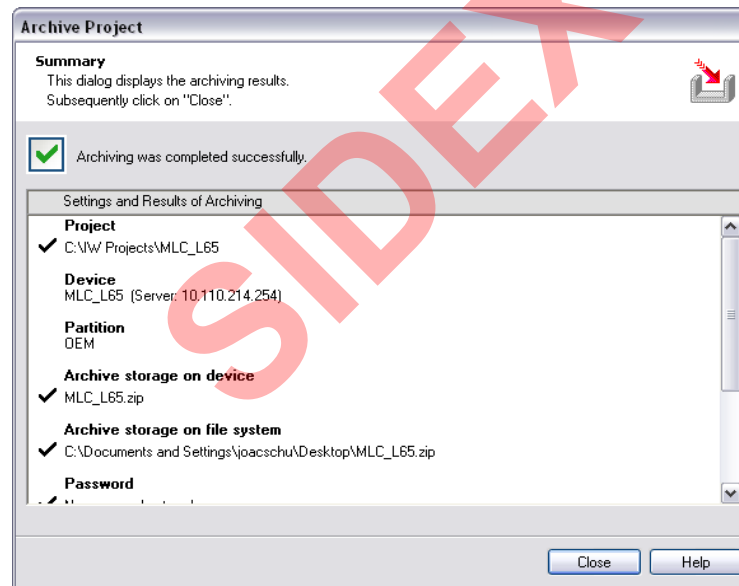
Restoring IndraWorks projects

- Restoring an MLC project archive may occur in different scenarios:

  - Service – diagnosis
    A service engineer restores an IndraWorks project to his own engineering notebook to perform service tasks on a running machine. After restoring the project direct switching to online mode is possible without downloading anything to MLC
  - Service – exchange of control or drive components
    In case of drive replacement etc. parameters have to be downloaded to the new drive.
  - Duplicating machines – 1st time installation
    The IndraWorks project is used to duplicate an existing machine. In this case all device data (control & drive parameters, CF partitions) have to be restored
  - Support of a customer
    During the commissioning phase of a machine the complete IndraWorks archive can be forwarded to Bosch Rexroth for further processing. After fixing a problem the revised project is returned to the customer

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Restoring IndraWorks projects
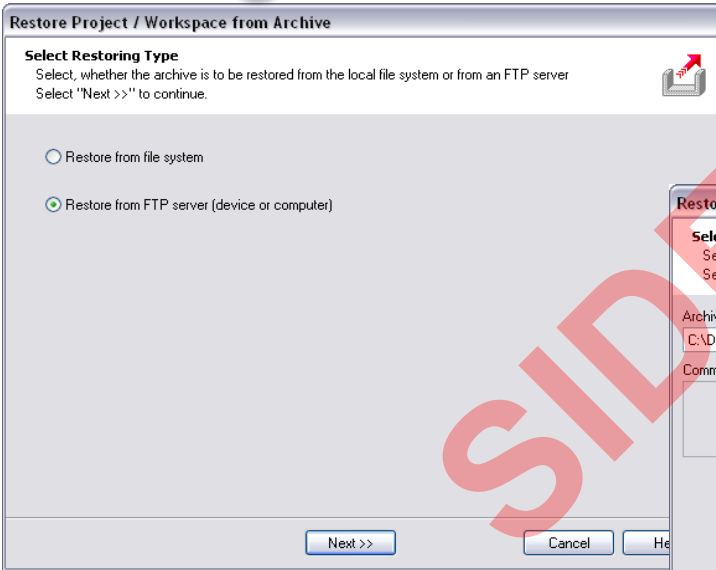
- To restore push the button "Restore project"
- You can restore from the HDD
- … or from IndraMotion MLC
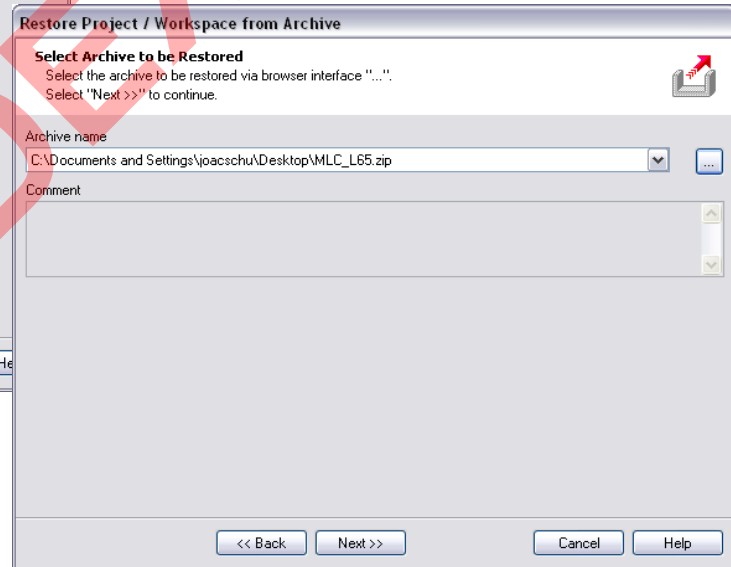
- If you restore from the file system specify the path and name of the archive

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Restoring IndraWorks projects
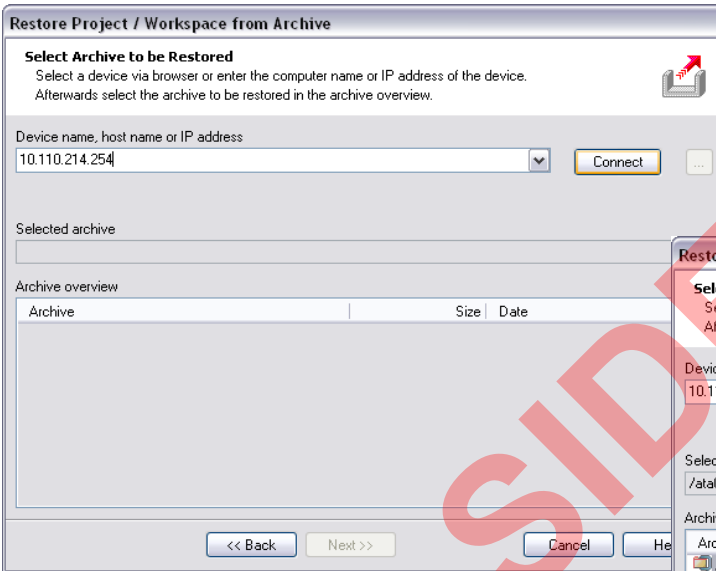
- If you want to restore from the CF card
- ... enter an IP address or host name
- ... and push "Connect" button
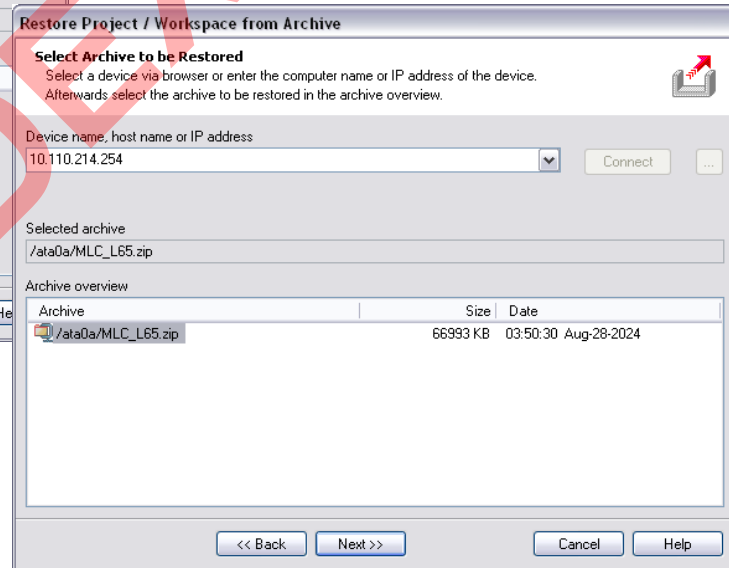
- A list of the archived project(s) on the CF is displayed
- Select the appropriate entry and push the "Next" button

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Restoring IndraWorks projects
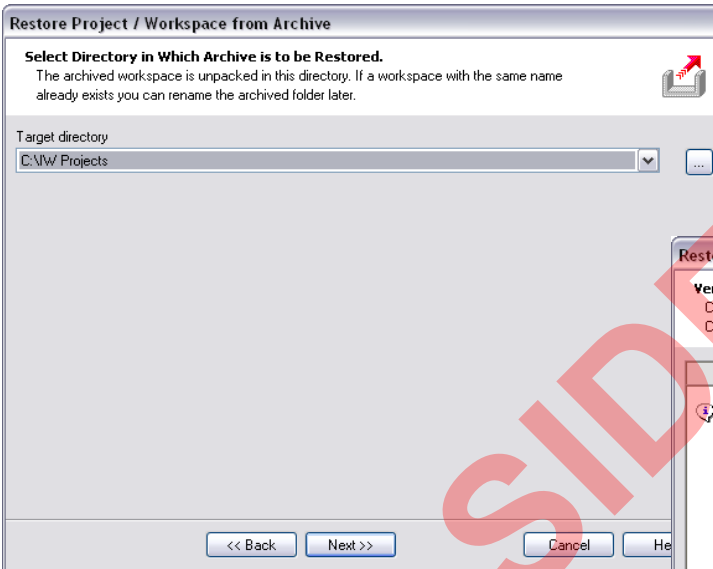
- Enter the target directory on your HDD to which you want to restore to
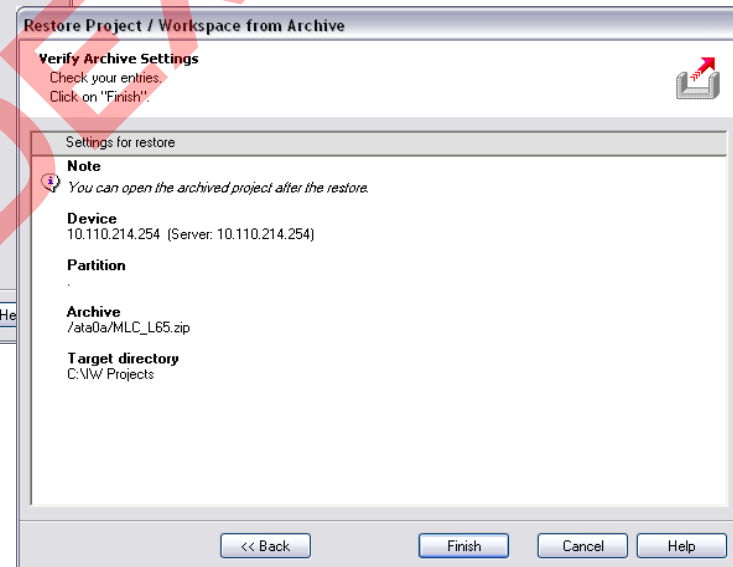
- A summary of the operations to be performed is displayed
- Push the "Finish" button to acknowledge the restore procedure

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Restoring IndraWorks projects

Restore Project / Workspace from Archive

Restore Archive
This operation can take several minutes. The project or the workspace can subsequently
be opened. Click on "Stop" to stop or cancel the operation.

Get Archive from Target Device: /ata0a/MLC_L65.zip

19%

Stop

<< Back   Next >>   Cancel   Help

- As a result is transferred from the MLC and unzipped
- … or directly unzipped from the HDD

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Restoring IndraWorks projects
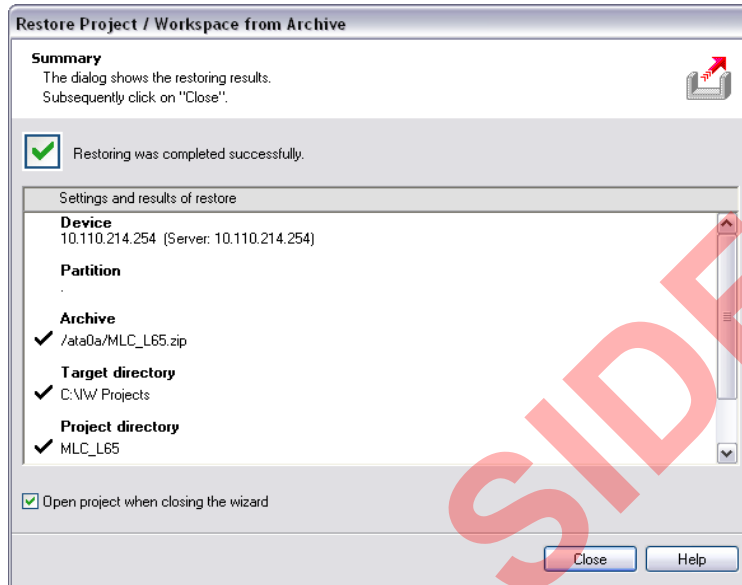
- On completion the result of the restore operation is displayed
- ... and you can immediately open the restored project
- ... mark the checkbox "Open project when closing the wizard" and and press the "Close" button

- A reminder is displayed because eventually device data must be restored

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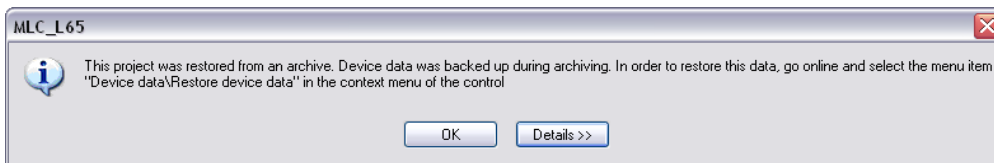
Restoring IndraWorks projects
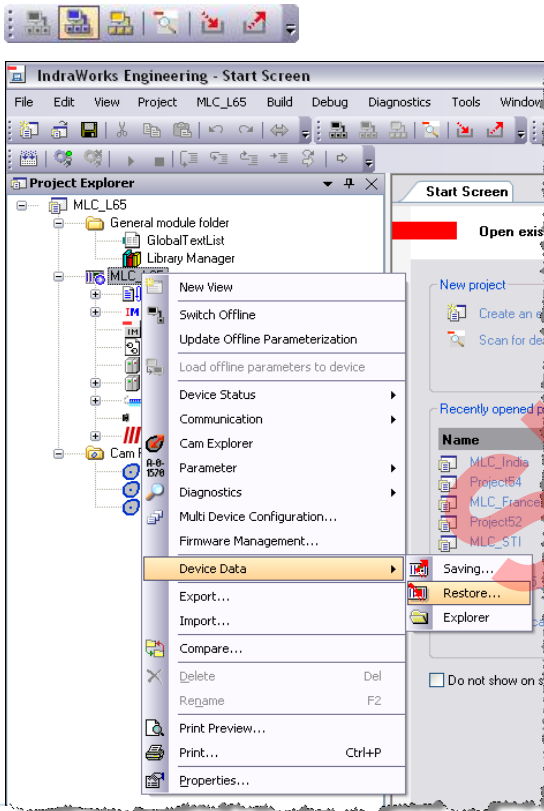
- To restore the Device Data switch to Online mode

- In version 14 the motion configuration is not downloaded automatically when going online

- Before restoring the device data, the motion configuration has to be downloaded

- Subsequently select the submenu entry "Device Data/Restore"

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Restoring IndraWorks projects
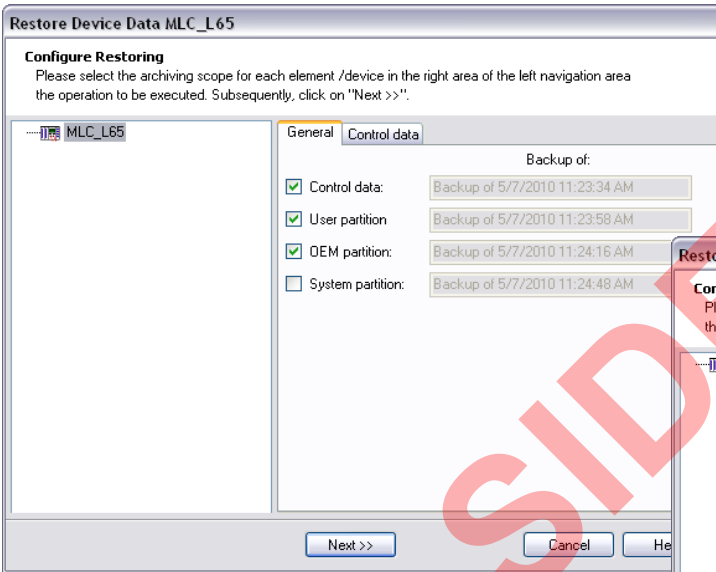
- Select what you want to restore
- In most cases you will restore the complete control data (control & drive parameters)
- … as well as User & OEM partition
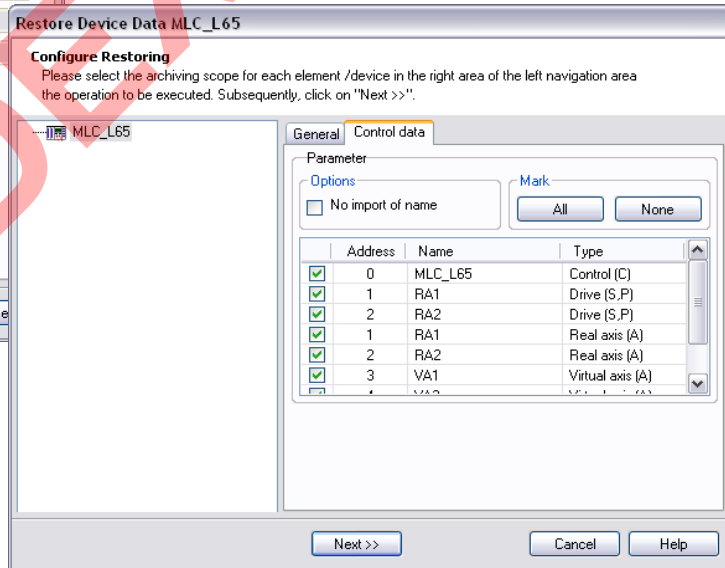
- On the tab "Control data" select the items you want to restore
- In this case restore the complete parameter set

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Restoring IndraWorks projects
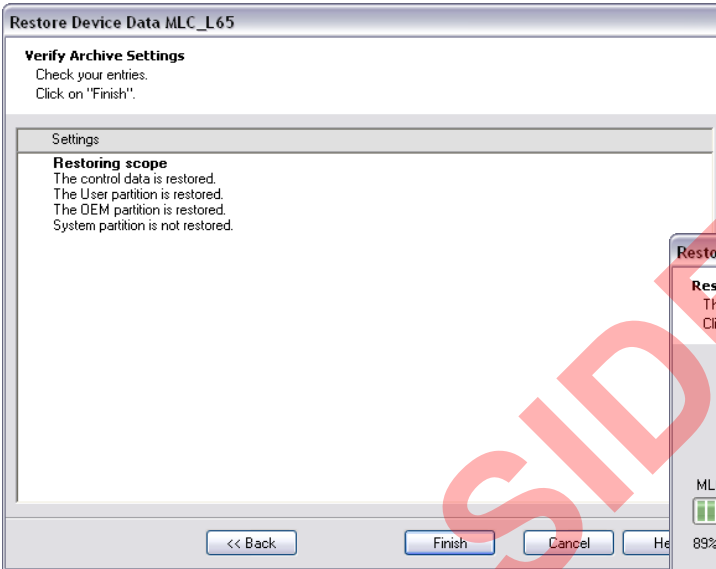
- A summary of the procedure to be performed is displayed
- Acknowledge this operation by pushing the "Finish" button

- As a result the selected partitions
- ... and the selected control and drive parameters are restored

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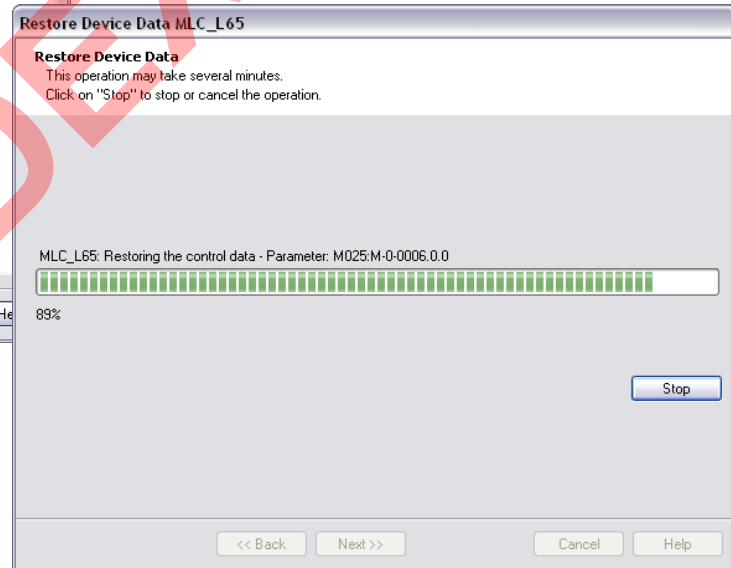
Restoring IndraWorks projects

