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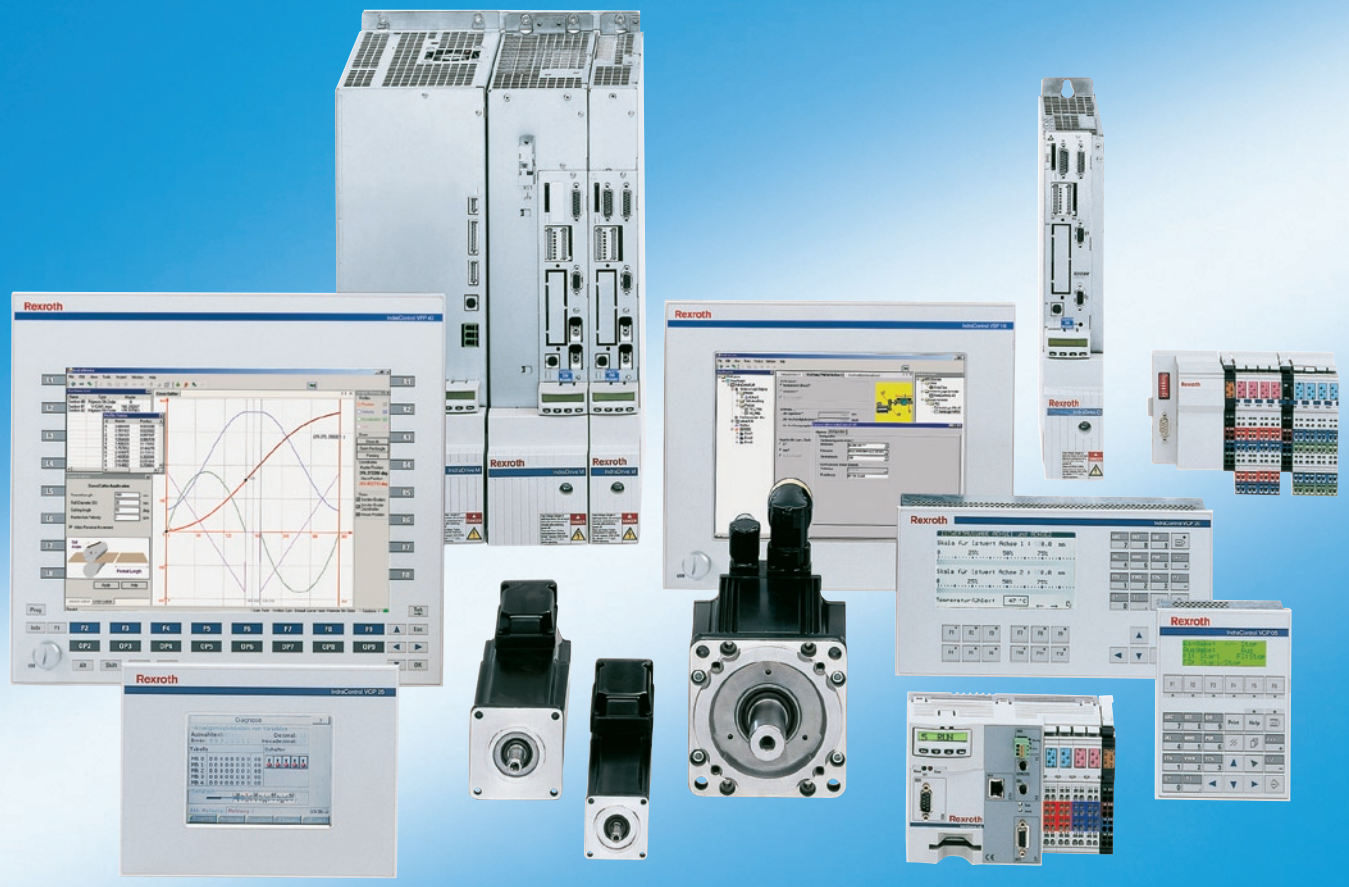
Rexroth Bosch Group

Rexroth IndraMotion MLC02VRS First Steps

R911314825
Edition 01

Training Manual



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First Steps

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Purpose of Documentation This documentation describes the First Steps with IndraMotion MLC.

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Edition	Release Date	Notes
DOK-IM*MLC-F*STEP**V01-KB01-EN-P	08.2005	First Release MLC01VRS
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Table of contents

1 FirstSteps - IndraMotion MLC

1.1 Technical requirements

PC, Pentium 4, 512MB RAM, 1.5GB Harddisc capacity, WindowsXP with SP 1 or Windows2000 with SP 4, **IndraWorks MLC** installed.

Control, type "**IndraMotion MLC L40**", actual firmware loaded

- IP-Address is known
- Control is connected with the programming device via Ethernet

Drive controller, type "**IndraDrive M**", actual firmware loaded

- Drive controller is connected to the control via SERCOS
- The address of the drive controller in the SERCOS-Ring is known

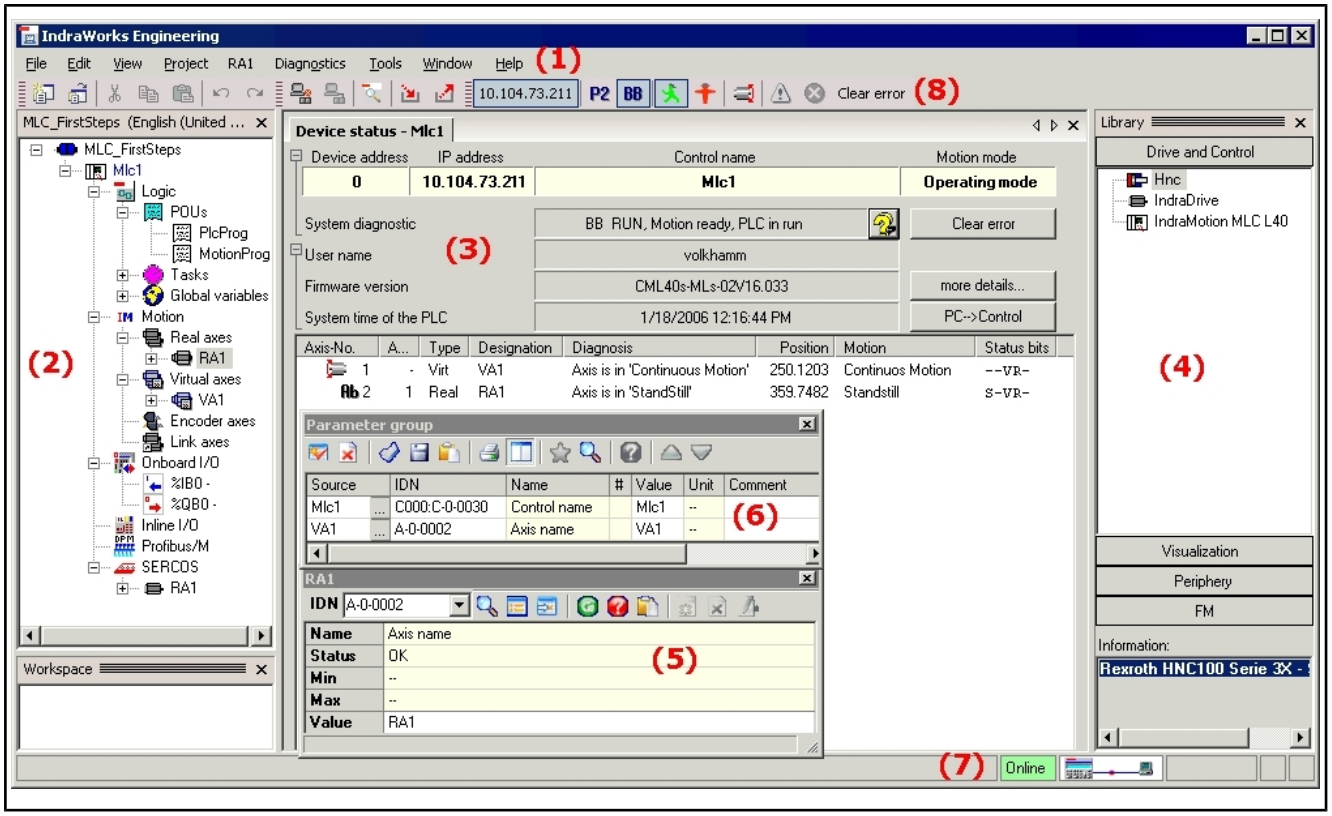
or, if no drive is available, a bridged SERCOS-Ring.