▪ After all data has been downloaded to the MLC

▪ ... the successful result is displayed:

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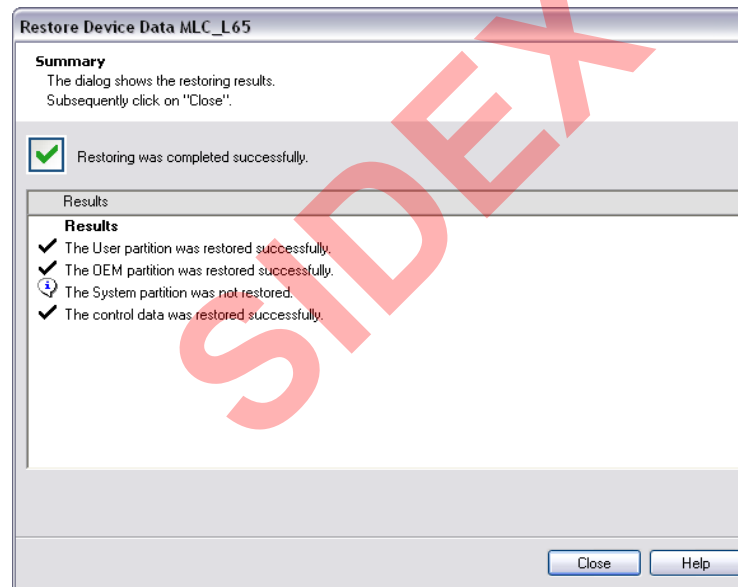
Export of control or drive parameters
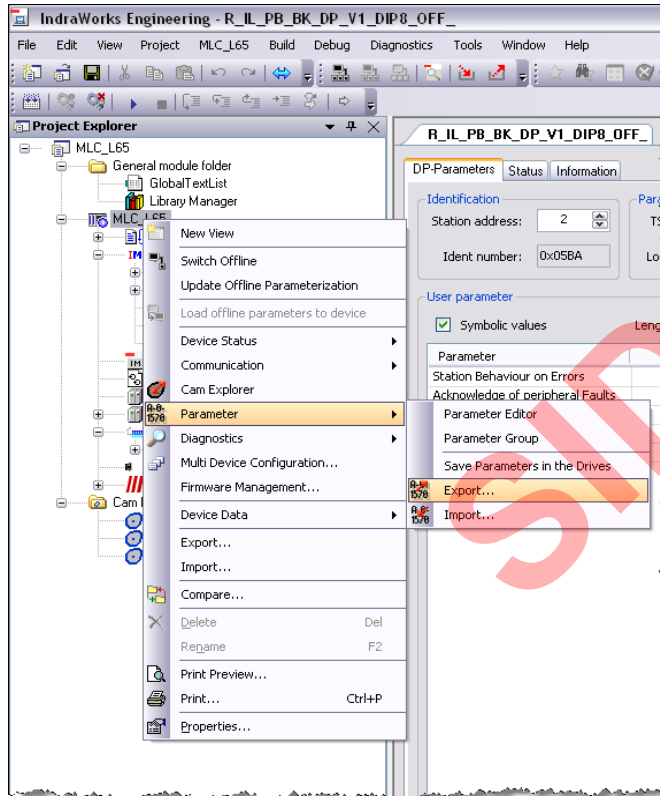
- **Parameter export**
- If you want to save the actual parameter values of your control and / or drives
- ... select the submenu entry "Parameter/Export"
- This is necessary for instance before downloading a new firmware

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Export of control or drive parameters
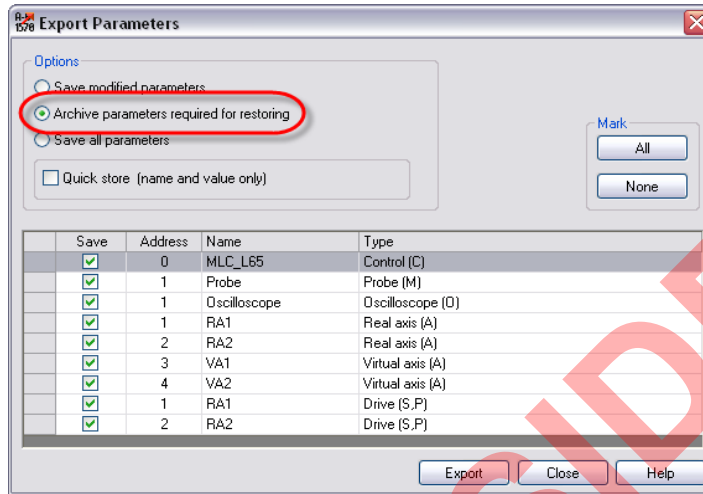
- Select "Archive parameters required for restoring"
- Export of all parameters or
- ... only of selected parameters is supported
- Push "All" to export the complete parameter set

- The parameter file is stored within the IndraWorks project folder
- If needed a subfolder for the parameter file can be created
- Enter a filename for the parameter file

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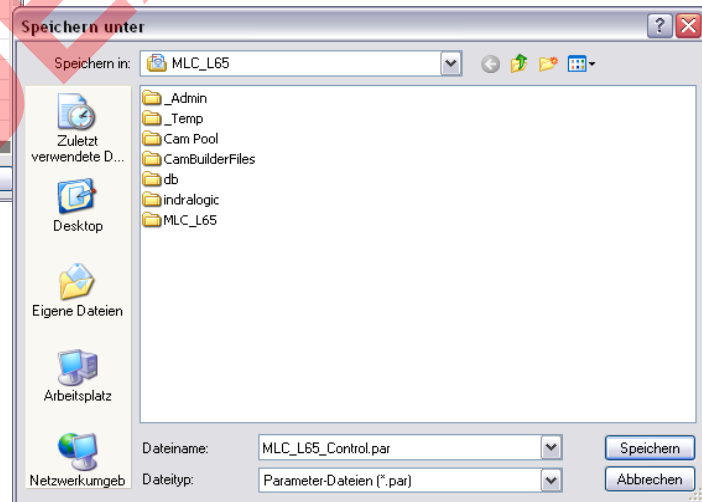
Export of control or drive parameters

- The parameters are uploaded from MLC and stored in a parameter file

- During this procedure the actual progress is displayed

```
Export Parameters                                    [X]
Parameter IDN : A001:S-0-0206.0.0
[IIIII                                              ]
                              Copy        Cancel
```
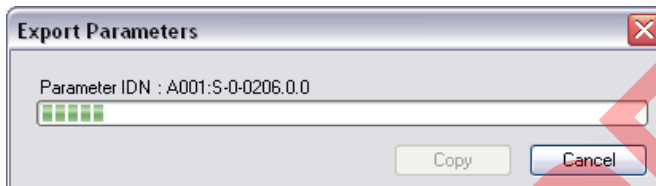
- On completion this information is displayed

```
Export Parameters                                    [X]
Export completed
[IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII]
                              Copy         Close
```
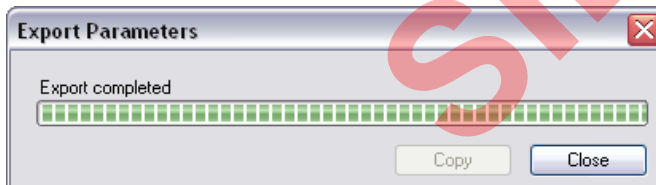
- As a result the parameters are saved in the parameter file which can be imported later on

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Import of control or drive parameters
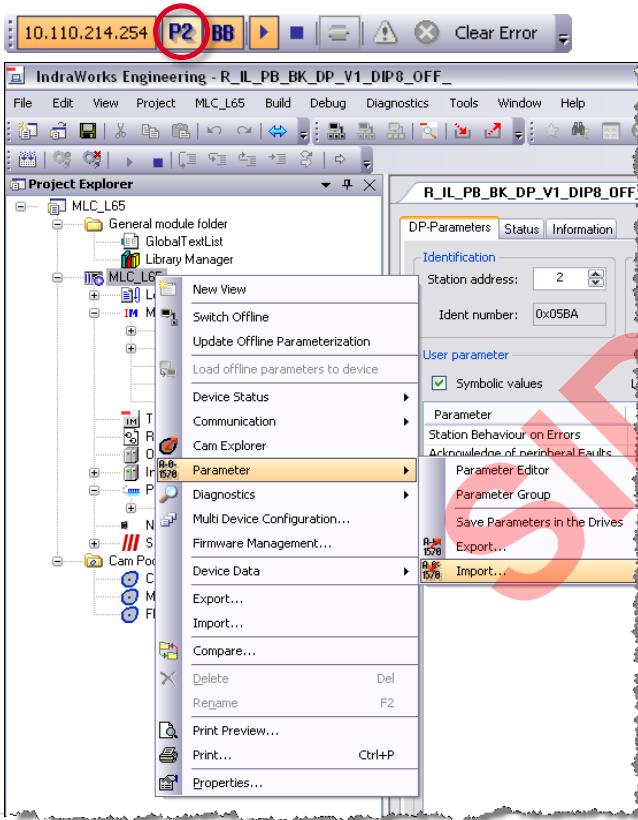
- **Parameter import**
- If you have a parameter file you can download the parameters to the MLC and in this way restore a prior state
- Before importing parameters switch the control to parameter mode
- … then select the submenu entry "Parameter/Import"

- This procedure is necessary for instance after a firmware upgrade

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Import of control or drive parameters
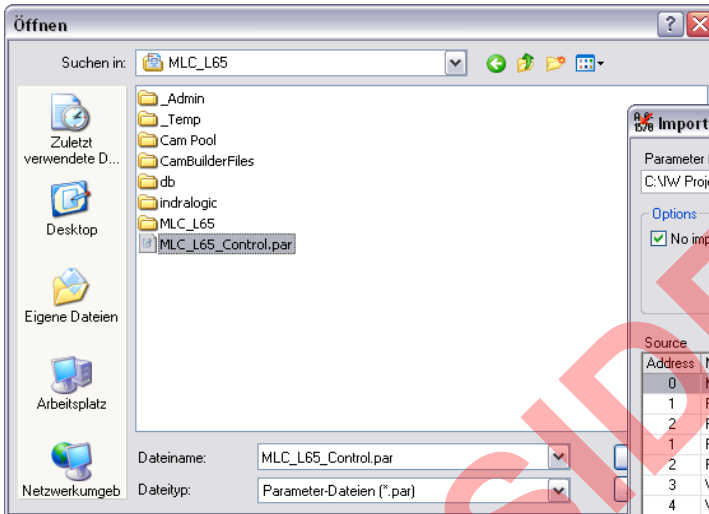
- Select the appropriate parameter file
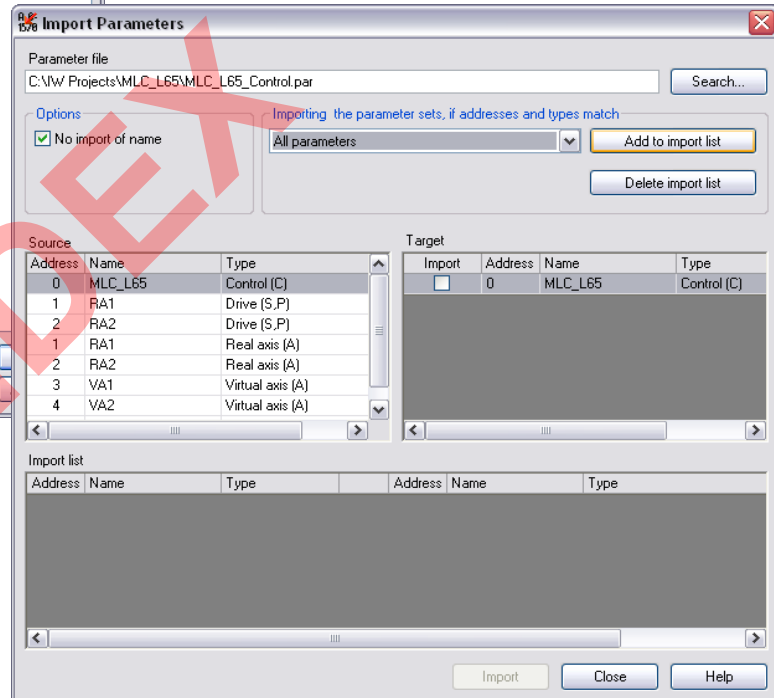
- The components within the parameter file are displayed
- A selective import
- ... as well as a full import is supported

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Import of control or drive parameters
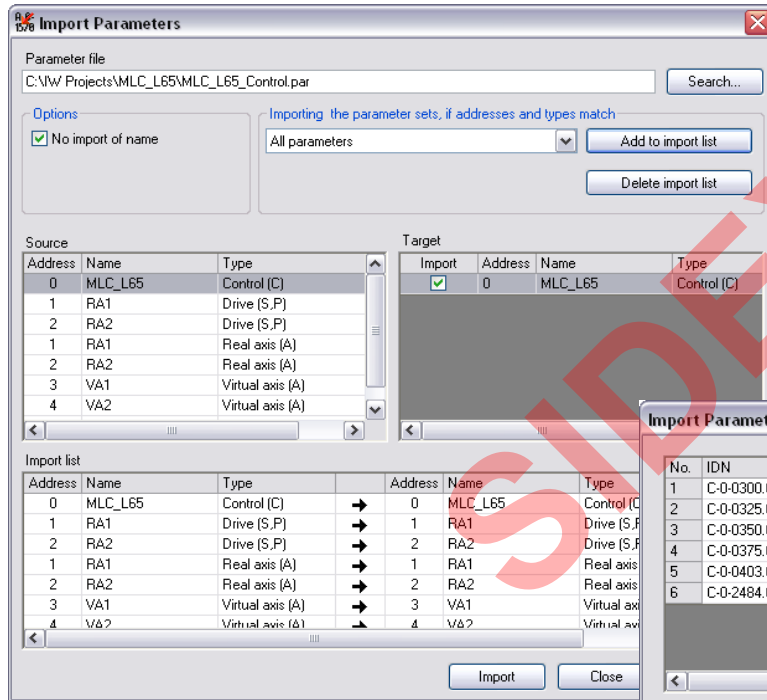
- If you press "Add to import list" a full import list is generated
- ... and after pressing the button "Import" the parameters are downloaded to the MLC and/or drives

- The progress of this operation is displayed as well as errors during the import

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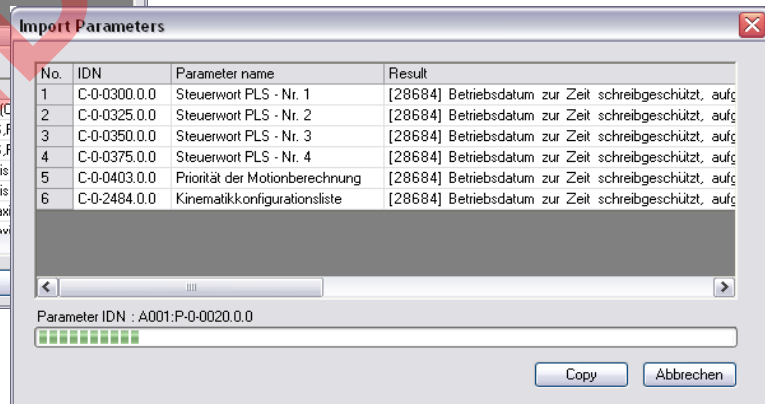
Import of control or drive parameters

- On completion the following information is displayed:
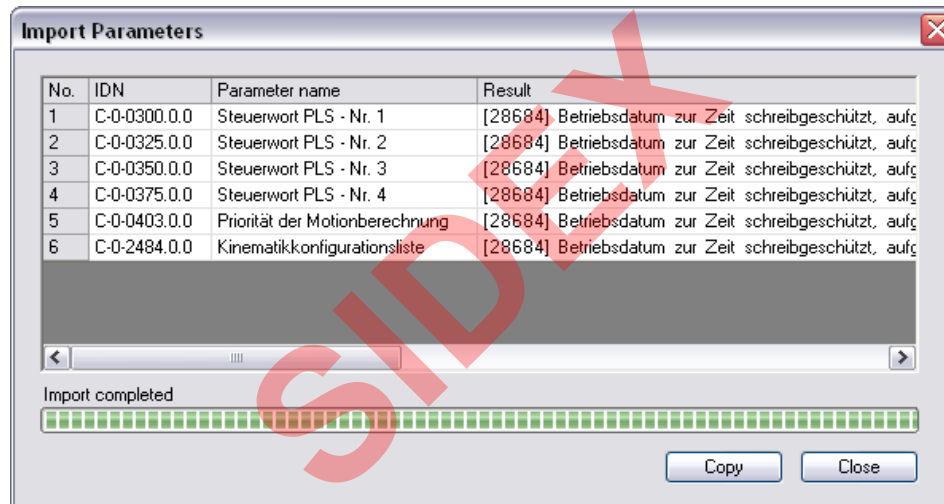
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Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
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- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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Task system of MLC

- The RTOS permits multi tasking, i.e. serveral functions (tasks) apparently are executed in parallel

- The different tasks are activated within a very short time span, as a result all tasks seem to be executed simultaneously

- The maximum number of tasks depends on the hardware platform (L25, L45, L65)

Concurrent memory access
If several tasks access global resources (global variables, function blocks etc.), data consistency is an issue, if the data size exceeds the word length of the CPU. The access has to be protected and simultaneous access of another task has to be prevented (e.g. use of semaphores)

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Task types

Task

| cyclic | Free wheeling | Event triggered | Triggered by external event |

Cyclic execution with fix time interval

The task is running endless. As soon as the assigned program has finished it is started again

The task is started after a rising edge of a Boolean variable

Task is triggered by an external event, e.g. motion cycle, onboard input

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Properties of a task

```
Task ─┬─ Task priority ── If several tasks are ready for execution the task
      │                    priority decides which task will be activated
      │
      ├─ Task type ─┬─ cyclic ── Cycle time
      │             │
      │             ├─ free wheeling
      │             │
      │             ├─ Event triggered ── Assigned Boolean variable
      │             │
      │             └─ Triggered by ── - Motion cycle
      │                external event   - Sercos cycle
      │                                 - Onboard inputs
      │
      └─ Watchdog ── The watchdog is used to monitor the tasks
                     computing time. An overrun results in a PLC
                     exception
```

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Task configuration

- The task configuration lists all configured tasks and their properties
- The properties of all existing tasks can be modified
- Additional tasks can be defined

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Default configuration

Motion Task

PLC Task

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Default configuration − Timing diagram