The creation of these requirements is described in

- Rexroth IndraControl L40, Project planning, DOK-CONTRL-IC*L40*****-PR02-EN-P and
- System Description IndraMotion MLC, online help.

1.2 User philosophy

The Motion-Logic-Programming tool integrates itself in the IndraWorks environment (figure below).



①	Title bar, IndraMotion menu	②	Project navigator (device display)
③	Workspace with sheets	④	Library with device info
⑤	Parameter editor	⑥	Parameter group
⑦	Status line	⑧	Symbol bar

Fig. 1-1: IndraWorks-(Motion-Logic-Control)-Desktop

A concrete project (2) is generated with devices from a library (4) inserted per **drag&drop**. Parameterizing and programming can follow.

1.3 Conceptual formulation of the first IndraMotion MLC-Project

Given is a virtual axis, which shall move with a constant velocity. This axis works as a master axis for a real axis, which is coupled by a gear unit.

The real axis contains a drive "IndraDrive M", which is connected via SERCOS Ring to the control "IndraMotion MLC L40".

The processing is also traceable without drive till section "Recording of the movement of axis VA1 (Trace)", page 20, the real axis must, after its configuration, section "Add real axis to project", page 8, be deactivated.

1.4 From the conceptual formulation to the moving axis

1.4.1 Reset control

By previous use, the control may contain old program elements, parameriza-tions and PLC-Data, which are removed in this step by clearing the memory.

Fig.1-2: Reboot of the control

After switch-on of the control, both outer buttons, <ESC> and <Enter> below the display, must be pressed at the appearance of text **BOOT 1.01** until the text **BOOTSTOP** is displayed. Subsequently both inner buttons must be pressed; now the text **REBOOT** appear. Then the buttons may be released.

The control run up to **BB STOP**, the memory is cleared, the motion component is ready and the PLC-Component is stopped in its execution.

1.4.2 Start IndraWorks and create project

Start IndraWorks from the desktop via Icon.

The loaded IndraWorks-MLC-Desktop shows the following start picture:

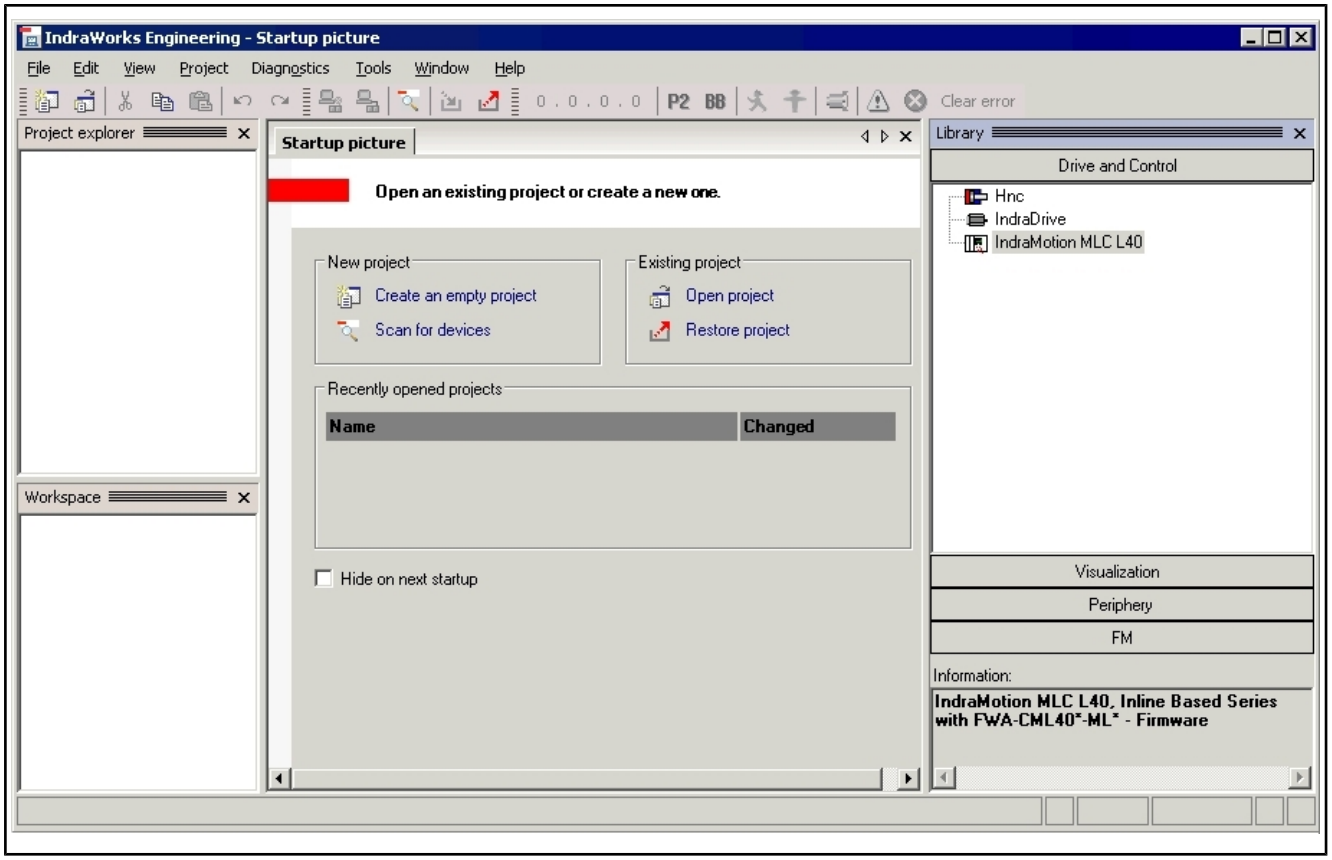


Fig.1-3: IW-MLC-Desktop after start of IndraMotion MLC

The subsequent to be generated device configuration for the solution of the conceptual formulation is administrated in a project.

Create a new project by dialog New project/Create an empty project (or via main menu File/New/Project):

A name and the directory for storing the new project must be determined.

The project shall be named "MLC_FirstSteps":

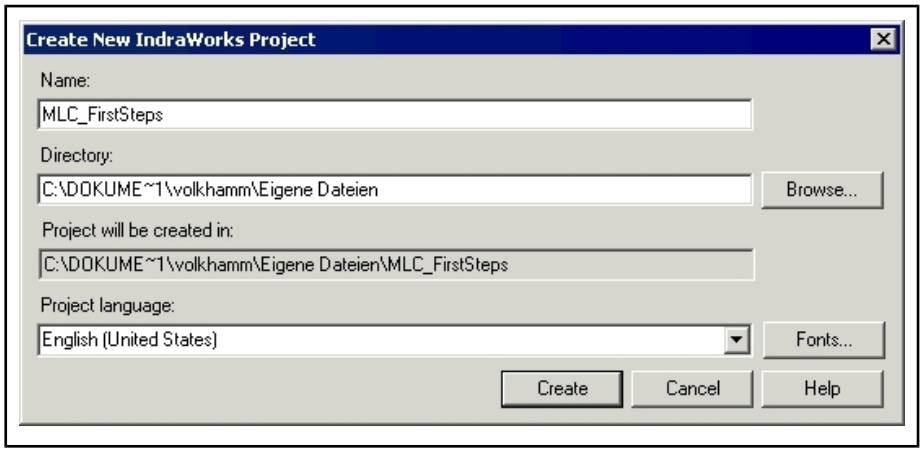


Fig.1-4: Edit a project name

As the directory you can use the default setting, or via button "Browse" select another directory, resp. create a new directory.

So a new project is created:

Fig.1-5: A project is created

☞ At the first project in the project navigator, a project folder with the same name is created automatically, where other projects may be added in the future.

1.4.3 Add control to project

At first expand the display of the devices in the library up to the designated device:

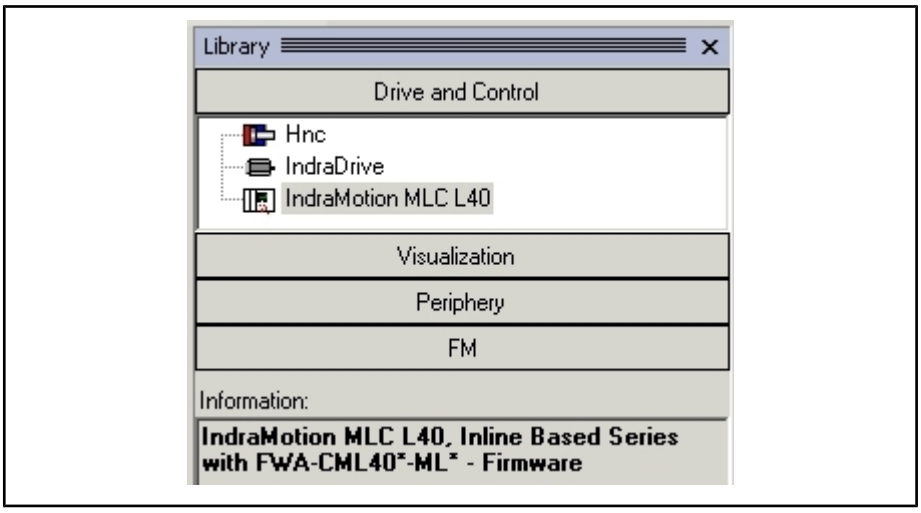


Fig.1-6: Expand of the libray

Set the focus by using the left mouse button to the control "IndraMotion MLC L40" below the folder "Drive and Control" and hold the button pressed:

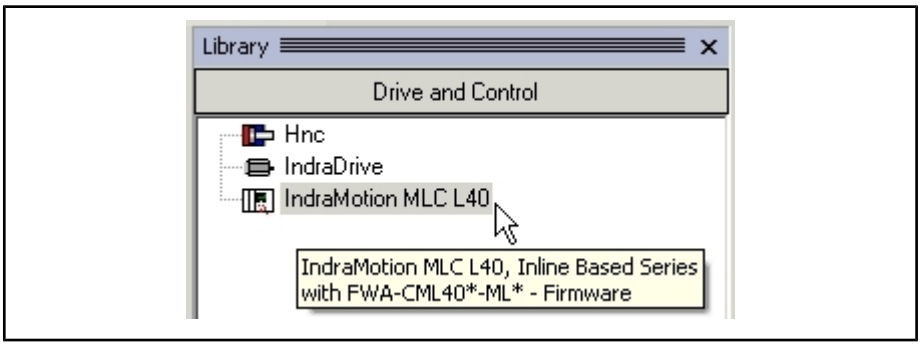


Fig.1-7: Selection of the "IndraMotion MLC L40" in the device library

At pressed left mouse button, drag the control into the project. Position the mouse to folder "MLC_FirstSteps" and release the mouse button:

Fig.1-8: Insertion of "IndraMotion MLC L40" into the actual project

Now a wizard appears; by means of it you can make all necessary settings in two steps within the actual project for the use of the device "IndraMotion MLC L40".

In step "General settings" (following figure) the device name, a comment to this device and the author must be entered. You can use the default values (a comment is optional), or you can change them. Then click to "Next".

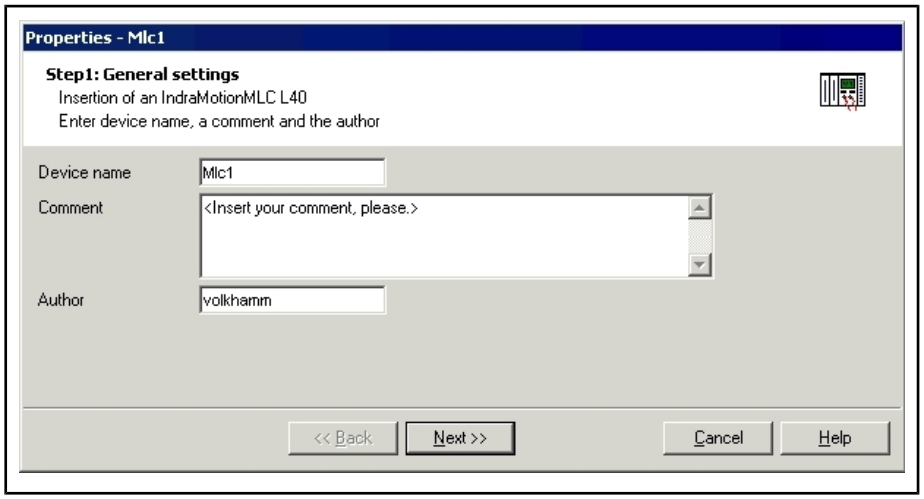


Fig.1-9: "General settings" in the device wizard "IndraMotion MLC L40"

In step "Configuration" (following figure) the firmware version must be set to **MLC02VRS** and also the IP-Address of the IndraMotion MLC L40 (otherwise no communication to the control is possible).