Motion cycle time = Sercos cycle time = 2ms

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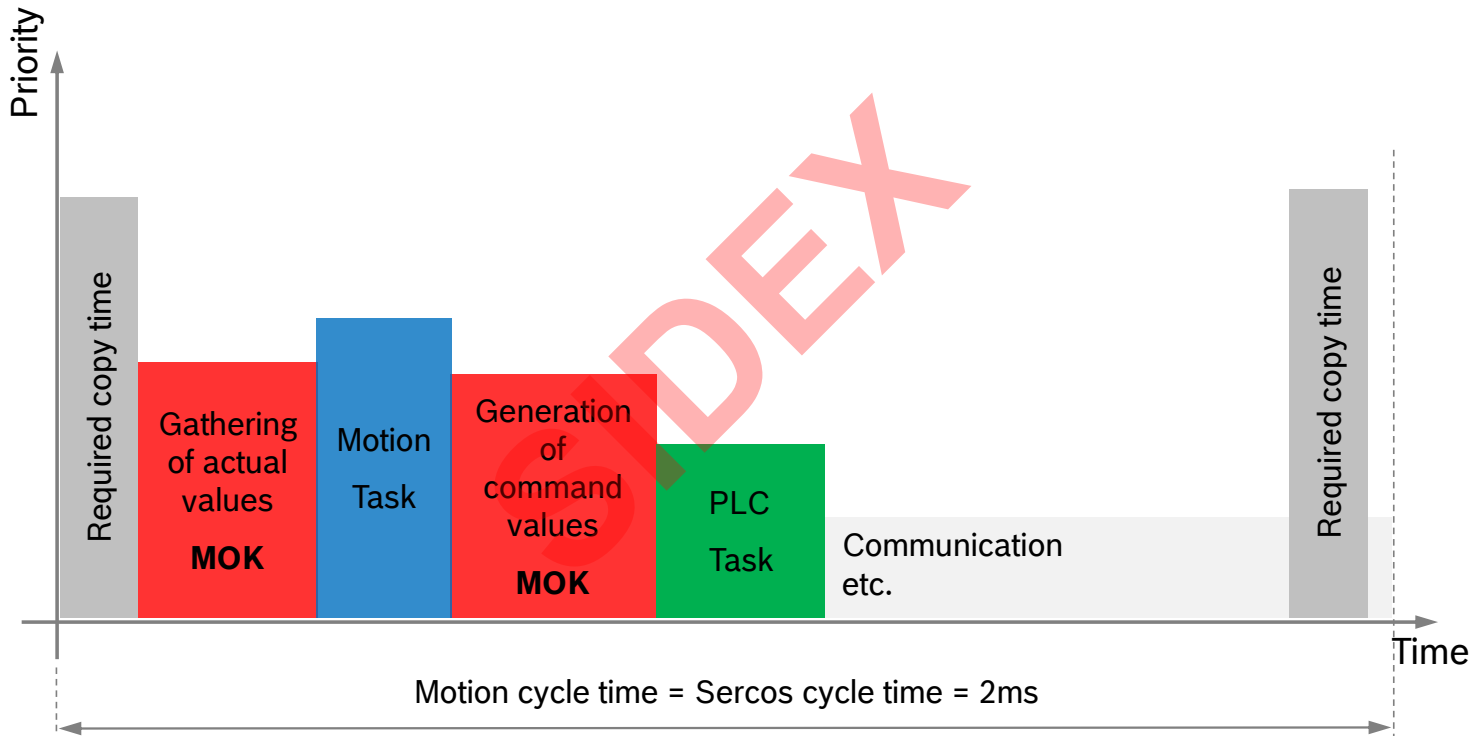
Optimizing the turn-around time for Sercos IOs

- Minimize setting for Sercos cycle time (C-0-0503)

- Add new program sioProg

    - In this program the Sercos IOs are handled

- Add additional task sioTask

    - Priority 2

    - Triggered by external event, event *Sercos cyclic*

    - Activate watchdog (duration depending on setting for Sercos cycle time)

    - Link program sioProg to task sioTask

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Optimizing the turn-around time for Sercos IOs

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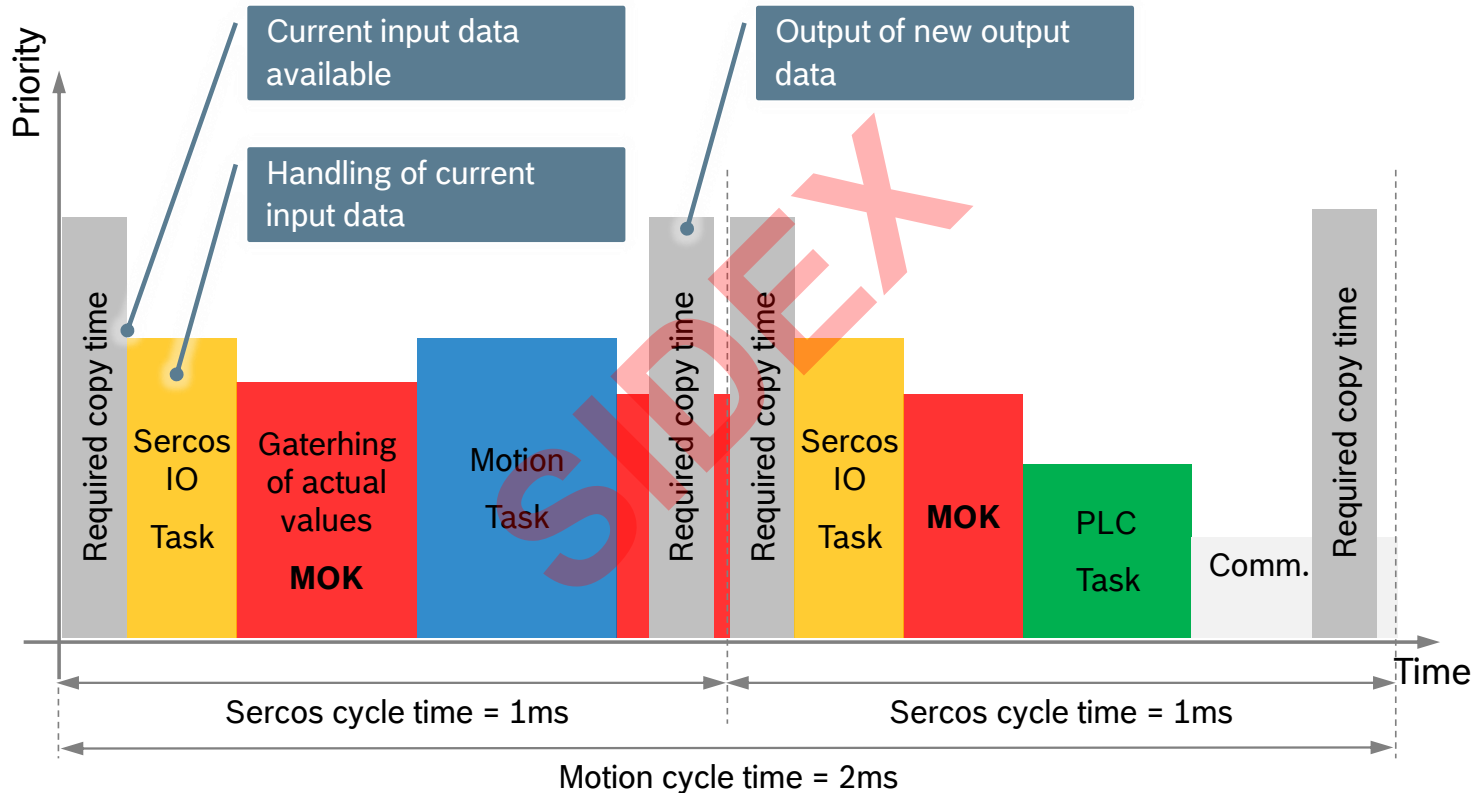
Optimizing the turn-around time for onboard IOs

- Add new program oioProg

  - In this program the onboard IOs are handled

- Add additional task oioTask

  - Priority 2

  - Triggered by external event,
    event *Local Input BitX* or *Local Input Byte*

  - Activate watchdog

  - Link program oioProg to task oioTask

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Optimizing the turn-around time for onboard IOs

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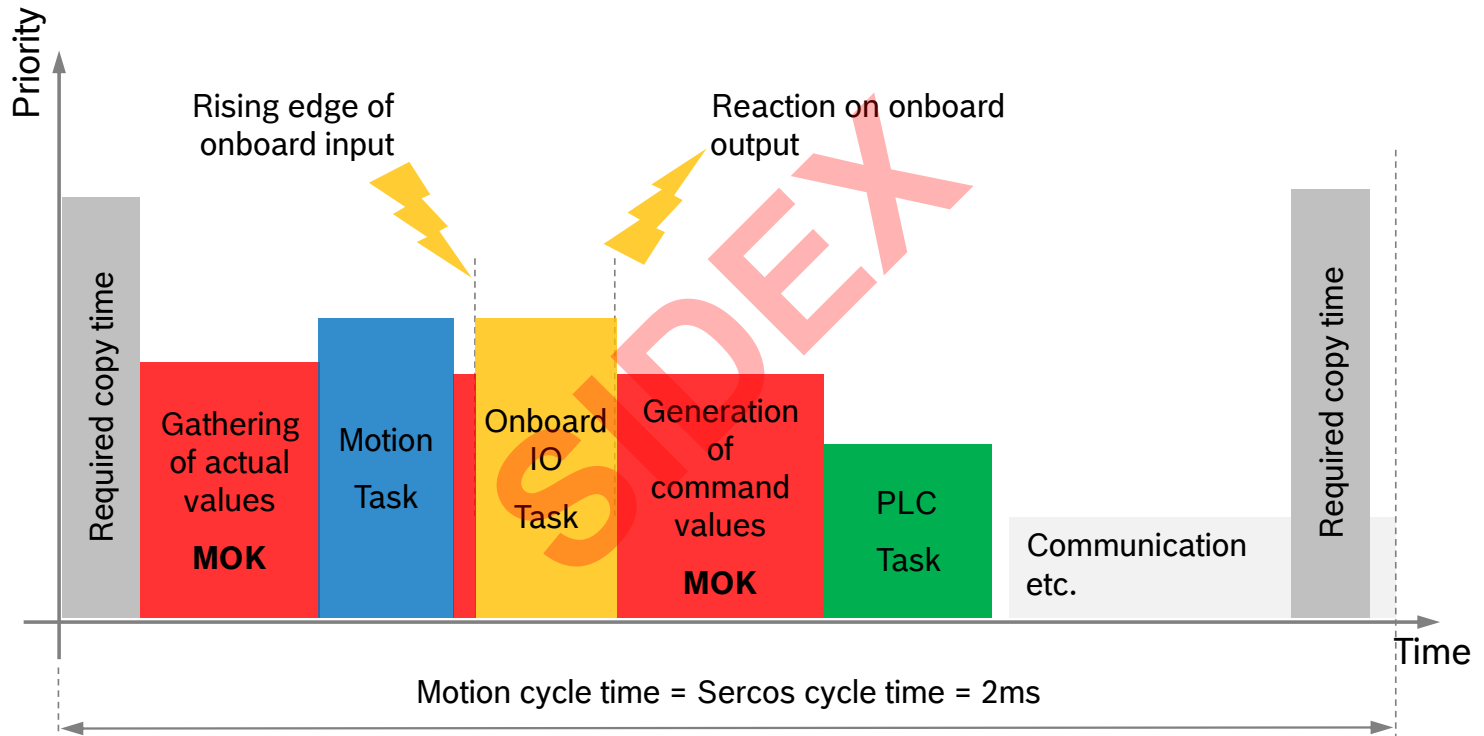
Diagnosing the task system − Cycle times

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Diagnosing the task system − Task List

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Diagnosing the task system − Task Viewer

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Diagnosing the task system − CPU load

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What is synchronized motion?

- In synchronized motion one or more slave axes follow a master axis

- The rotational angle φ of the master axis (master axis position) is sent to the slave axis

- On the basis of this master axis position a synchronous command position is calculated:

    $\psi = f(\varphi)$ rotary axis
    $s = f(\varphi)$ linear axis

- As a result the slave axis follows the master axis synchronously

Master   Slaves

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Synchronized motion and bus systems
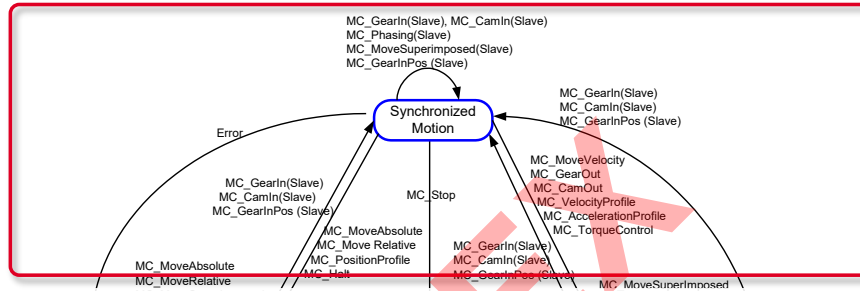
- A prerequisite of synchronous operation is an adequate communication system
- sercos 2 and sercos III offer equidistance
- … based on TDMA → Time Division Multiple Access
- Fieldbus systems like PROFIBUS DP and DeviceNet don't meet this assumption
- Synchronous operation is not available for PROFIBUS drives!

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Available synchronization modes

Velocity synchronization

Conveyor belt

Phase synchronization

Offset printing machine

Electronic CAM

Cross seal

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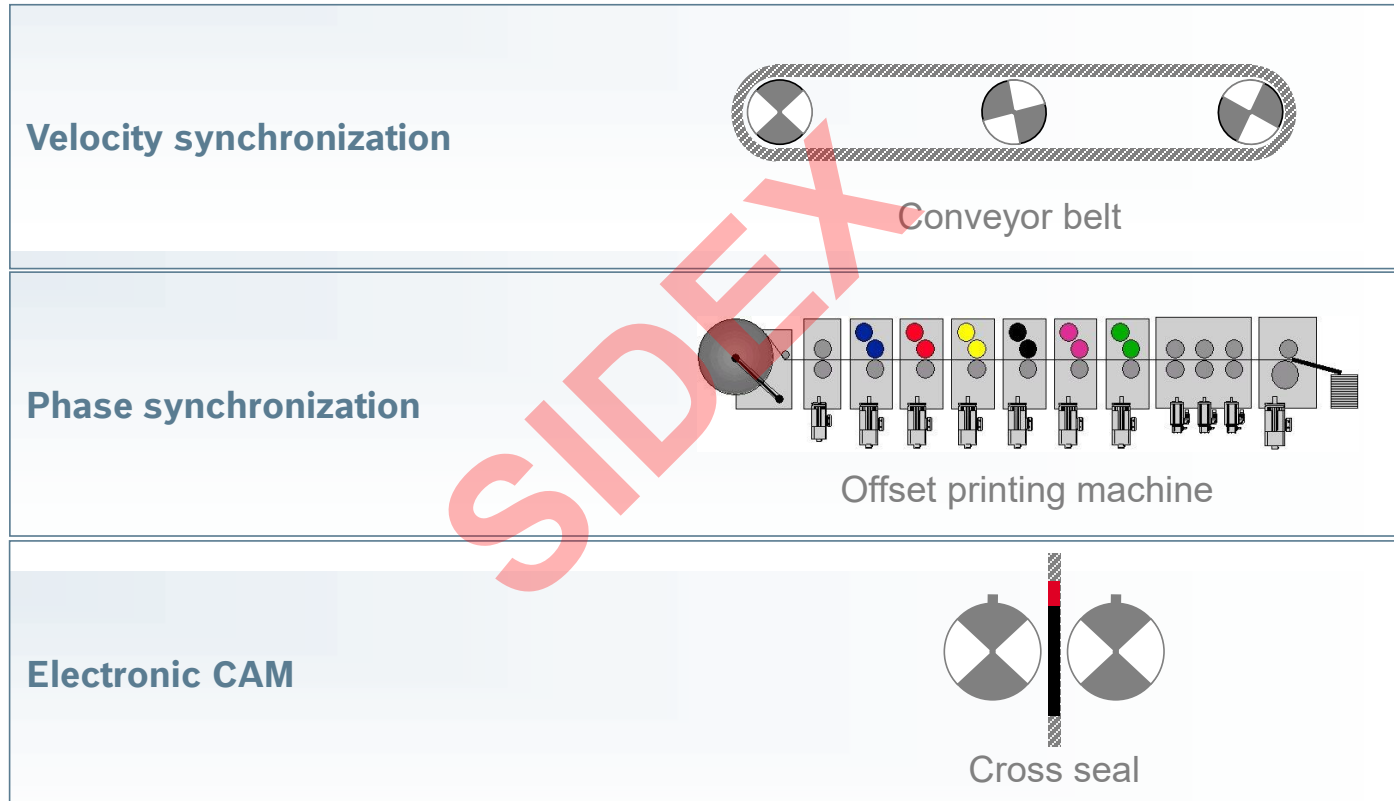
Real master axis

- The master axis position is based on an encoder signal

- For example encoder signal of an IndraDrive connected by sercos to an MLC

Real Master axis

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Virtual master axis

- Master axis positions are generated internally on controller level

- ... and transmitted cyclically to the slave axis

- As a result the real slave axes follow this virtual master

- A virtual axis is an imaginary object which exists only in software

- ... and can be controlled with standard PLCopen function blocks or the AxisInterface

Virtual master axis
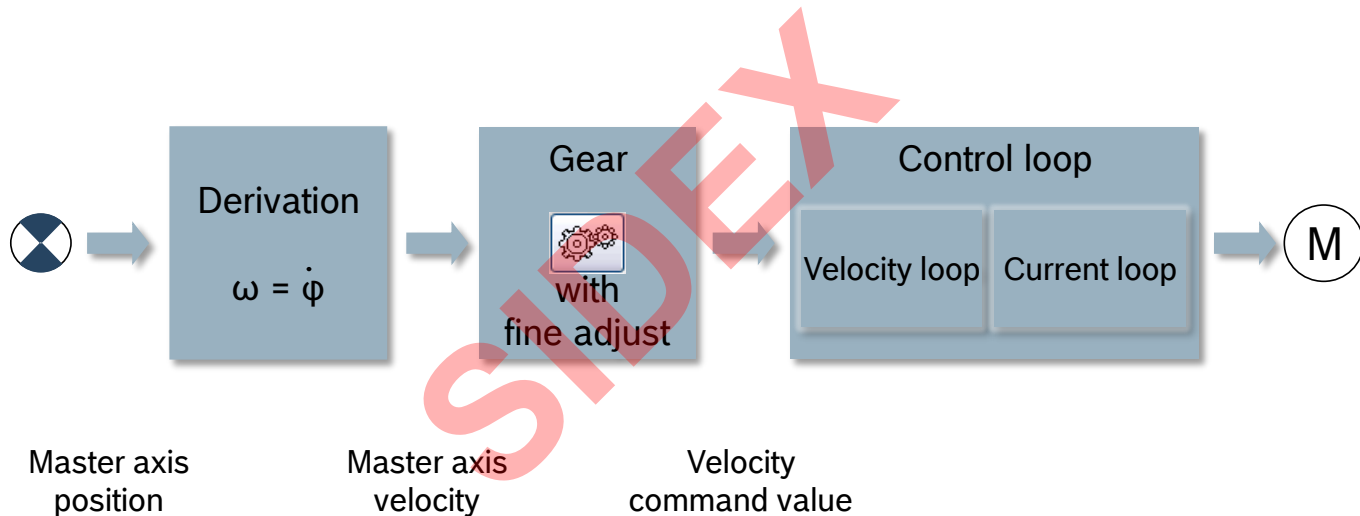
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Velocity synchronization (1)

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Velocity synchronization (2)
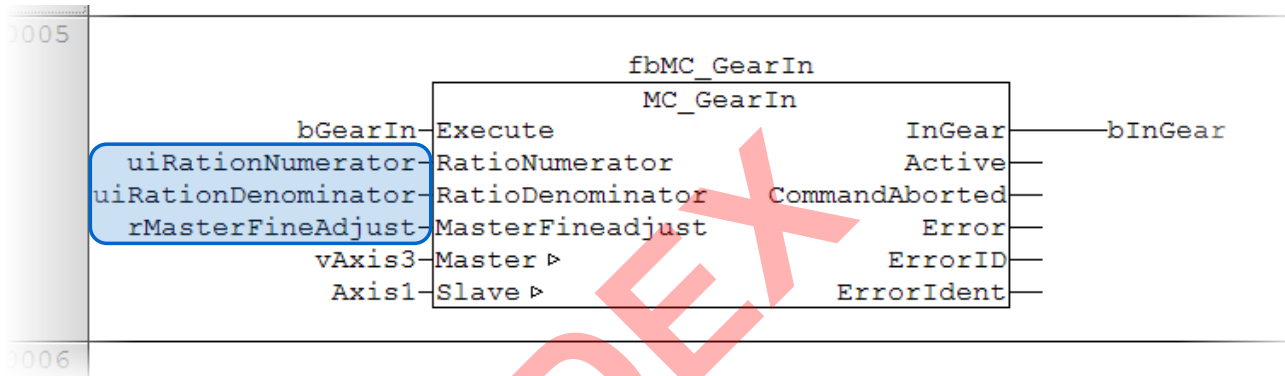
Execute	→ refer to general information on PLCopen	
RationNumerator,		
RatioDenominator	Gear ratio	
MasterFineadjust	Master fine adjust (e.g. tension control)	

$$n_{Slave} = n_{Master} \times \frac{nRatioNumerator}{RatioDenominator} \times (1 + MasterFineadjust)$$

Master	Master axis
Slave	Slave axis
InGear	Slave axis in velocity synchronization

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Velocity synchronization (3)