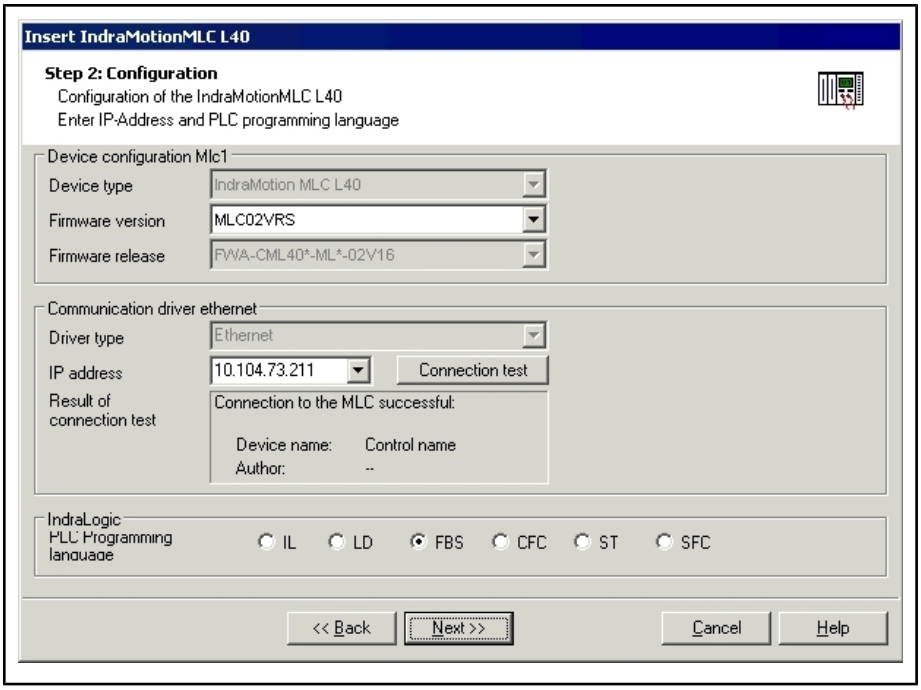


Fig.1-10: Step "Configuration" in device wizard "IndraMotion MLC L40"

The "Connection test" checks, if a control with this IP-Address exist (Ping) and responses with the device name of the control and the name of the actual user (author). Both may be different to the preset device name and author in the previous figure.

In the lower part of the dialog window you have the possibilty to select another PLC-language as the proposed for your future programs. Then click to "Next".

Now you can activate the function modules. For our work no change is required here. Please click on "Finish"

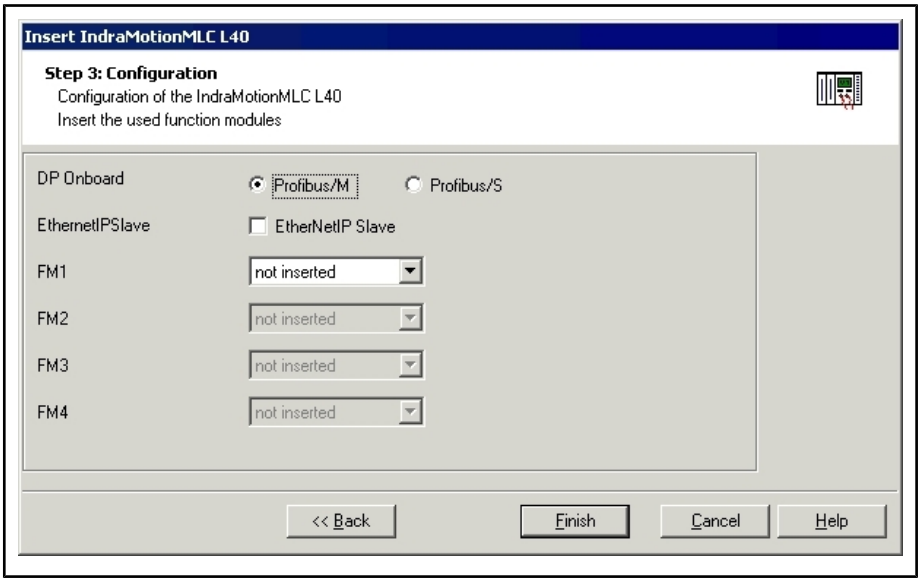


Fig.1-11: Step "Configuration function modules"

In the following waiting time the IndraLogic-Subproject, which belong to the IndraMotion-Project, is created in the background.

So the device "Mlc1" of type "IndraMotion MLC L40" is added to the actual project:

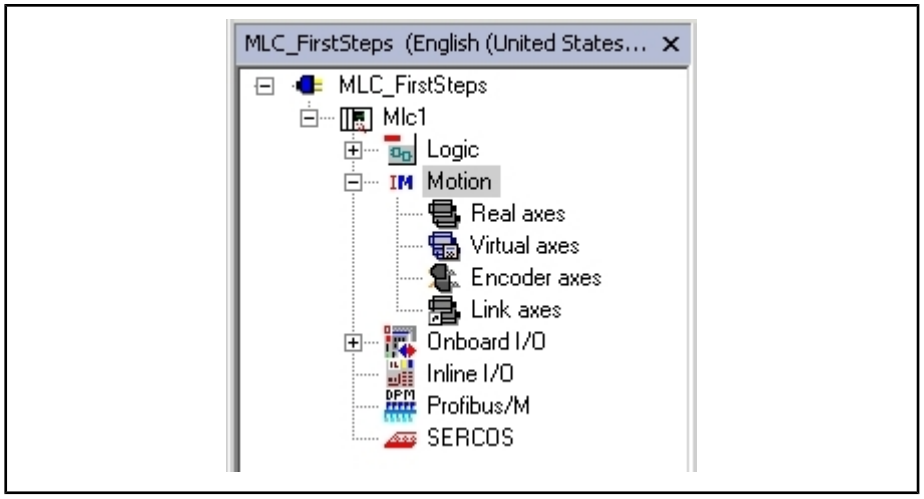


Fig.1-12: "Mlc1" of type "IndraMotion MLC L40" is added to the project

1.4.4 Add virtual axis to project

Unlike real axis, which may run at different interfaces, e.g. SERCOS or Profibus, and must be declared accordingly, a virtual axis must only be declared. In the project navigator click with the right mouse button to folder Motion/Virtual axis and select in the PopUp-Menu the entry "Add a virtual axis".

Fig.1-13: Declaration of a virtual axis

Analog to the entry of the Mlc1 a wizard supplies the required dialog windows for completion.

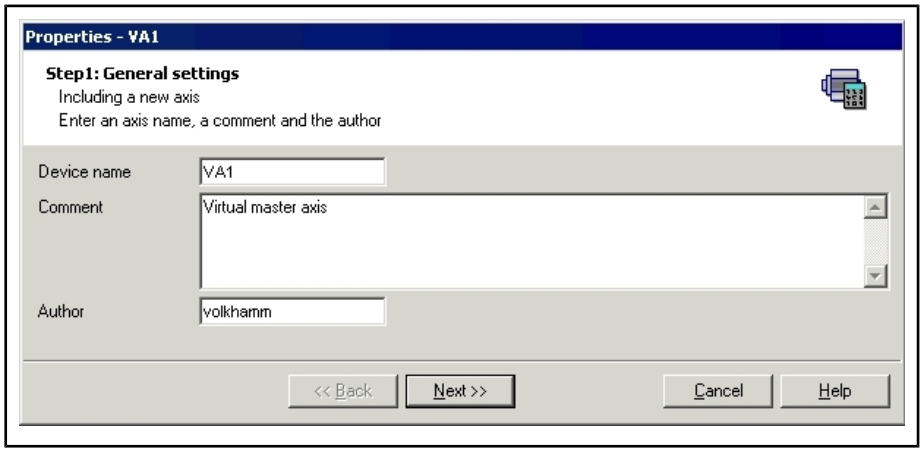


Fig.1-14: Dialog "General settings" for a virtual axis

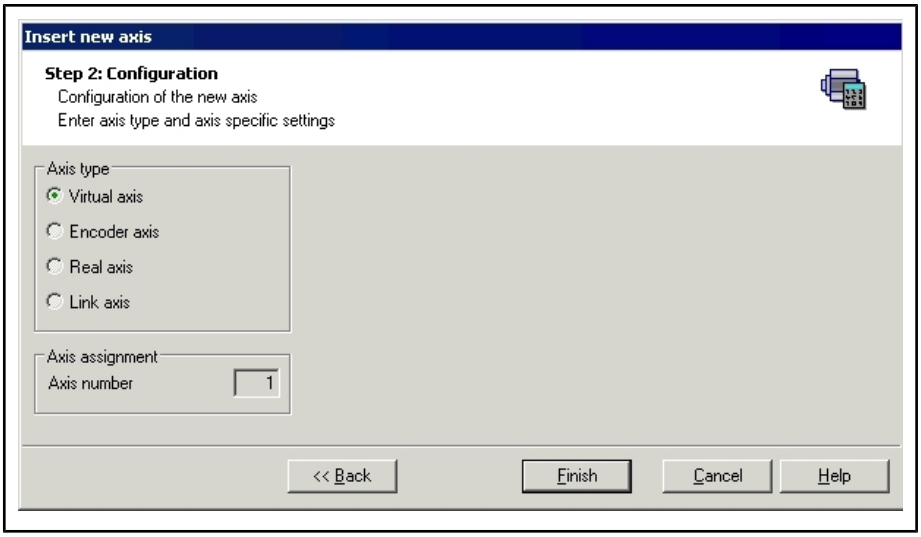


Fig.1-15: Dialog "Configuration" for a virtual axis

The axis number "1" may be used alternatively to axis name "VA1".

1.4.5 Add real axis to project

The activities for a real axis must only be performed if actually a drive is existing, or you deactivate the axis as shown at the end of the section!

The in principle procedure is analog to "Add control to project", page 4:

In the drive explorer, focus the drive controller IndraDrive below the folder "Drive and Control" by the left mouse button and hold the button pressed (following picture).

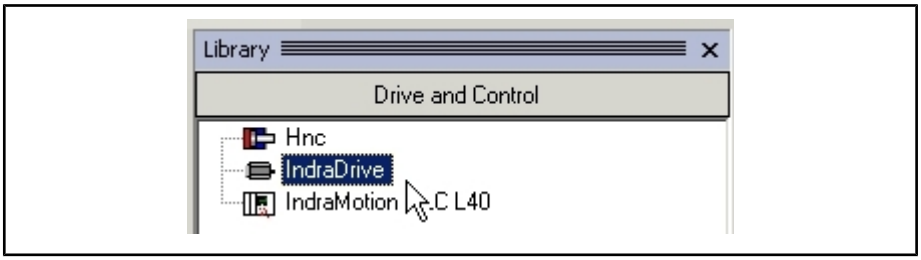


Fig.1-16: Selection of the drive from the library

Drag at pressed left mouse button the drive into the project.

Position the mouse to "SERCOS" below "Mlc1", and release the mouse button:

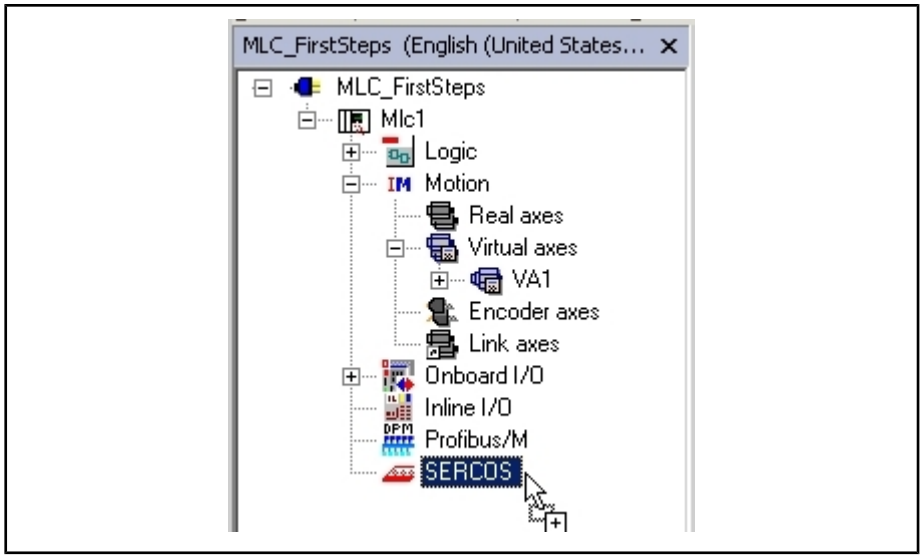


Fig.1-17: Insertion of the drive into the actual project

Now a wizard appears; by means of it you can make all necessary settings in two steps within the actual project for the use of the device "IndraDrive".

In step "General settings" (following figure) the device name, a comment to this device and the author must be entered. You can use the default values, or you can change them. Name the device RA1. Then click to "Next".

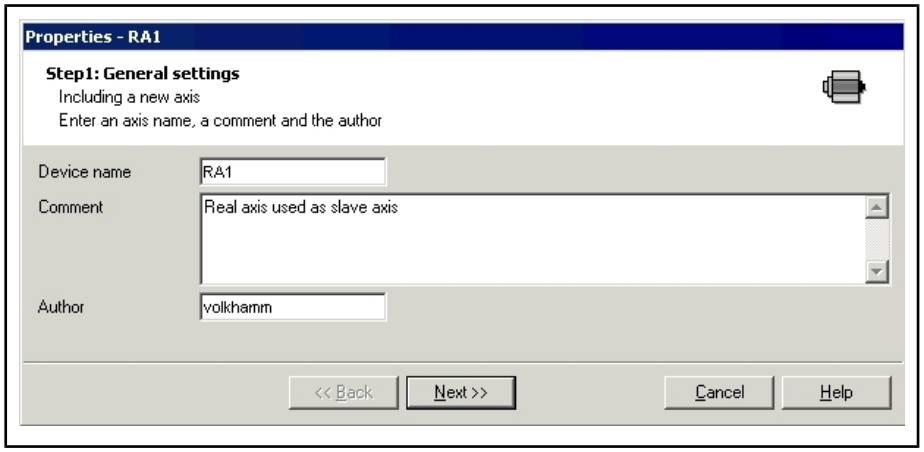


Fig.1-18: Step "General" in the device wizard "Include a new drive"

In step "Configuration" (following figure) the firmware for the drive (MPH_0x/ MPB_0x) and the address of the drive "IndraDrive M" in the SERCOS-Ring must be preset (address in the drive configuration, here "1"), otherwise no communication to the drive is possible.

Please check the drive firmware.

The axis number "2" may be used alternatively to axis name "RA1". Click then on "Next".