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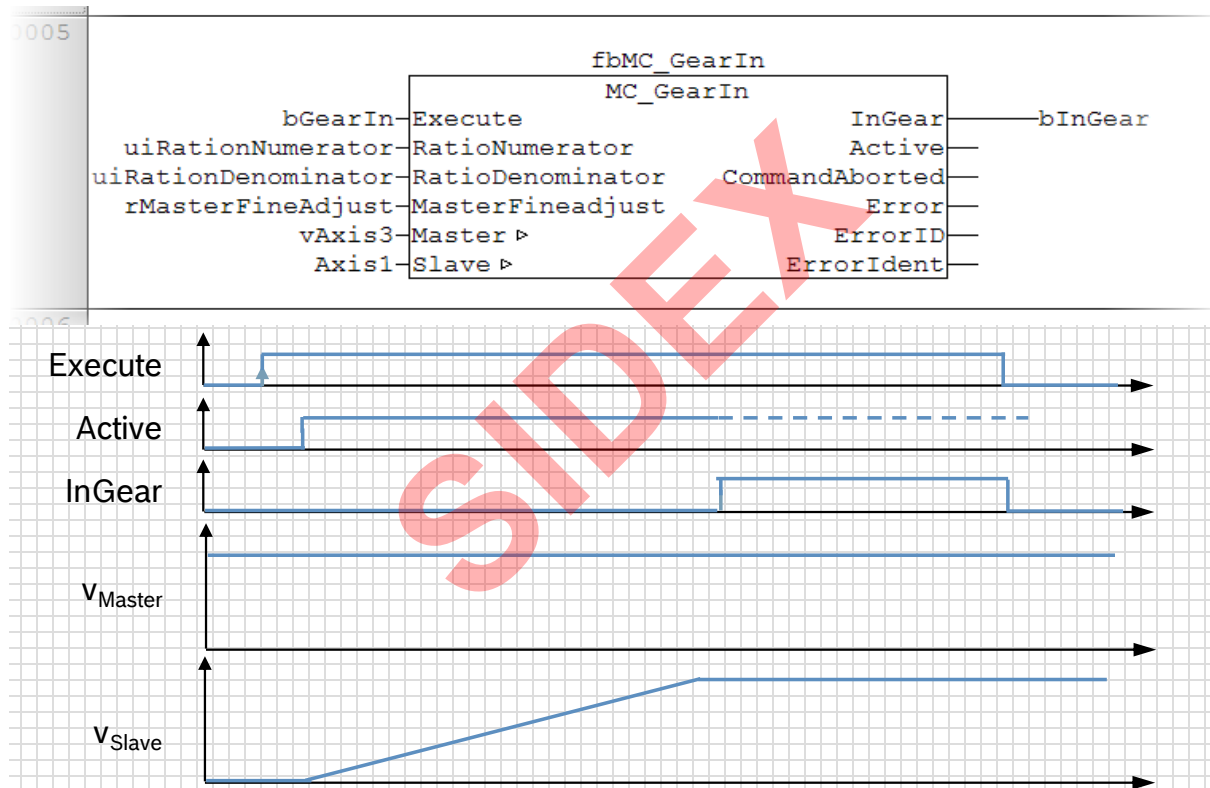
Velocity synchronization (4)

ML_TechInterface.library
Operation Mode "Velocity Synchronization"

When this operation mode is activated, the drive is operated using an electronic gear with fine adjustment. This functionality causes a velocity synchronization between the master axis and the selected slave axis.

The following command activates the operation mode:

`arAxisCtrl_gb[].Admin._OpMode.en: = ModeSyncVel;`

or

`arAxisCtrl_gb[].Admin._OpMode.b.MODE_SYNC_VEL: = TRUE;`

☞ The AxisInterface uses the MC_Power, MC_GearIn and MC_GearOut PLCopen FBs internally to carry out the switchover.

The following table contains the attributes supported by this operation mode:

Element	Name	Type	Default	Cyclically scanned
arAxisCtrl_gb[ ]	SyncMode.OutputRevolution	UINT	1	Yes
	SyncMode.InputRevolution	UINT	1	Yes
	SyncMode.Fineadjust	REAL	0.0	Yes
	SyncMode.Master	AXIS_REF		Yes
	Admin.Axis	AXIS_REF		No
arAxisStatus_gb[]	Admin.MODE_SYNC_VEL	BOOL		Not applicable

Attributes, operation mode "velocity synchronization"
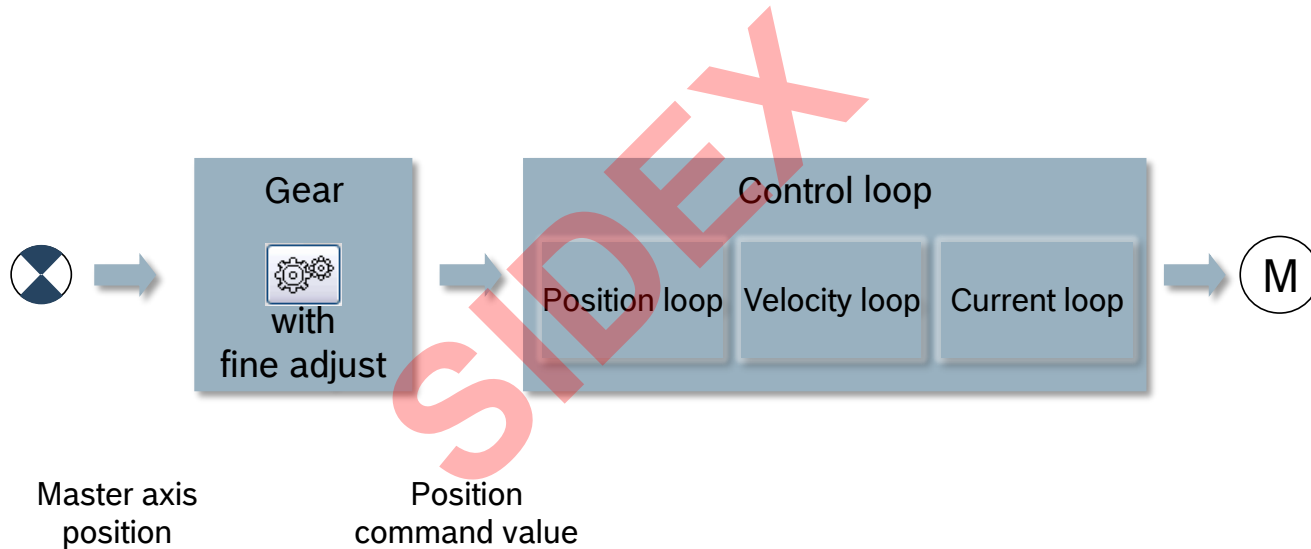
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Phase synchronization (1)

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Phase synchronization (2)
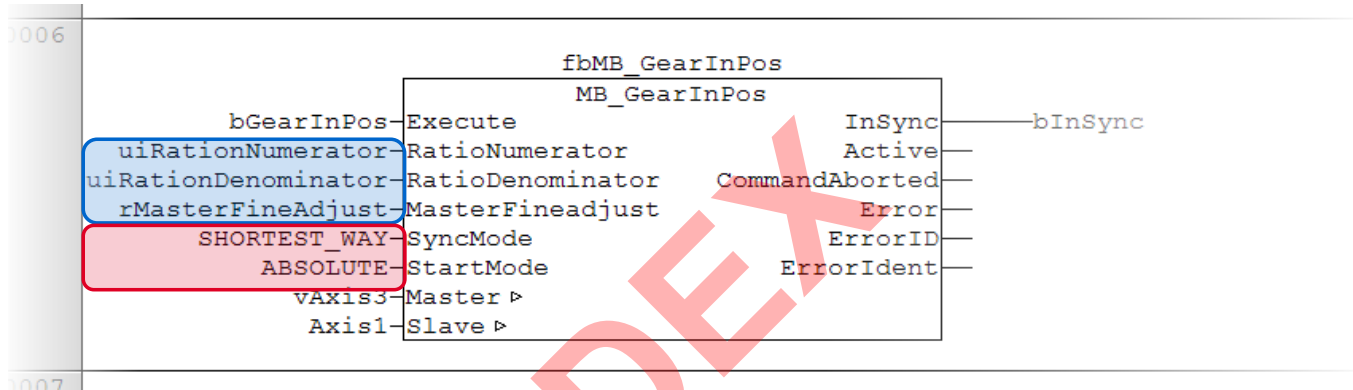
Execute   → *refer to general information on PLCopen*
RationNumerator,
RatioDenominator,   → *refer to MC_ GearIn*
MasterFineadjust
SyncMode   *Synchronization direction*
StartMode   *Synchronization type (absolute, relative)*
Master   *Master axis*
Slave   *Slave axis*
InSync   *Slave axis in phase synchronization*

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Phase synchronization (3)

Master axis

Offset
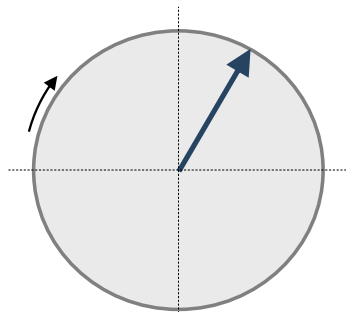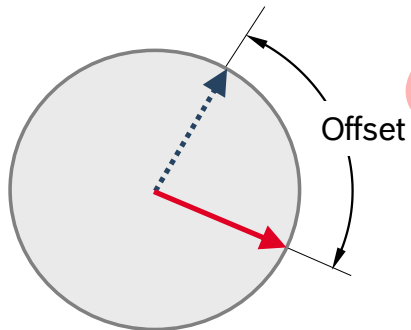
Slave axis
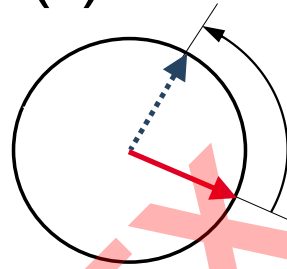
SHORTEST_WAY
Shortest way
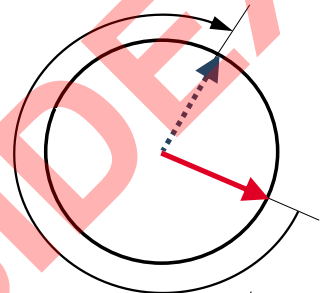
CATCH_UP
Positive direction
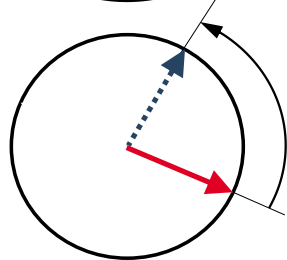
SLOW_DOWN
Negative direction

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Phase synchronization (4)

ML_TechInterface.library
Operation Mode "Phase Synchronization"

When this operation mode is activated, the drive is operated using an electronic gear with fine adjustment. This functionality causes a phase synchronization between the master axis and the selected slave axis.

The following command activates the operation mode:

```
arAxisCtrl_gb[].Admin._OpMode.en: = ModeSyncPhase;
```

or

```
arAxisCtrl_gb[].Admin._OpMode.b.MODE_SYNC_PHASE: = TRUE;
```

☞   The AxisInterface uses the MC_Power, MB_GearInPos, MC_GearOut and MB_PhasingSlave PLCopen FBs internally to carry out the switchover.

The following table contains the attributes supported by this operation mode:

Element	Name	Type	Default	Cyclically scanned
arAxisCtrl_gb[ ]	SyncMode.OutputRevolution	UINT	1	Yes
	SyncMode.InputRevolution	UINT	1	Yes
	SyncMode.Fineadjust	REAL	0.0	Yes
	SyncMode.SyncDirection	MC_SYNC_DIRECTION	SHORTEST_WAY	Yes
	SyncMode.StartMode	MC_START_MODE	ABSOLUTE	No
	SyncMode.Master	AXIS_REF		Yes
	Admin.Axis	AXIS_REF		No
	SyncMode.PhaseOffset	REAL	0.0	Yes
	SyncMode.PhaseOffsetVel	REAL	1.0	No
	SyncMode.PhaseOffsetAcc	REAL	100.0	No
arAxisStatus_gb[]	Admin.MODE_SYNC_PHASE	BOOL		Not applicable
	SyncMode.PhasingSlaveDone	BOOL		Not applicable

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Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
- Motion Programming Basics
- MLC Diagnosis system
- Sercos – the automation bus
- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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Cams

Linear
slave axis movement

$s(\varphi)$

φ

$\psi(\varphi)$

Rotary
slave axis movement

- For complex non-linear motion profiles
- Generate rotary or linear slave axis movement
- ... depending on a master axis
- Master signal is rotary angle φ (generally)

Electronic Cam

216

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Cams – Examples (1)

90.00 mm
60.00 mm
22.00 mm
R30.00 mm
145.00 mm
80.00 mm

Source: www.wikipedia.de

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Cams – Examples (2)

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Cams – Examples (3)

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Cams − Overview

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Cam table

Point table

φ [Grad]	0	10
r [%]	0	

	358,59375	358,945313	359,296875		360
	0	0	0		0

Interpolation
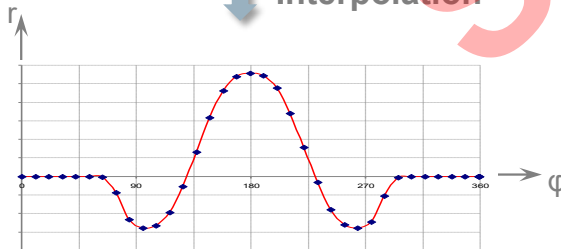
- Cam table describes coupling of master axis and slave axis

- Calculation of slave axis positions is determined by interpolation between discrete table positions

IndraDrive

- 4 tables with 1024 points

- 4 tables with 128 points

- Cubic spline interpolation is used to calculate intermediate slave axis positions

- Values are normalized (Percentage values)

- Cam shaft distance as additional parameter

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Cam table

☑ Simple and clear function

☑ Low computing effort
All the coefficients required for spline interpolation are determined in a calculation that is made before the time of execution

☑ The slave axis position can then be determined very easily during runtime

☑ Suitable if no online modification is required

☑ Easy data exchange with 3rd party tools

☒ All polynomial coefficients must be recalculated after a support point is changed

☒ Large data amounts

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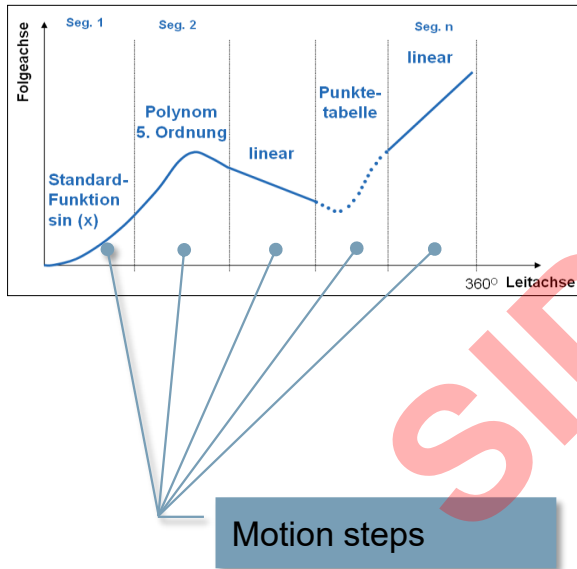
Motion Profile

- Mathematical function describes motion curve („Formula")

- These motion rules describe the coupling of slave axis and master axis as an analytical function

- The complete motion profile is defined step-by-step using motion rules

- A step with the associated motion rule is called "motion step"

- For more details on motion rules refer to VDI 2143

- Mainly polynomial functions of the 5th order or higher are used

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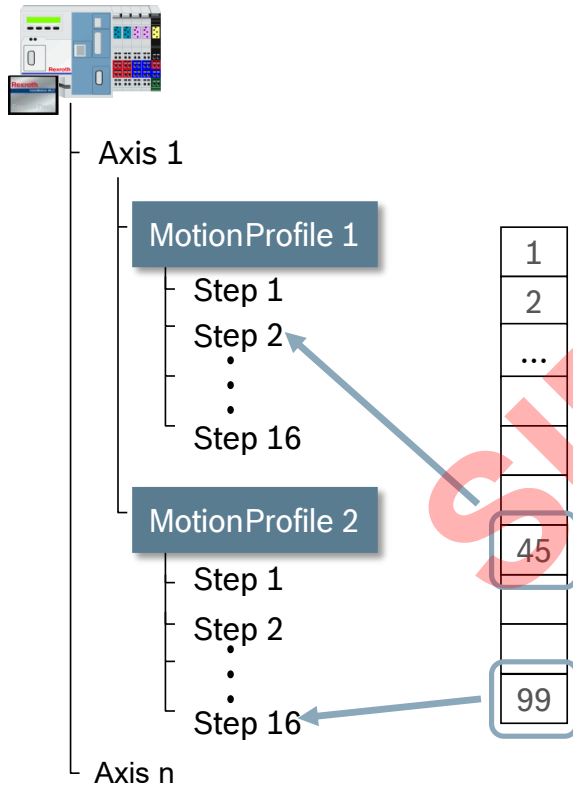
Motion Profile

- 2 Motion profiles per axis with up to 16 steps
- Point tables still can be used within a motion profile
- 99 Point tables with 1024 points
- Processing in PLC program by function blocks
    - MB_MotionProfile
    - MB_ChangeProfileSet
    - MB_ChangeProfileStep
    - MB_ChangeCamData

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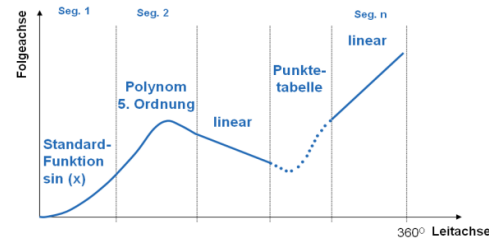
Centralized and decentralized Cam concept

Decentralized Concept

Master axis position

Command position

Centralized Concept

Master axis position

Command position

☑ Drives with basic operation sufficient

☒ Increased Computing effort in MC

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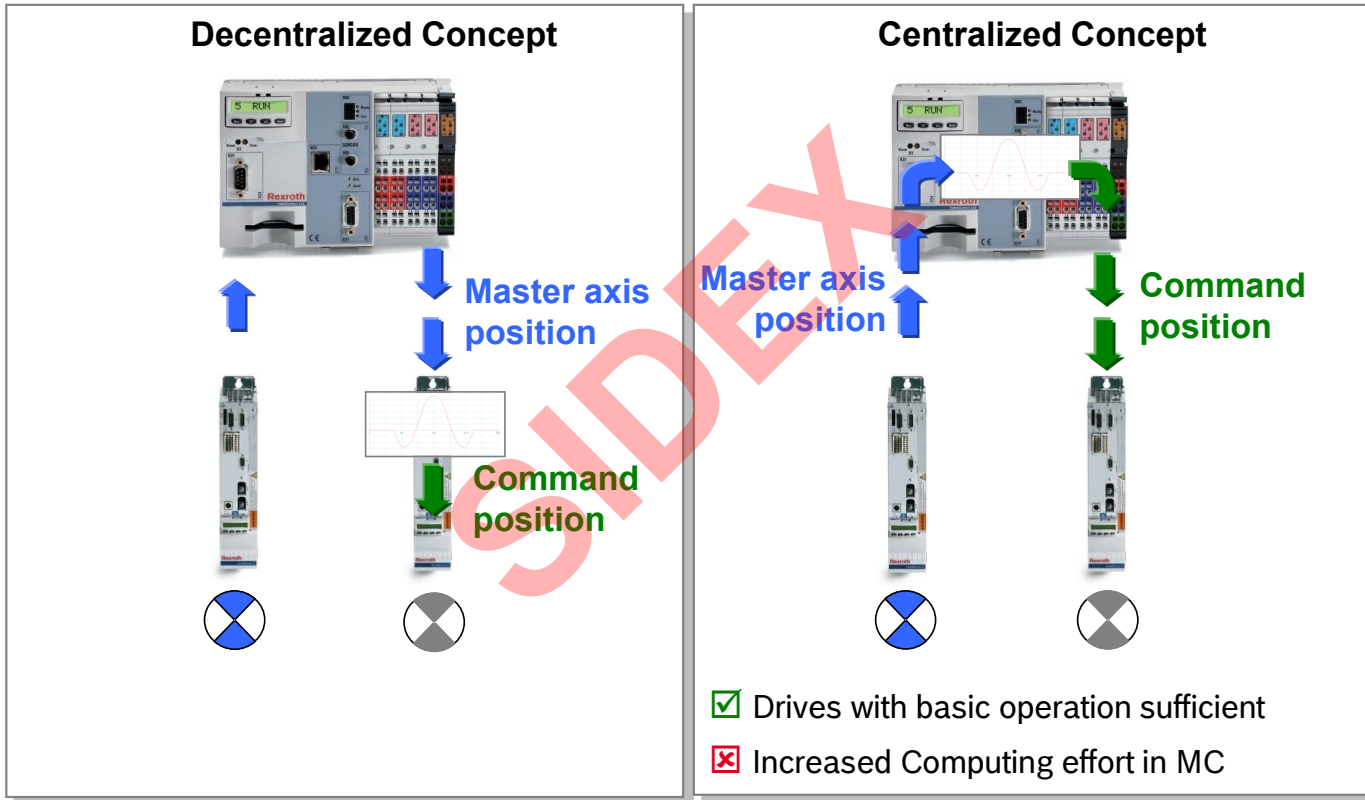
Motion Profile

☑ Low amounts of data
The required information is limited to only the specification of the boundary values of the individual motion steps

☑ Easy online modification
The individual motion steps easily can be modified independent of other motion steps

☑ Only drives with basic operation required
Drives with PackProfile are adequate

☒ Increased computing effort at runtime

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FlexProfile

Axis 1

FlexProfile 1

- Step 1
- Step 2
- ⋮
- Step 64

FlexProfile 2

- Step 1
- Step 2
- ⋮
- Step 64

FlexProfile 4

Axis n

| 1 |
| 2 |
| … |
| 45 |
| 99 |
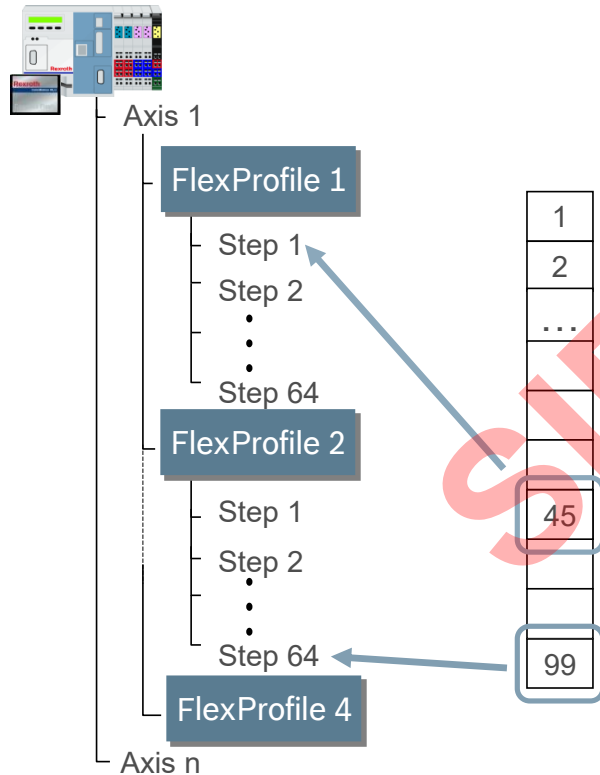
- 4 FlexProfiles per axis
- Max. 64 steps described by motion rules or point tables with max. 1024 points
- Processing in PLC program by function blocks
    - ML_FlexProfile
    - MB_ChangeFlexProfileSet
    - MB_ChangeFlexEventSet
    - MB_ChangeCamData

Poly. 5 — linear — Poly. 5 — Point table

Slave axis position / Master axis position / Stroke / Master Axis section

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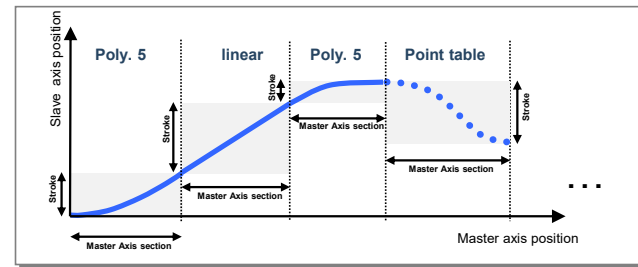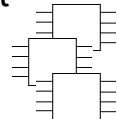
FlexProfile − Basic Features
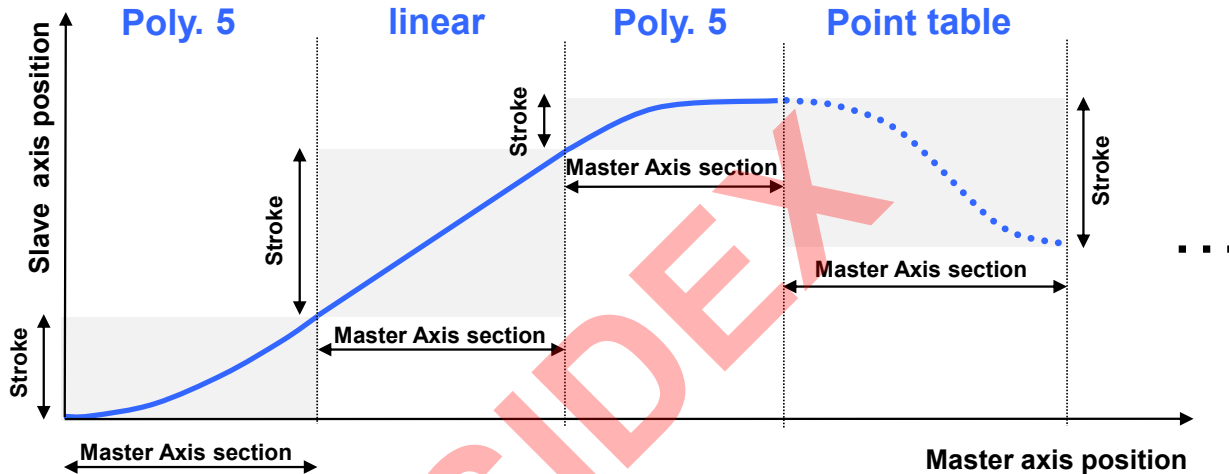
- Compose up to 16 motion steps to a FlexProfile
- Free scaling of master axis (no restriction to 360°)
- Free scaling of slave axis (no restriction to 360°)
- Relative definition of master axis section and stroke
- Time controlled motion supported
- Rich set of motion rules (cf. VDI 2143 and extended motion rules)

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FlexProfile − Standardized Motion rules (VDI 2143)

Rest → Rest
- Standstill *
- Simple sinoid (simple sine curve) *
- Bestehorn sinoid (offset sine curve)
- Acceleration-optimized offset sine curve *
- Torque-optimized offset sine curve *
- Gutman sinoid *
- Modified sinoid *
- Modified acceleration trapezoid *
- 5th-degree polynomial
- 7th-degree polynomial *

Velocity → Velocity
- Linear interpolation
- 5th-degree polynomial
- 7th-degree polynomial *
- Modified sinoid *

Rest → Velocity
- 5th-degree polynomial
- 7th-degree polynomial *

Velocity → Rest
- 5th-degree polynomial
- 7th-degree polynomial *

General motion
- 5th-degree polynomial
- 7th-degree polynomial *

*) only with FlexProfile

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FlexProfile − Motion Rules (examples)
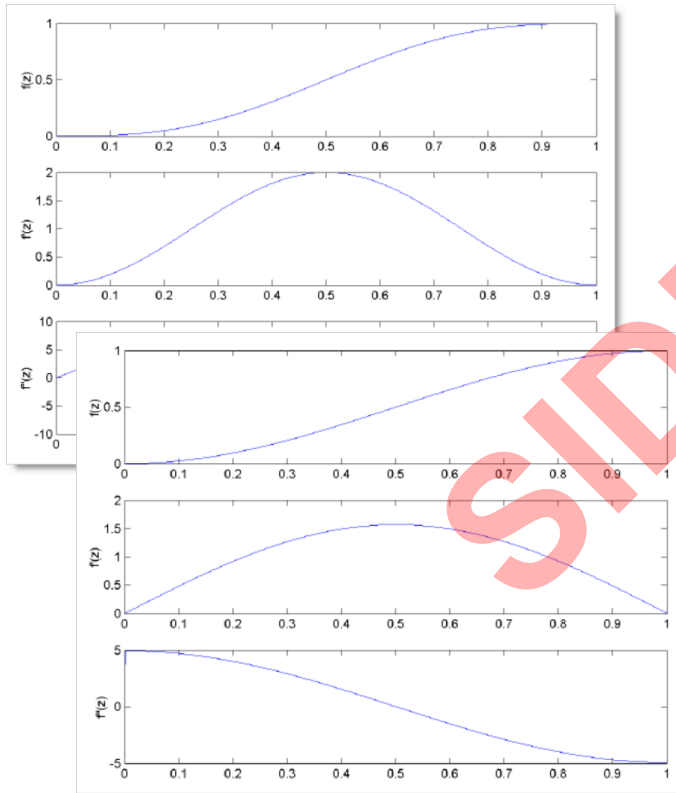
- Rest in Rest 5th-degree polynomial (Position, velocity and acceleration)

- Rest in Rest, simple sinoid (Position, velocity and acceleration)

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FlexProfile − Motion Rules (examples)
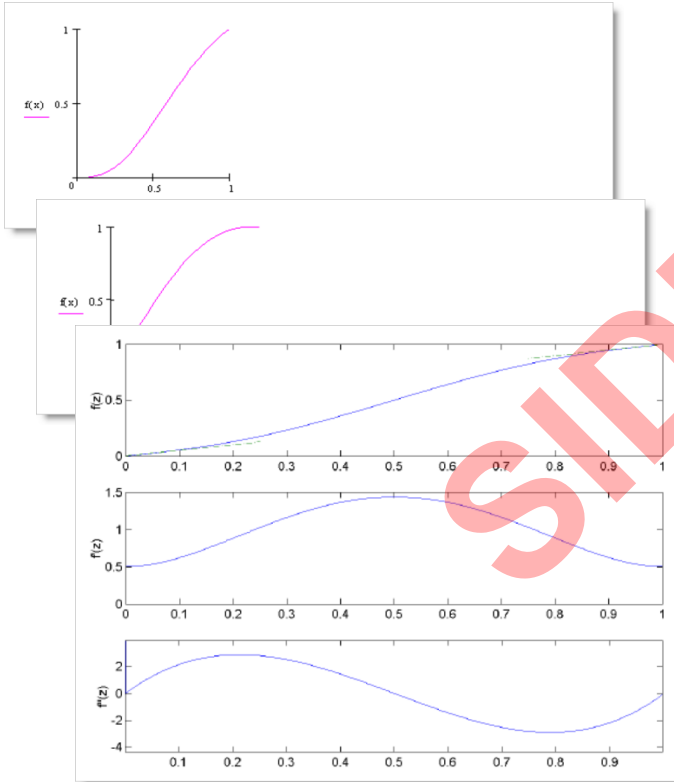
- Rest in Velocity 5th-degree polynomial (position)

- Velocity in Rest 5th-degree polynomial (position)

- Velocity in Velocity 5th-degree polynomial (Position, velocity and acceleration)

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FlexProfile − Supplemental Motion rules

Standardized motion rules
according to VDI 2143
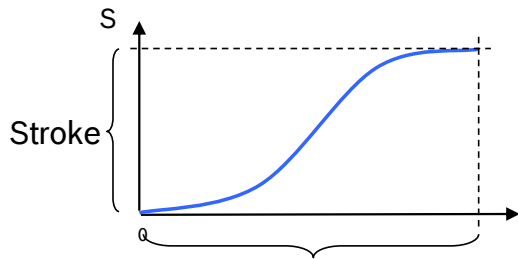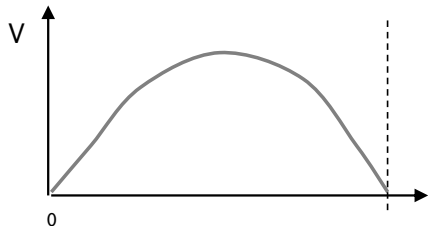
Supplemental motion rules
Acceleration-limited motion (trapezoid profile)
Acceleration-limited sinoid
Jerk-limited motion

Master axis section

Master axis section results

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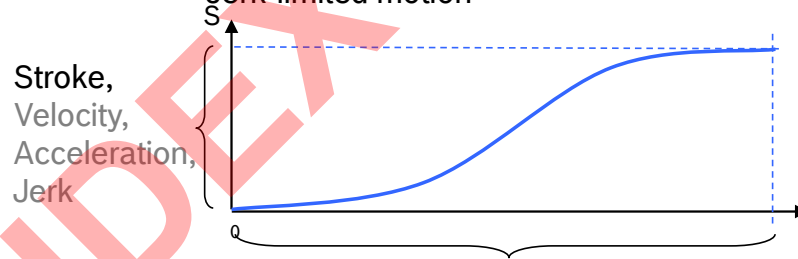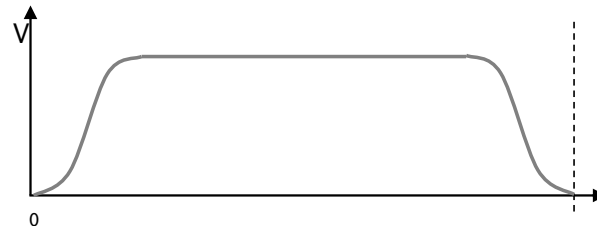
FlexProfile − Supplemental Motion rules

Polynomial 5th order with velocity limitation   Polynomial with damped oscillation

	Polynomial with velocity limitation		Polynomial 5th order
	Polynomial 5th order		Polynomial with damped oscillation

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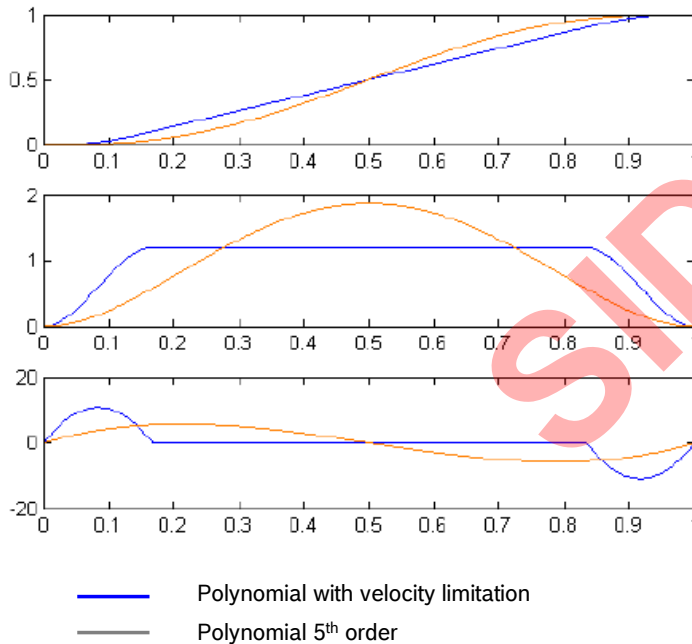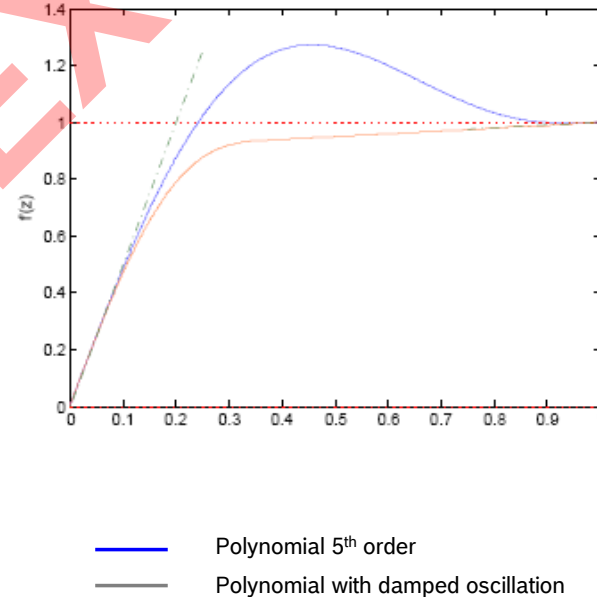
FlexProfile − Execution mode

- **Cyclic execution mode**
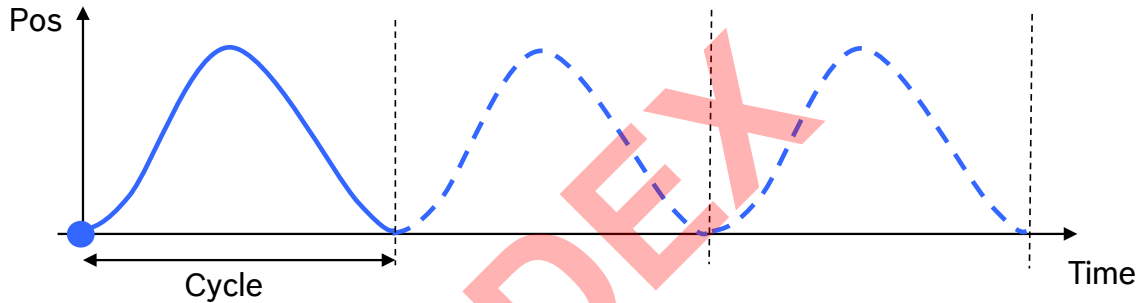
- **Single shot execution mode**

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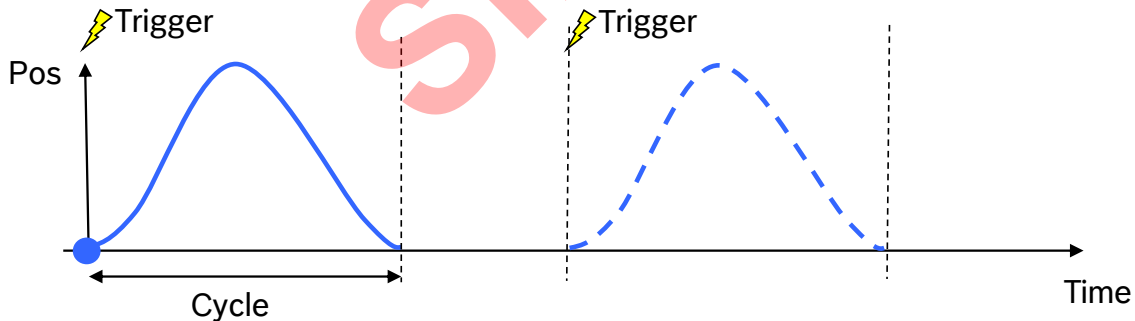
FlexProfile − Switching

- **Switching on angle**

Pos, Switching command in PLC, Time, Switching angle

- **Immediate Switching**

Pos, Switching command in PLC, Time

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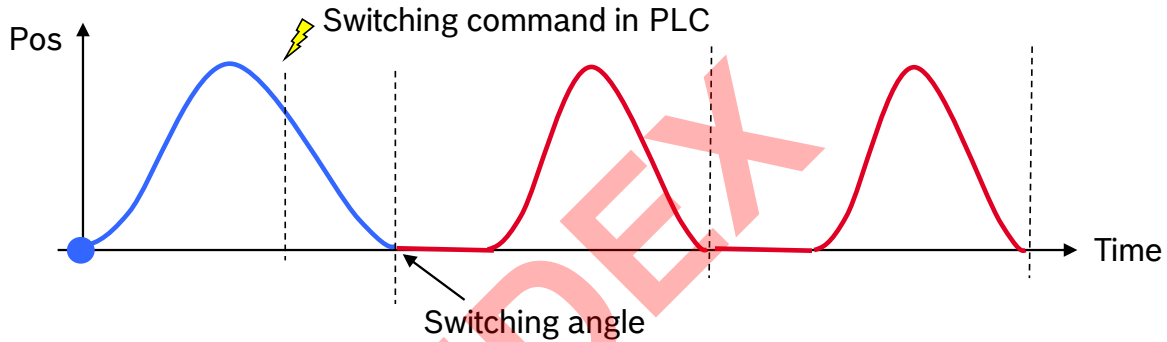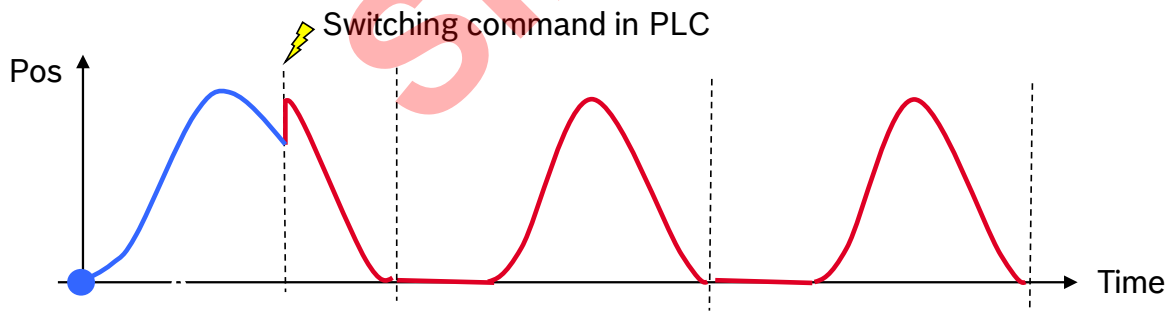
FlexProfile − Switching