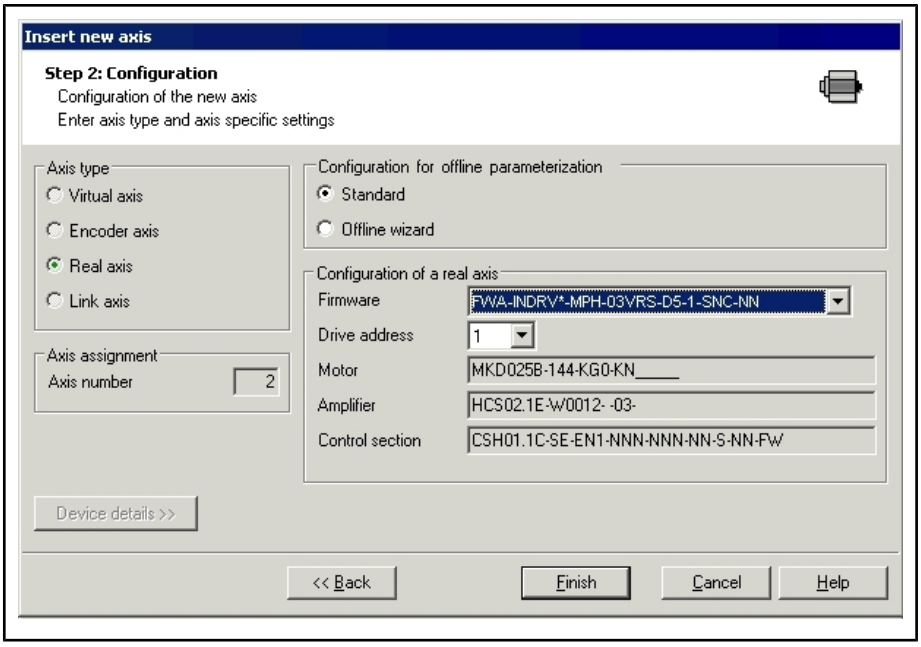


Fig.1-19: Step "Configuration" in the device wizard "Include a new drive"

Now the motion project is completely configured. Both axes (VA1 and RA1) could now be parameterized in detail. But for our interests the default setting is quite enough.

For parameterization, open folders VA1 and RA1 (above) in the following figure.

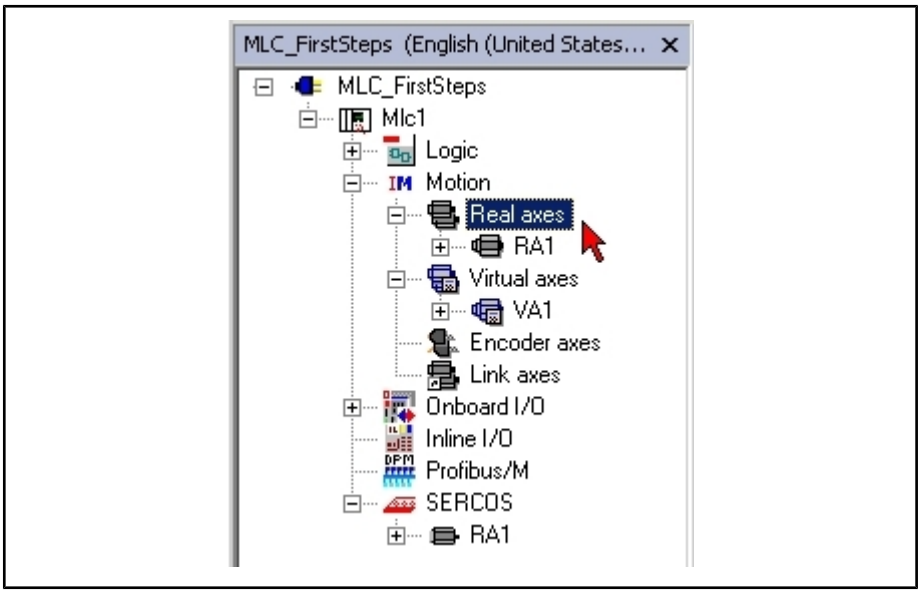


Fig.1-20: Motion-Subproject completed

☞ If you have actually **no** drive, disable the just made configuration of the real axis.

For that purpose click on the symbol of the instance of real axis RA1 with the left mouse button. The symbol changes to a check mark, which changes after deleting to the new icon "Axis disabled" (this procedure is reversible!).

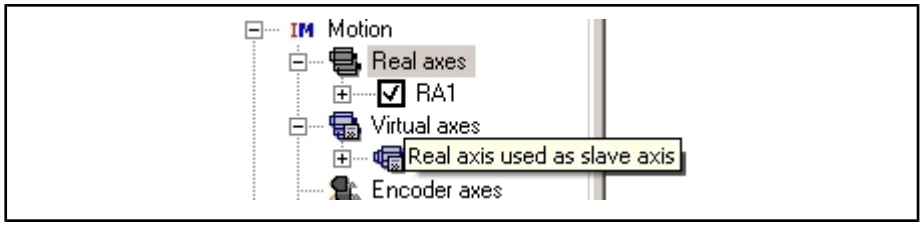


Fig.1-21: Deactivating the real axis

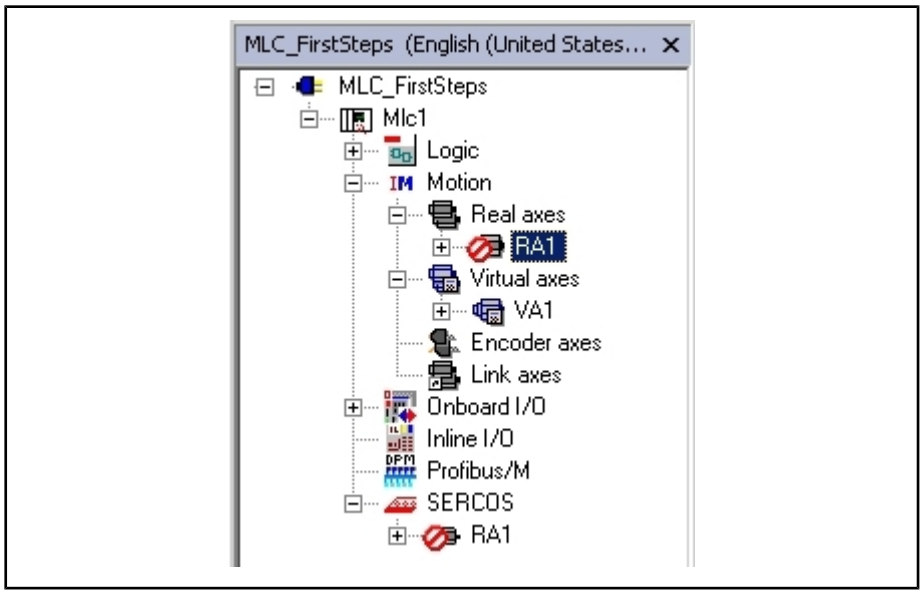


Fig.1-22: Deactivating of the real axis completed

1.4.6 Download of the Motion-Subproject

By dragging the IndraMotion MLC L40 and all axes into the project "MLC_First-Steps" as well as the parameterization of the control- and axes elements (and the possibly disabling), the first section of the adaption is completed.

The up to now gathered informations must now be load into the control. For that purpose click on the icon "Switch project online" in the project symbol bar, or select the menu entry Project/Online:

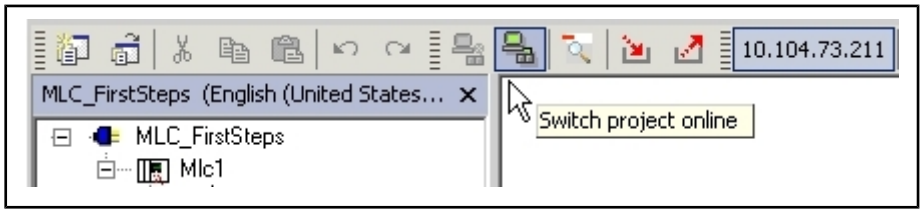


Fig.1-23: Load Motion-Data into the control

The user is point out to differences between the project in the control and his project. After accordance the overwriting take place. The display of the control changes from **BB STOP** via several intermediate steps to **P2 STOP**.