- **Hard switching**

- **Soft switching**

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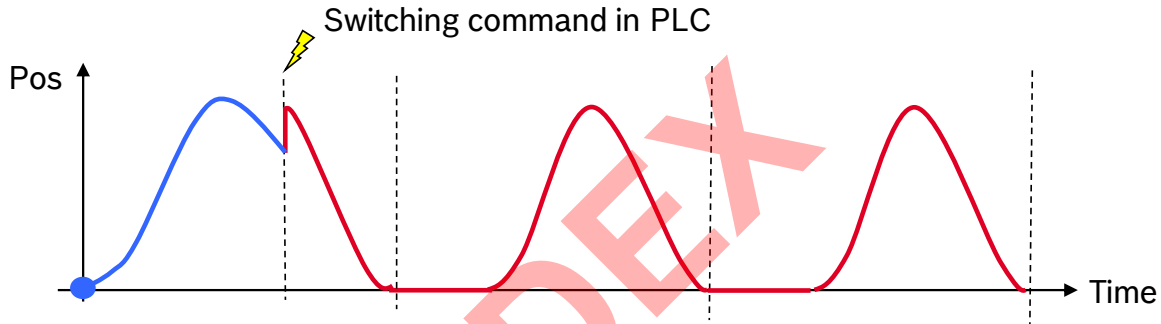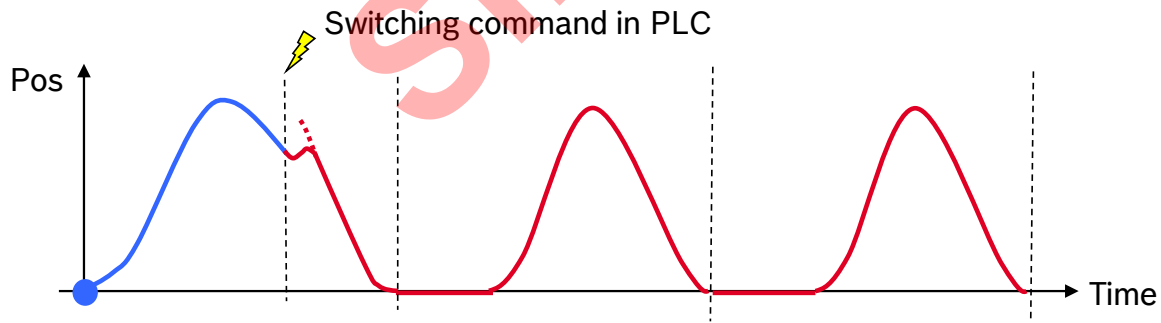
FlexProfile − Events

Events can be attached to sections. Events consist of Trigger and Action
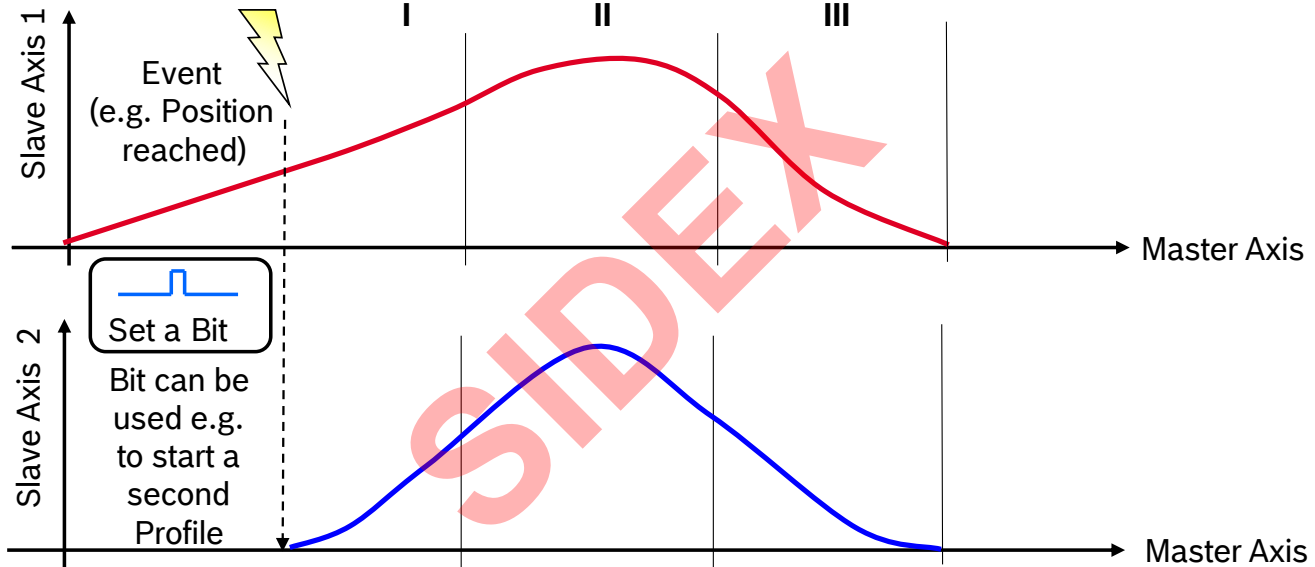
Example: Coordination of motion movements
Trigger: - Relative / Absolute **master position** respectively **Time** reached
           - Relative / Absolute **slave position** reached
           - **PLC** Signal

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FlexProfile − Events

Actions

- Set bit immediately
- Set bit at end of step
- Set bit at end of profile
- Set bit immediately with transition to next step

Event

Only with Flex !

ACTION_STATUSBIT_INSTANT

ACTION_STATUSBIT_AFTERSEG

ACTION_STATUSBIT_AFTERPROFILE

ACTION_STATUSBIT_INSTANT_NEXTSEG

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FlexProfile − Events

Event Condition

Absolute master axis position reached
Relative master axis position reached
Absolute slave position reached
Relative slave position reached
Time elapsed
PLC Signal

Event Action

Set Bit immediately
Set Bit at end of step
Set Bit at end of profile
Set Bit immediately and switch to next step

An Event with Event Condition "PLC signal" is fired with a bit in AxisData[ ].**dwFlexEventControlBits_q**

The bit number correlates with the event number! Please note that the event number sometimes is displayed 0-based and on other screens 1-based!

The events can be checked using AxisData[ ].**dwFlexEventStatusBits_i**

Define a high-prior task to evaluate these events (motion driven and priority higher then MotionTask)!

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FlexProfile − Time controlled motion

Slave / Linear / Poly 5 / Linear / **Flex Step** / Master

Slave / Linear / Poly 5 / Linear / **Flex Step** / Master
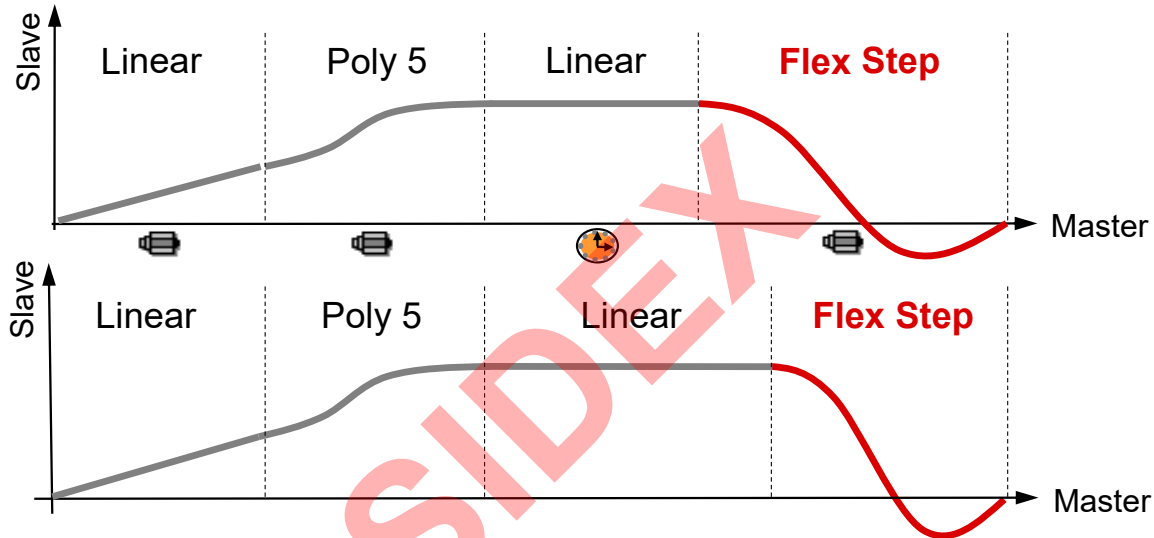
Flex Step
- Dynamic motion step
- Motion curve adapted at runtime
- ... according to the margin values
  of adjacent motion steps
- Reestablishes relation to master axis position

Stroke

?

Master Axis section/position

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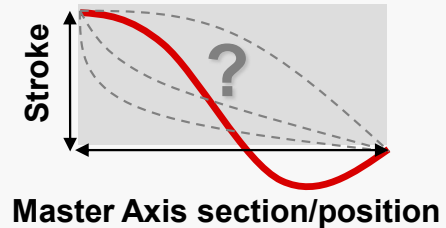
FlexProfile − Flex Step types

- Flex Step with relative stroke and relative master axis section
- Flex Step with relative stroke and absolute master axis section
- Flex Step with absolute stroke and relative master axis section
- Flex Step with absolute stroke and absolute master axis section
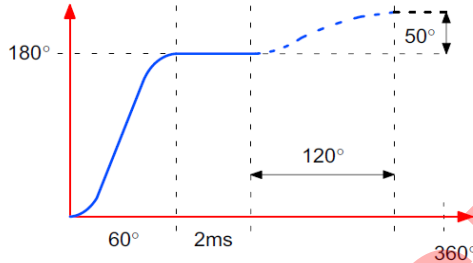
Flex step with a relative stroke and a relative master axis section
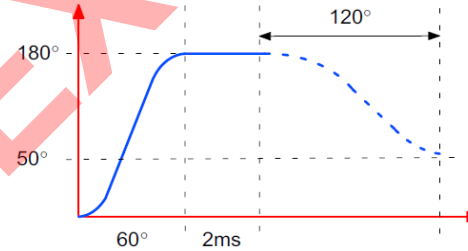
Flex step with an absolute stroke and a relative master axis section
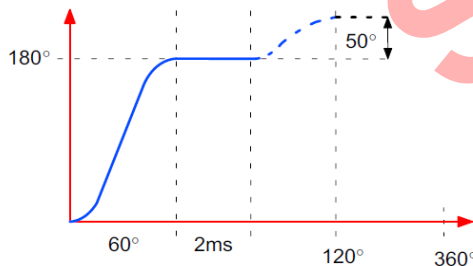
Flex step with a relative stroke and an absolute master axis section
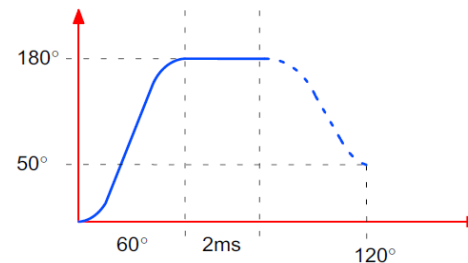
Flex step with an absolute stroke and an absolute master axis section

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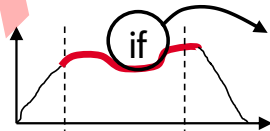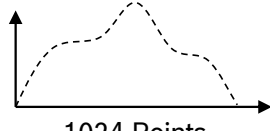
FlexProfile − Time controlled motion
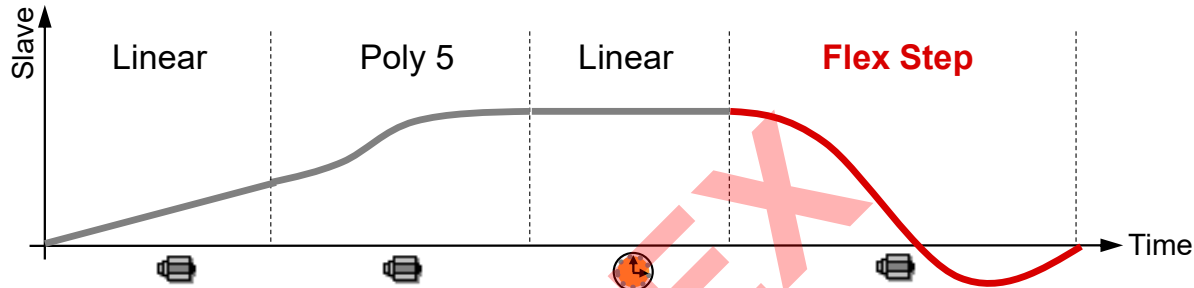
Duration of time controlled step remains constant in spite of modification of master axis velocity!

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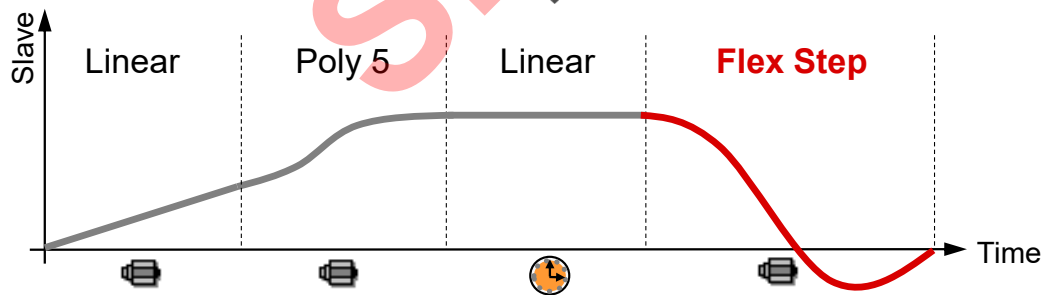
FlexProfile − Overview on Function Blocks

MB_ChangeFlexProfileSet
Setup and write FlexProfile

MB_ChangeFlexEventSet
Define Events and assign them to a step

MB_ChangeCamData
Write Point table in to the MLC

1024 Points

ML_FlexProfile

Activate a FlexProfile

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FlexProfile − Example cross sealing

Close   Seal   Open

X

Position Foil

200mm

Seal bars

Seal table

Z

Flex

Position Foil

Duration 200ms

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FlexProfile − Example cross sealing

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FlexProfile − Example bottling machine

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S1: Distance Sensor [mm]

S2: Distance Synchronize [mm]

S3: Distance to go down [mm]

S4: Immersion depth [mm]

t1: Time Filling 1st level [ms]

t2: Time go up [ms]

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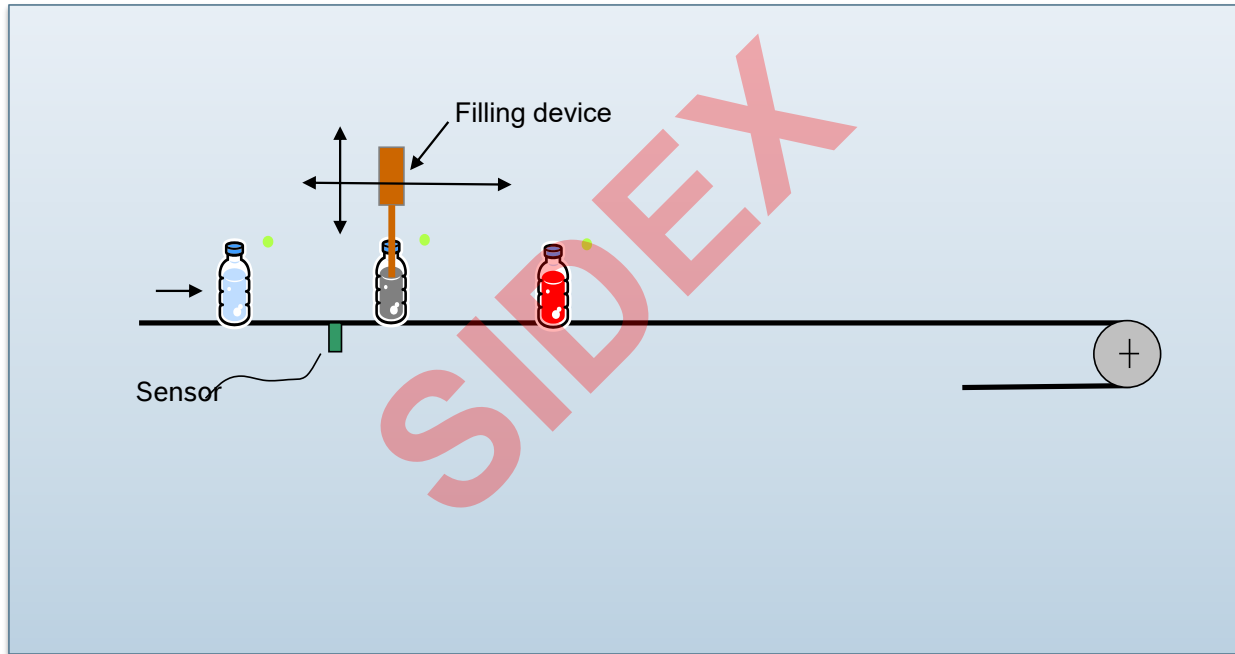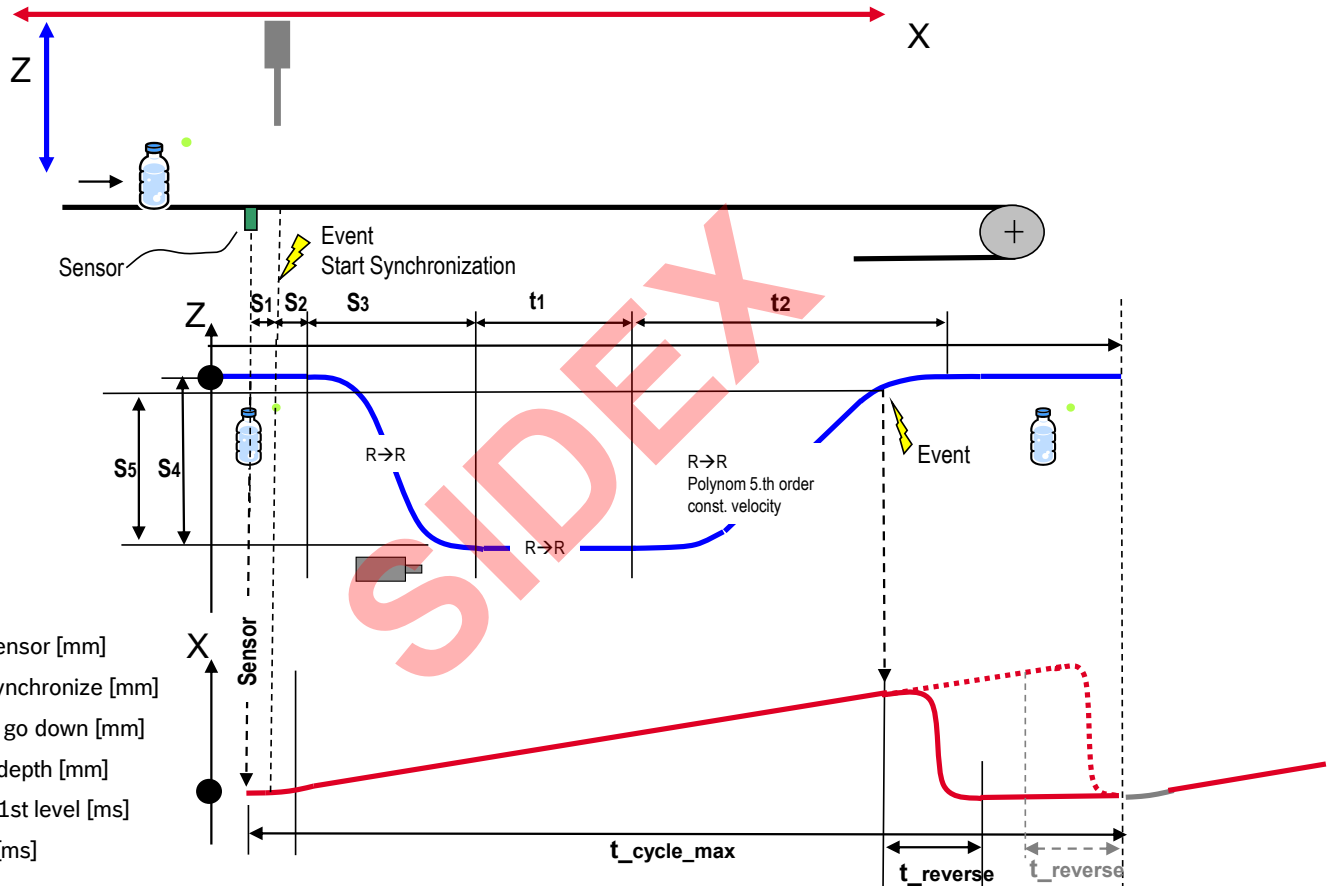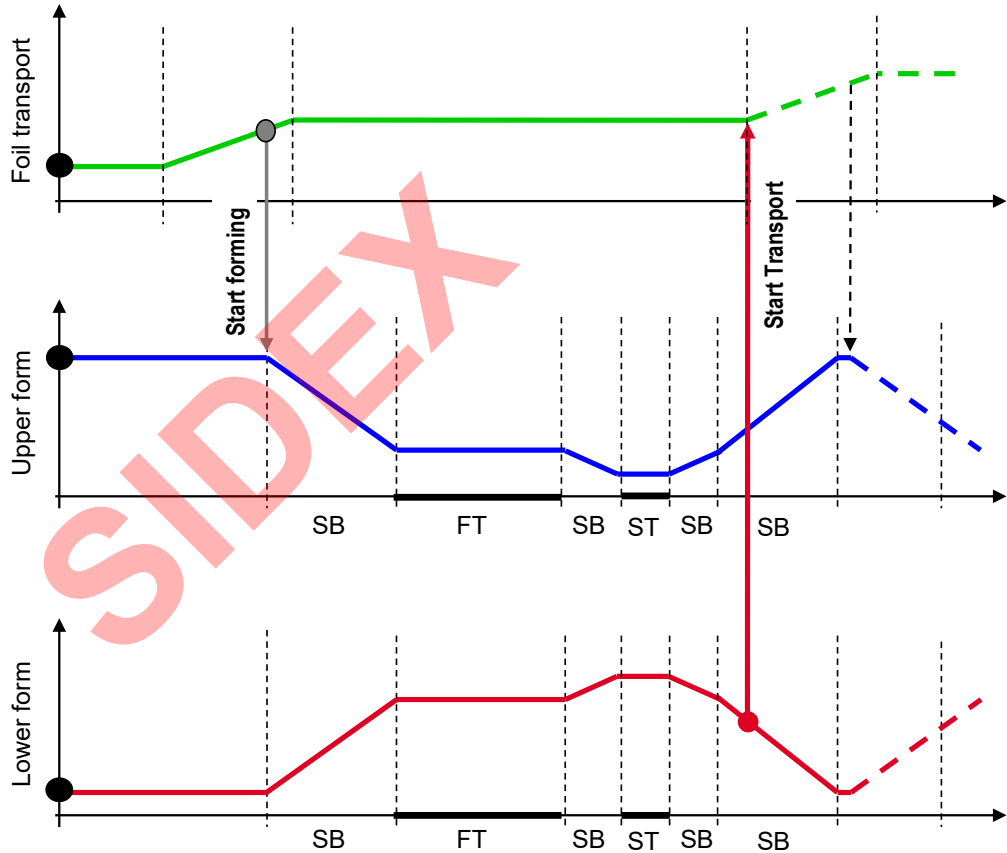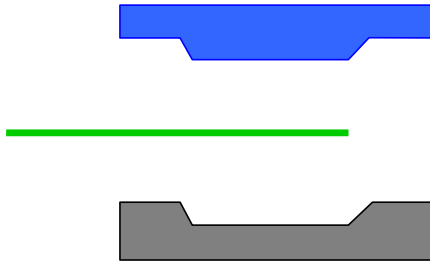
ST - Punching time
FT - Forming time
SB – Punching movement V,A,J