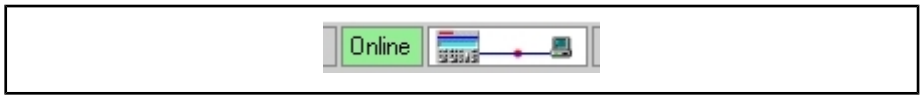


Fig.1-24: Successful completion of the download

Without this download step the control is missing gathered data in the background.

Finally the motion must be switched from "Parameter mode (**P2**)" to "Operating mode (**BB**)".

For that purpose click on the BB-Icon in the MLC-Symbol bar.

Fig.1-25: Switching to operating mode

1.4.7 Programming motion sequence

The logic of the motion sequence is given by way of the use of PLC-Blocks based on the technical specification PLCopen.

The use of these PLCopen-Blocks take place within the BRC-PLC-Programming tool "IndraLogic", according to EN 61131-3.

For that purpose expand in the project explorer consecutively the node "Logic" below "Mlc1" until the following picture is displayed:

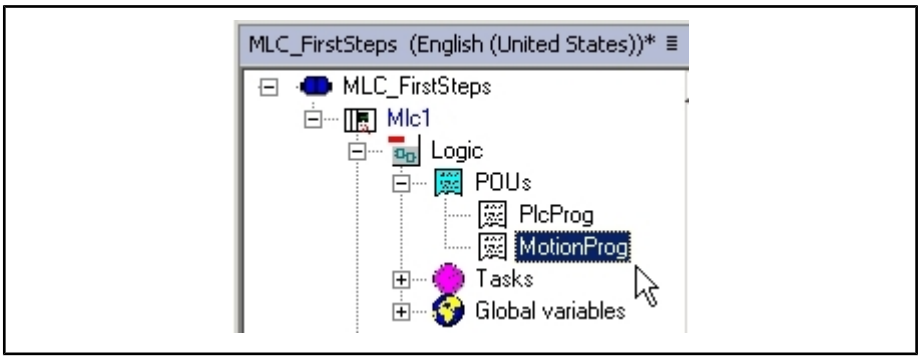


Fig.1-26: Project explorer after expanding the node "Logic"

Click with the left mouse button twice to "Motion_Prog" (or with the right mouse button). Thereupon the PLC-Programming tool "IndraLogic" is opened and the program "Motion_Prog" is focused.

By this call of "IndraLogic" a programming frame is provided, by which you directly can start with the programming of the motion sequence. The programming language for the program you have determined by dragging the control into the project navigator ("Add control to project", page 4).

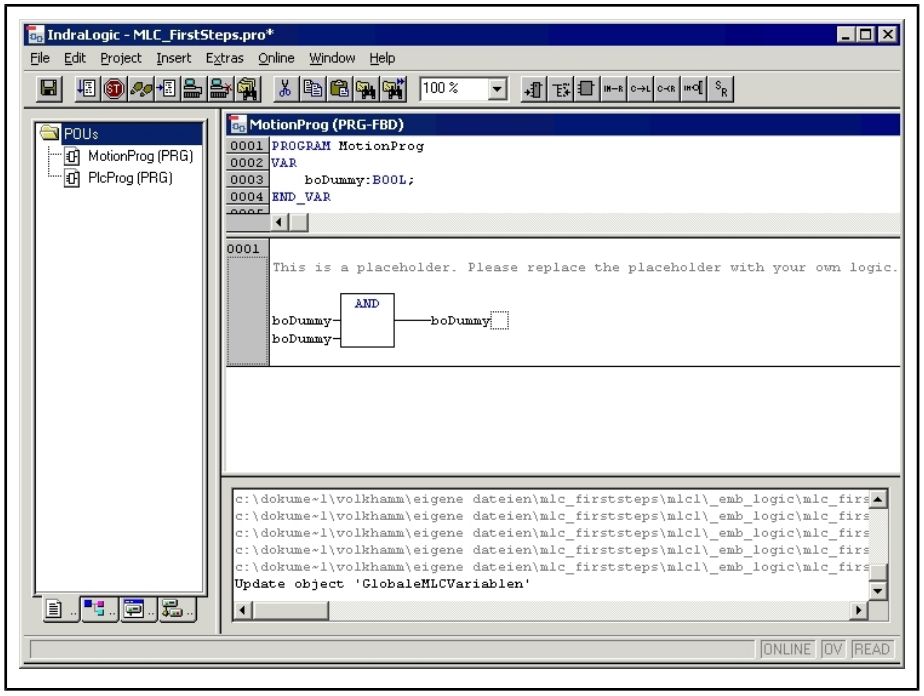


Fig.1-27: PLC-Programming environment "IndraLogic" after the first start in IndraMotion MLC for project "MLC_FirstSteps"

1.4.8 Programming the virtual axis VA1

According to the "Conceptual formulation of the first IndraMotion MLC-Project", page 2, instances of the PLCopen-Blocks MC_MoveVelocity and MC_Stop are called by use of VA1.

An instance of MC_Power is not required for virtual axes.

Proceed as follows:

Insert in the implementation a new network with the right mouse button:

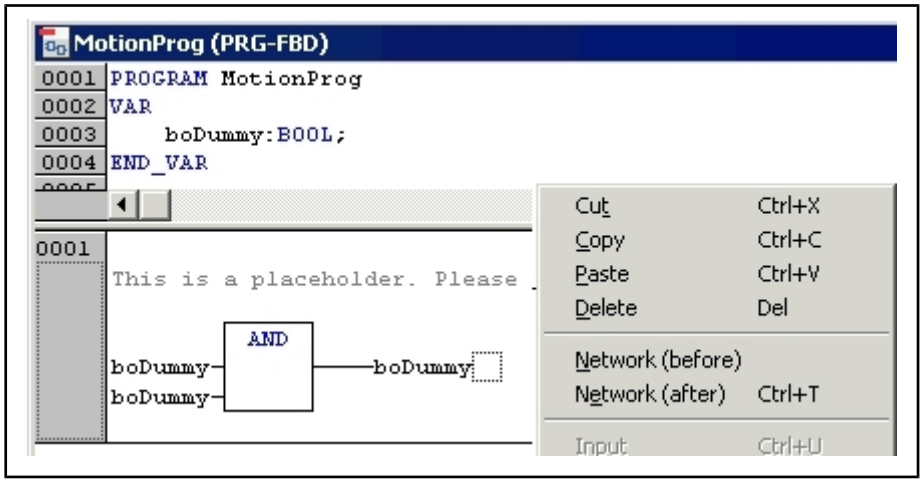


Fig.1-28: IndraLogic, insert a new network

Generate a common block as follows:

- Go to the grey quad in network 0002.