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Point table − Motion Profile − FlexProfile
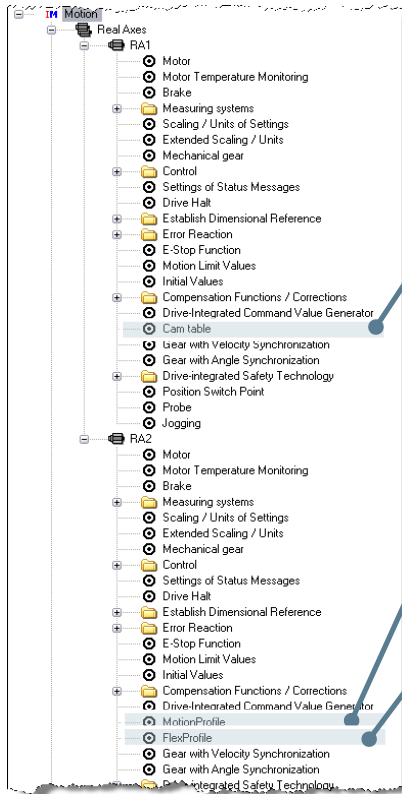
Point tables
- Drive feature
- 4 point tables per axis
  with max. 1024 points
- Only for real axes
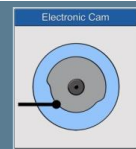
Motion Profile
- Control feature
- 2 motion profiles per axis
  with up to 16 motion steps
- Always related to master axis position
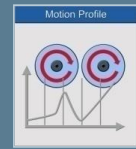
FlexProfile
- Control feature
- 4 FlexProfiles per axis
  with up to 16 motion steps
- Related to master axis position or to time
- Relative or absolute reference of
  master and slave axis
- Variable switching/synchronization of profiles
- Event handling

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Agenda

- System topology and system components
- IndraWorks supported operation systems
- First steps with IndraWorks
- Parameter system
- Motion Programming Basics
- MLC Diagnosis system
- Sercos – the automation bus
- Data backup and restore
- Task System
- Synchronized Motion
- Electronic CAMs: Point table – MotionProfile – FlexProfile
- CamBuilder
- IMST – IndraMotion Service Tool
- Additional sources of information

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CamBuilder – Overview

- CamBuilder is a graphical tool for creation and modification of Cams

- Suitable for

  - IndraDrive

  - IndraMotion MLD and

  - IndraMotion MLC/XLC

- Operations

  - Graphical creation and modification of Cams

  - Download and upload of Cams to/from IndraDrive, IndraMotion MLD and IndraMotion MLC/XLC

  - Import and export of Cams in different formats (Excel, XML, parameter file *.par)

- CAM Builder is integral part of IndraWorks

- A license code has to be entered for activation

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Flexible use of Cams

CamBuilder

IndraWorks
Engineering

CAM-Pool

IndraMotion MLC

Processing in MLC

Motion Profile
FlexProfile

Alternative Processing

sercos
the automation bus

IndraDrive

Processing in IndraDrive

Cam table

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Licensing of CamBuilder

- Select menu entry Tools/Options
- Select General/Software licenses
- The current licensing state is displayed
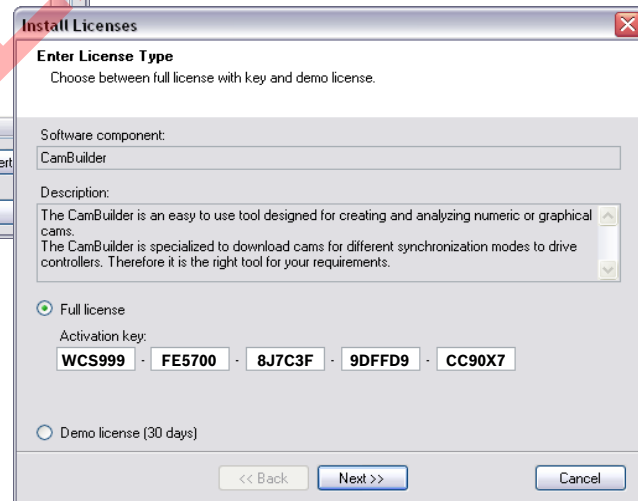
- You can activate a 30 days demo license
- ... or enter a license key and activate a full license

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Licensing of CamBuilder
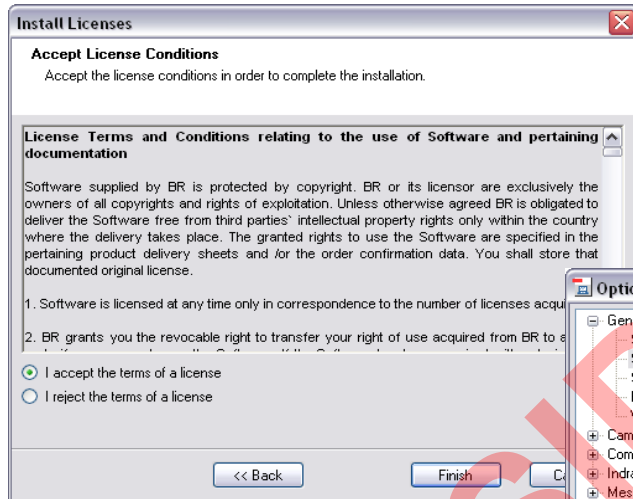
- Accept the terms of license
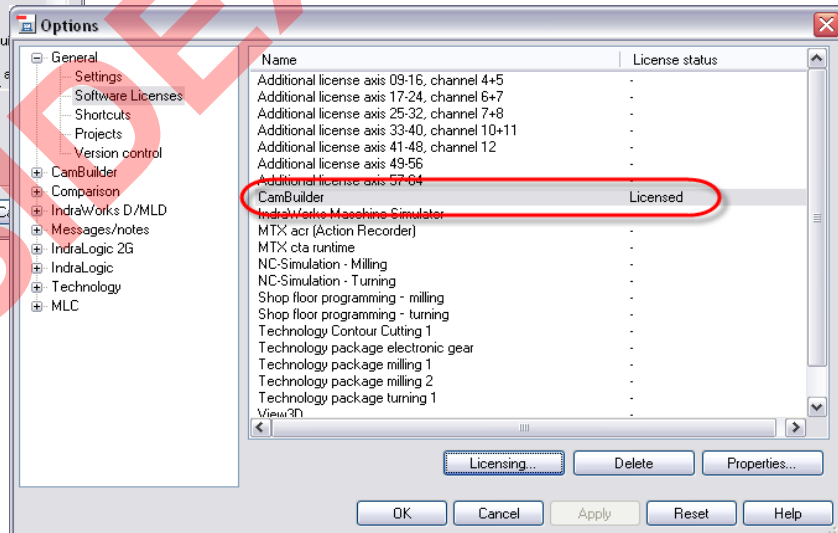
- The license status of CamBuilder is "Licensed"

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Using the CamBuilder

▪ After activation of the CamBuilder and opening the group "CamBuilder" in the Device Library you can add the following elements to you project:
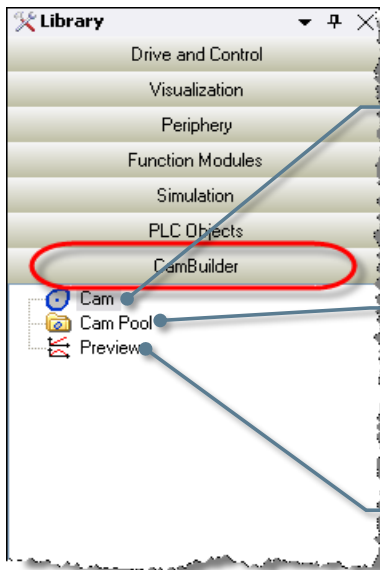
Cam
Add a Cam to your CamPool to create your own motion curves. Cam tables, MotionProfiles and FlexProfile are supported

CamPool
CamPool is subfolder in your IndraWorks project which is used as a storage for all your motion curves (Cam tables, Motion profiles and FlexProfiles

Preview
Multiple motion curves can be combined to a Preview to see several axes in correlation to another

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CAM Builder − Motion Step Editor

- Easy composition of CAM profile by a sequence of motion steps
- Definition of position-related motion steps, and
- Definition of time-related motion-steps

☞ Graphical creation and modification of FlexProfiles

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Add CAM Pool to project
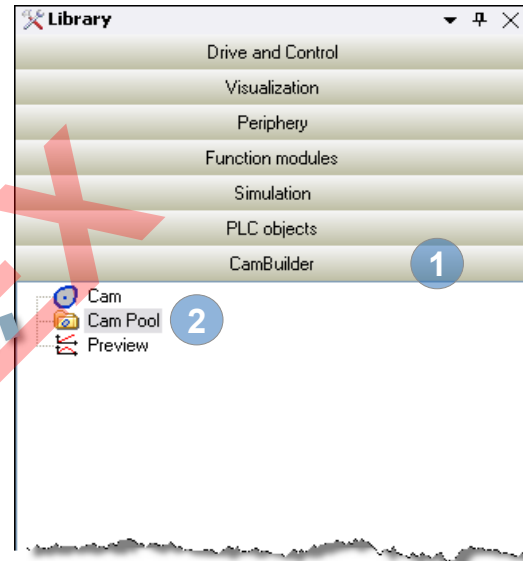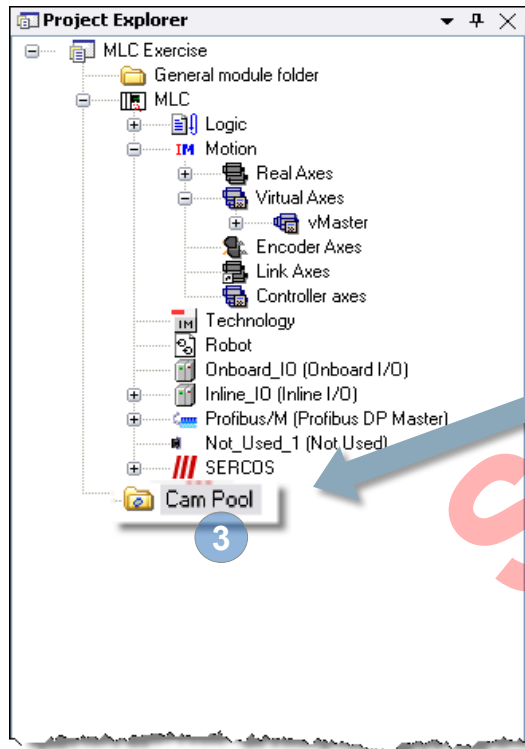
1	Open Group CamBuilder in Library
2	Select "CamPool"
3	Add CamPool to IndraWorks Project

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How to create a FlexProfile (1)

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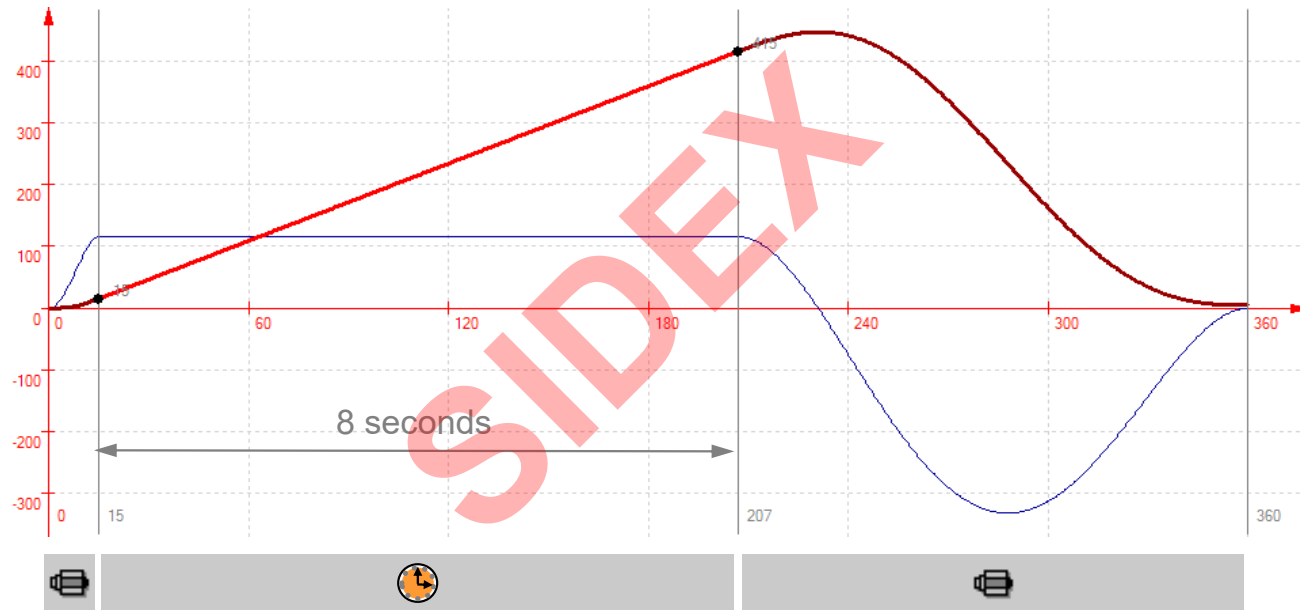
How to create a FlexProfile (2)
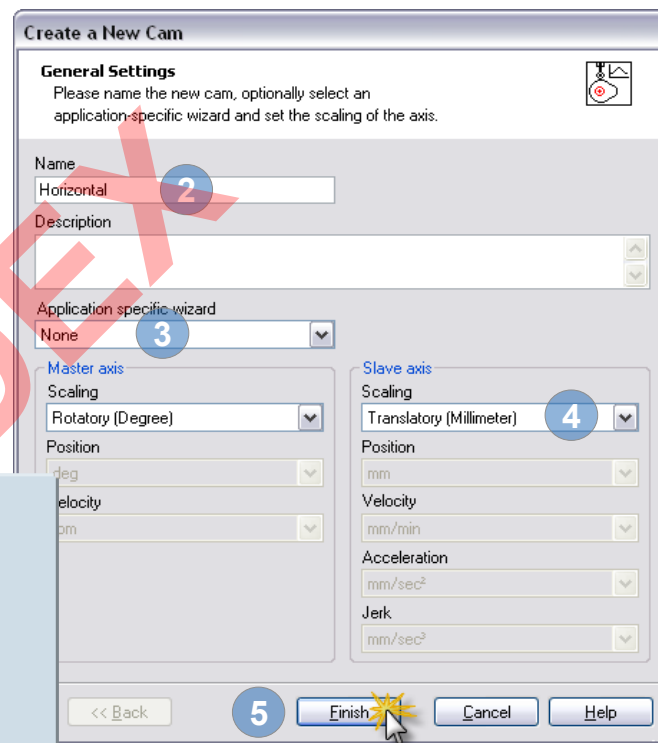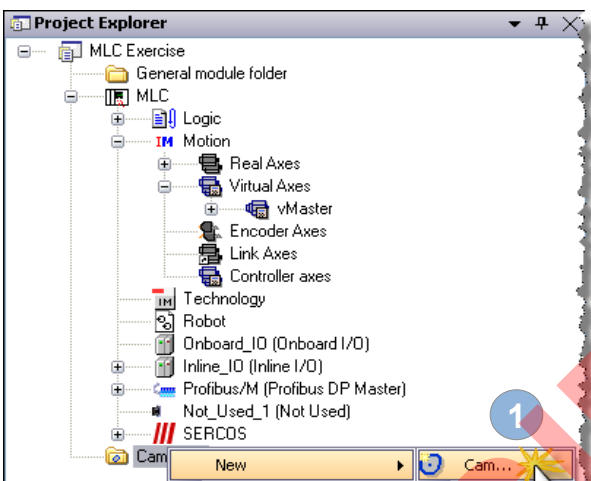
1 Create new Cam

2 Enter name "Horizontal"

3 Application specific wizard: None

4 Translatory scaling (mm)

5 Press "Finish" button

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How to create a FlexProfile (3)
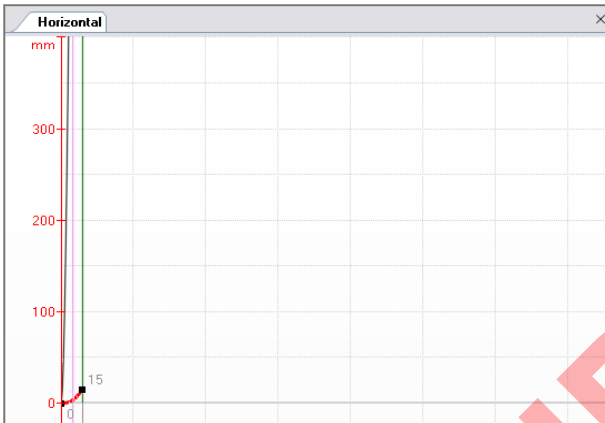
1. Enter master axis velocity
2. Switch Edit mode to "Relative"
3. Enter stroke value of slave axis
4. Enter master axis section
5. Motion law "Rest in Velocity – Poly5"
6. Enter velocity value

260

How to create a FlexProfile (4)

1. Add motion step after highlighted step
2. Select Reference to Time
3. Enter stroke value for slave axis
4. Enter duration of step
5. Motion law
   "Velocity in Velocity – Constant velocity"

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How to create a FlexProfile (5)

1. Add motion step after highlighted step
2. Select Reference to Master axis position
3. Enter Slave axis stroke value (-415)
4. Enter Master axis Endpoint (360)
5. Set velocity value to zero
6. Select FlexStep with relative distance and absolute master axis range

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How to create a FlexProfile (6)

3.75 seconds

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How to create a FlexProfile (7)

1 Create new Cam

2 Enter name "Vertical"

3 Application specific wizard: None

4 Translatory scaling (mm)

5 Press "Finish" button

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How to create a FlexProfile (8)

1 Enter master axis velocity

2 Switch Edit mode to "Relative"

3 Enter stroke of slave axis

4 Enter master axis section

5 Motion law "Rest in Rest – Standstill"

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How to create a FlexProfile (9)

1. Add motion step after highlighted step
2. Select Reference to Master axis position
3. Enter stroke of slave axis
4. Enter master axis section
5. Motion law "Rest in Rest – Poly5"

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How to create a FlexProfile (10)

1. Add motion step after highlighted step
2. Select Reference to Time
3. Enter stroke value for slave axis
4. Enter duration of step
5. Motion law "Rest in Rest – Standstill"

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How to create a FlexProfile (11)

1 Add motion step after highlighted step

2 Select Reference to Master axis position

3 Enter Slave axis stroke value (-415)

4 Enter Master axis Endpoint (360)

5 Select FlexStep with relative distance and absolute master axis range

Motion Step Editor - Vertical

Master axis velocity
4 rpm

No	Reference	ΔY [mm]	ΔX [deg]	ΔT [ms]
1		0	15	625
2		-140	60	2500
3		0	90	3750
4		140	60	2500

Step Type
FlexStep with relative distance and absolute master a ▼

Motion Law
General Motion - Polynomial 5th order ▼

Startpoint | **Endpoint**

	Startpoint		Endpoint	
X4	165	deg	X5	225	deg
Y4	-140	mm	Y5	0	mm
V4	0	mm/min	V5	0	mm/min
A4	0	mm/sec²	A5	0	mm/sec²
J4	0	mm/sec³	J5	0	mm/sec³

Motion step maxima

Vmax	6299.8916	mm/min
Amax	129.3258	mm/sec²
Jmax	528.1686	mm/sec³
Cmdyn	8397.283	mm²/sec³

Turning Point Displacement   0.50000

Description

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How to create a FlexProfile (12)

1. Add motion step after highlighted step
2. Select Reference to Master axis position
3. Enter Slave axis stroke value (0)
4. Enter Master axis Endpoint (135)
5. Motion law "Rest in Rest – Standstill"

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How to create a Preview

1. Open Group CamBuilder in Library
2. Select "Preview"
3. Add Preview to CamPool

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How to create a Preview

Add profiles to preview by drag & drop and modify settings

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Download FlexProfile for 1st axis
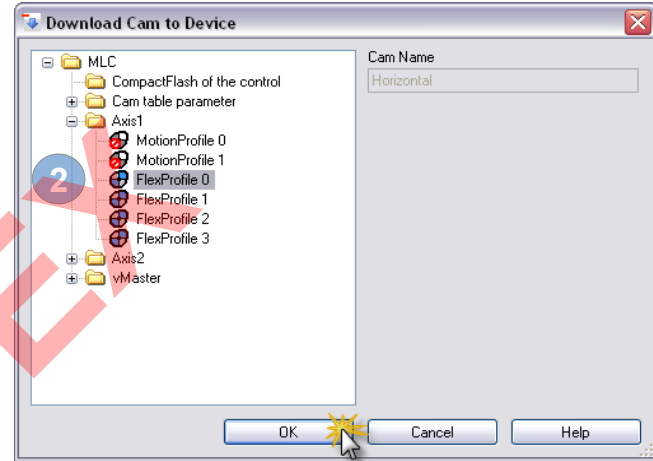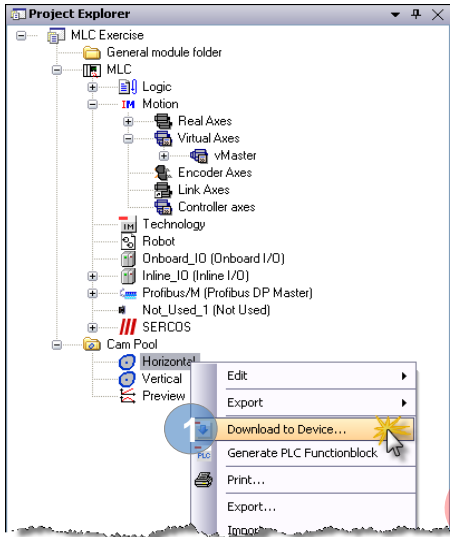
1   Select "Download to Device ..."

2   Select "FlexProfile 0" for 1st axis
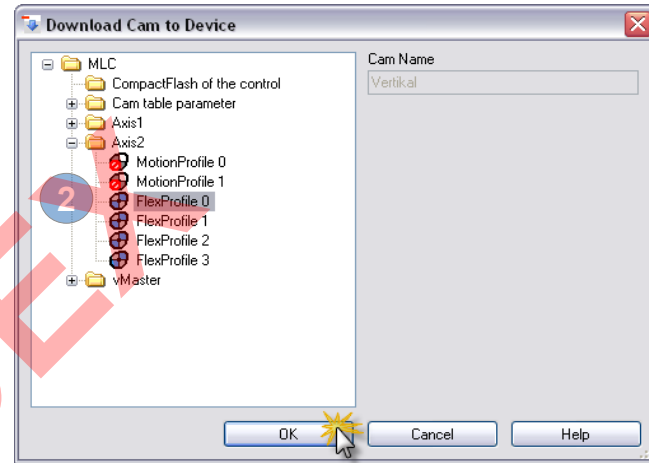
3   After download to MLC an information is displayed

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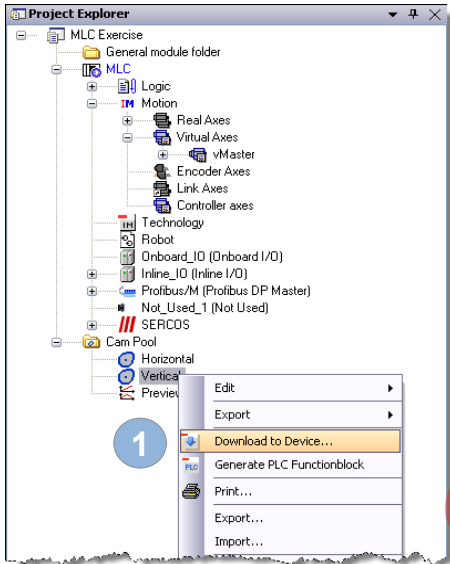Sidex Suministros, S.L: Polígono Industrial El Tiro, s/n. 30100 Murcia. Teléfono: 968 306 000. E-mail: info@sidex.es
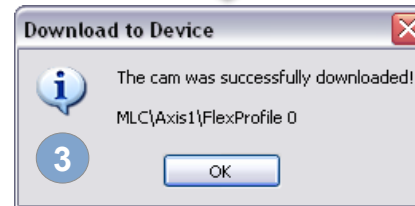
Download FlexProfile for 1st axis
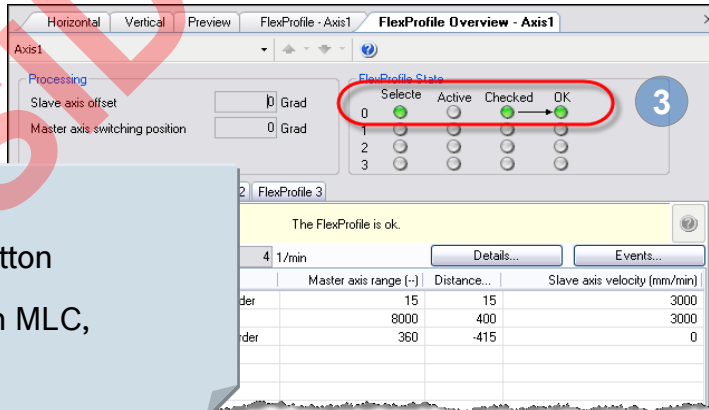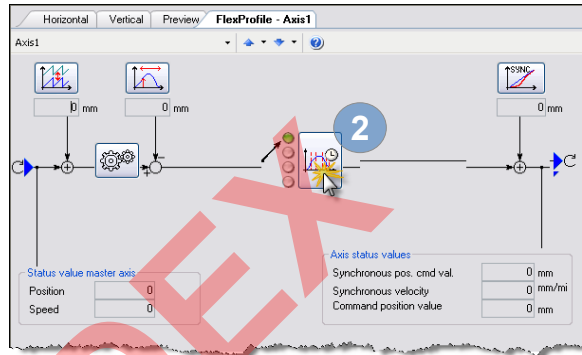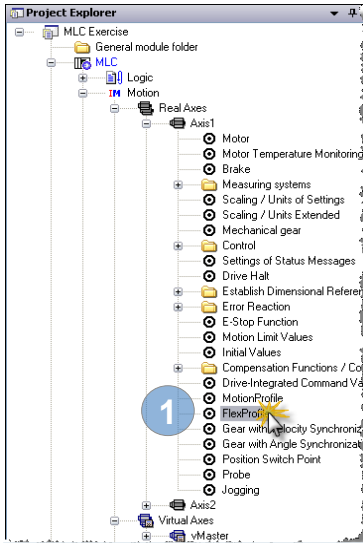
1. Double click on "FlexProfile"

2. Push "FlexProfile overview" button

3. The 1st FlexProfile is stored on MLC, has been checked and is OK!

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Download FlexProfile for 2nd axis

1 Select "Download to Device …"

2 Select "FlexProfile 0" for 2nd axis

3 After download to MLC an information is displayed

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Download FlexProfile for 2nd axis

1. Double click on "FlexProfile"

2. Push "FlexProfile overview" button

3. The 2nd FlexProfile is stored on MLC, has been checked and is OK!

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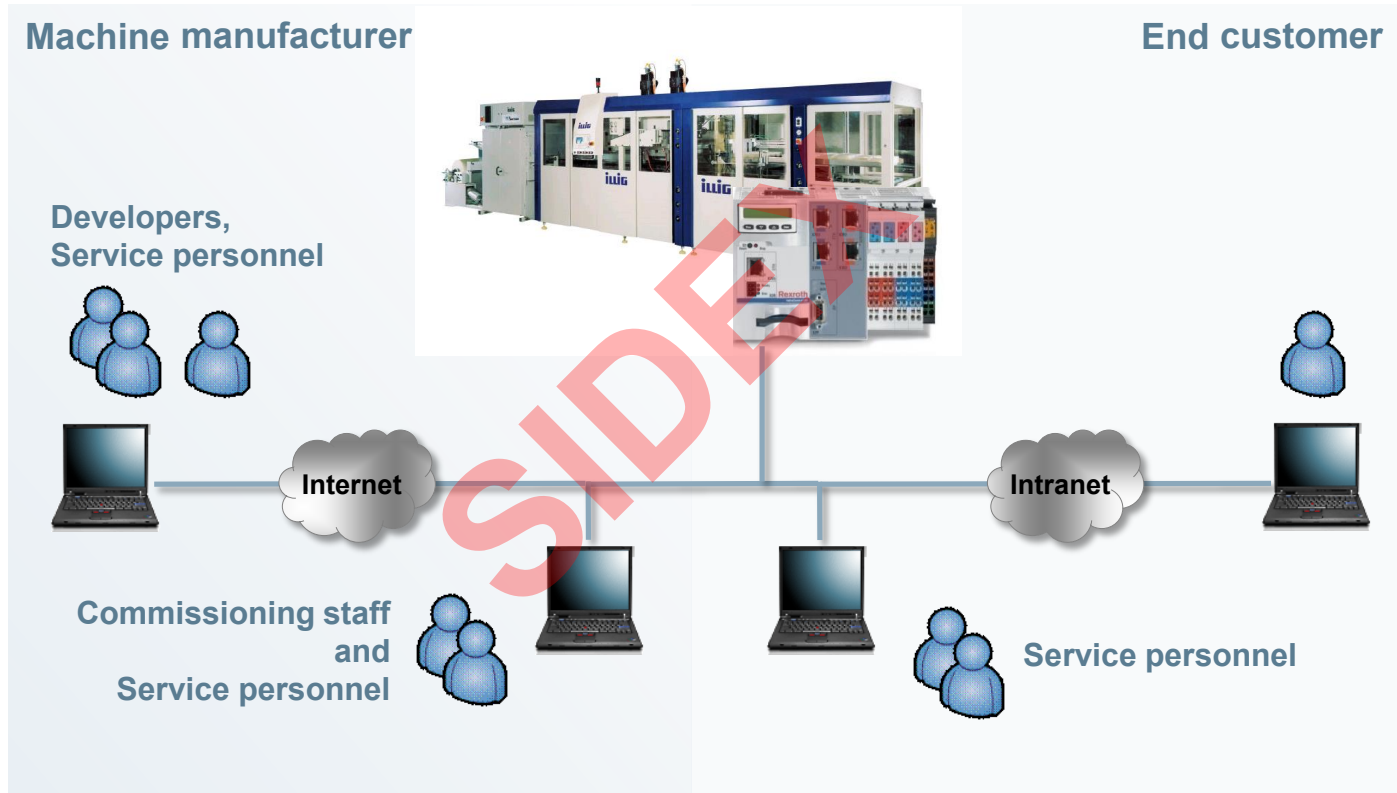
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IMST − Documentation

- Complete Documentation of IndraMotion Service Tool

- ... available on the media directory
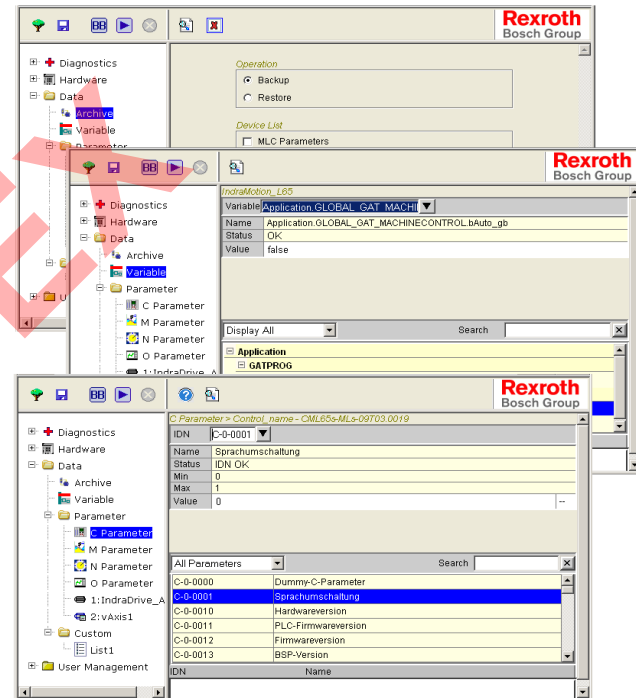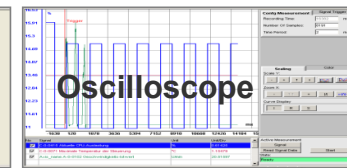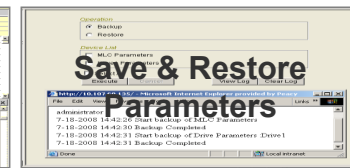- or in print format
- in German and English language

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IMST − IndraMotion Service Tool

Machine manufacturer   **End customer**

**Developers,
Service personnel**

**Commissioning staff
and
Service personnel**

Internet

Intranet

Service personnel

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IMST − IndraMotion Service Tool

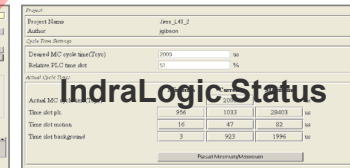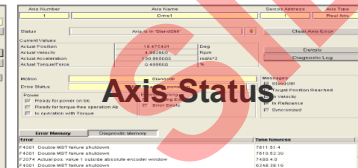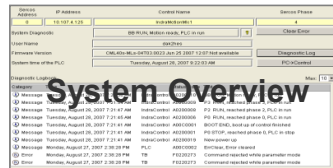- Easy access using a browser to control and drive data without IndraWorks

- Integrated into runtime system of IndraMotion MLC

- Basic configuration and tool for simplified maintenance and commissioning

- Ease of use by navigation in a tree structure, toolbar and tooltips

- Integrated user management
  - Access privileges depending on current user level
  - Flexible definition of user groups
  - Individual adjustment of privileges

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IMST − IndraMotion Service Tool

- Status and diagnosis of control hardware, drives and communication interfaces
- Parameter editor
- Access to PLC variables
- User-specific lists
- Electronic type plate (Hardware, Firmware, Serial number)
- Simple Oscilloscope operation
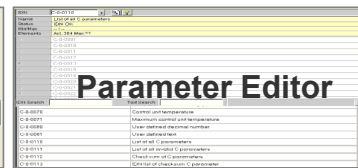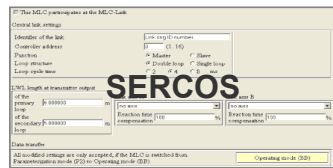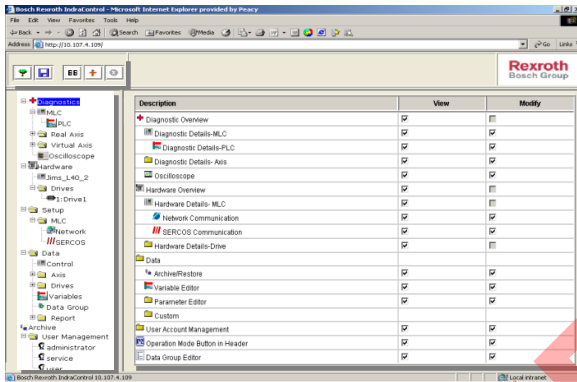
System Overview

Axis Status

IndraLogic Status

Field bus Status

SERCOS

Parameter Editor

Save & Restore Parameters

Oscilloscope

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MLC Documentation

- All MLC manuals for released MLC versions are available in the Intranet on the media directory
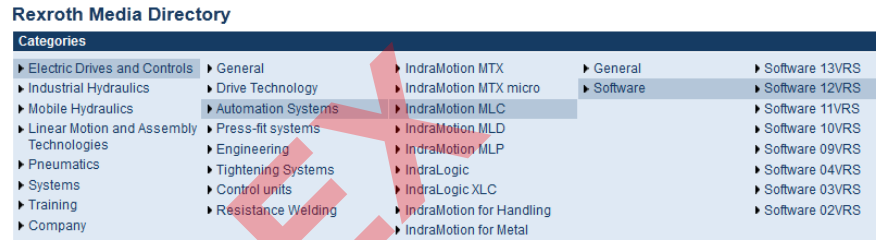
www.boschrexroth.com/mediadirectory
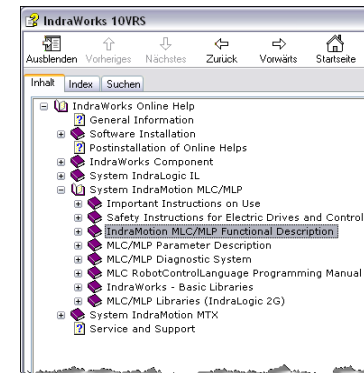
- MLC manuals for the current version can be found on the installation DVD IndraWorks MLC

- The Online Help system provides the same information

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IndraMotion MLC and IndraLogic XLC

Marzo 2016 • Rocio Sevilla