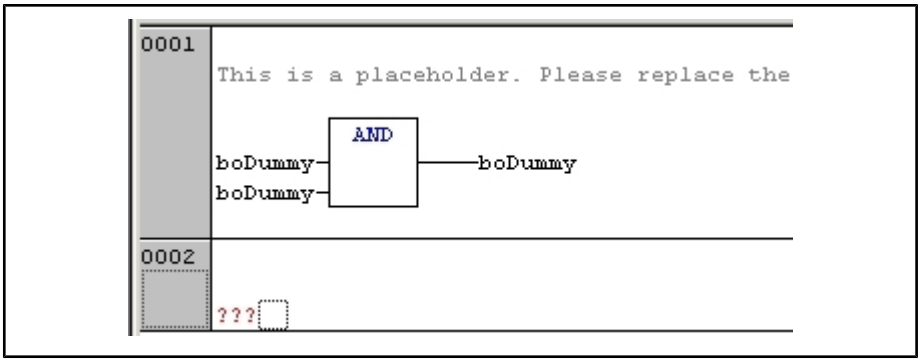


Fig.1-29: IndraLogic, new network 0002 with grey quad

- Right mouse button, "Box Ctrl+B" results in an AND

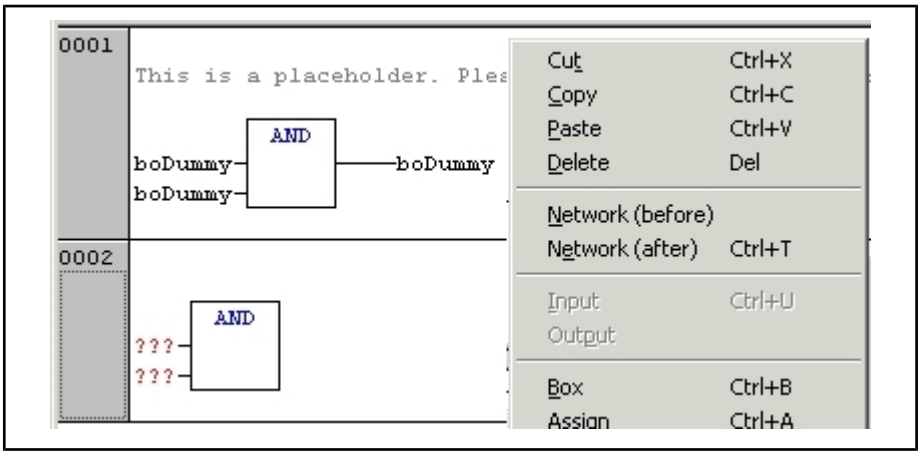


Fig.1-30: IndraLogic, generating a new block

- Open with function key <F2> the input help.
- Select among the standard function blocks from the PLCopen-Library (... \Rexroth\IndraWorks\IndraLogic\Targets\IndraMotion_MLC_L40_01VRS \Lib\ ML_PLCopen.lib\Motion), provided by Bosch-Rexroth, the block MC_MoveVelocity.
- Confirm with "OK".

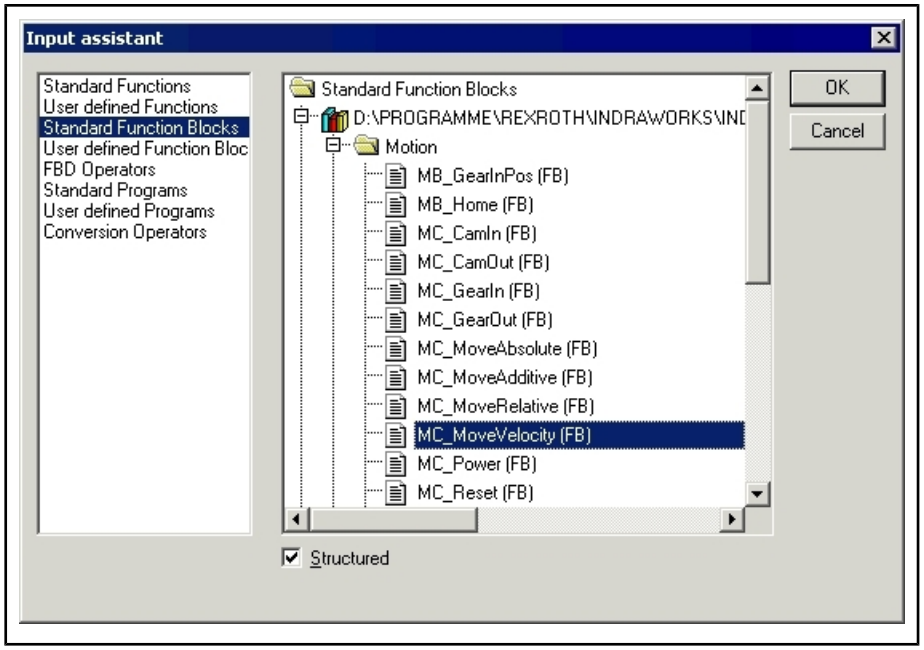


Fig.1-31: IndraLogic, selection of MC_MoveVelocity from the ML_PLCopen.lib

Confirm now the insertion of the block MC_MoveVelocity with <Enter> and mark by a click of the left mouse button the 3 question marks above the block. Specify the instance name "MoveVelVA1" for this block and complete the input with <Enter>. Thereupon the window "Declare Variable" is opened, which you can directly quit with "OK":

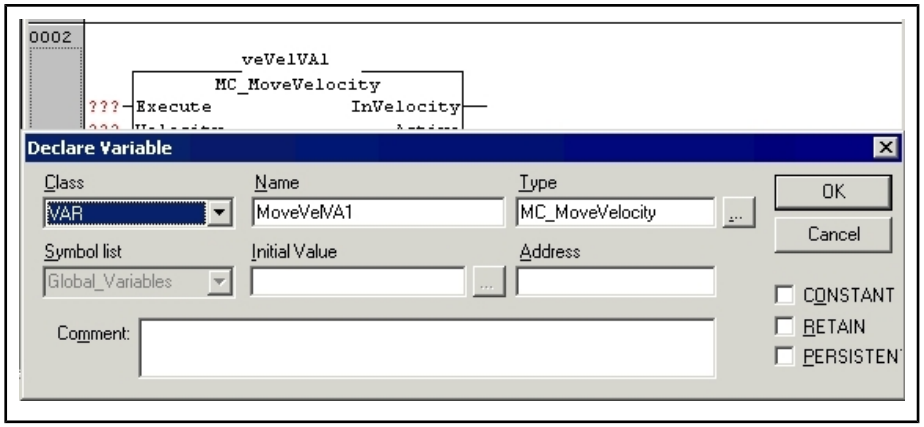


Fig.1-32: IndraLogic, Declaration of the instance name of a block, type "MC_MoveVelocity" by means of window "Declare Variable"

So you have declared the instance MoveVelVA1 of the PLC-Open-Block MC_MoveVelocity. Connect now the inputs of the block.

Analog to the instance name of the block, connect the input "Execute" with a variable with name "ex_MoveVelVA1", type BOOL:

- Mark the 3 question marks at the input "Execute".
- Enter the name "ex_MoveVelVA1" and complete with <Enter>.
- The opening window for the variable declaration you can quit directly with <Enter>.

To connect the input "Velocity", proceed as follows:

- Mark the 3 question marks at input "Velocity".
- Input the name "VcomVA1" and complete with <Enter>.

- For the type insert REAL and as initial value 200 (rpm), <Enter>.

For the input "Acceleration" insert 20 (rad/s²) and for "Deceleration" 20 (rad/s²),

To connect the input "Axis", proceed as follows:

- Select by means of the input help <F2> from the range of the "Global Variables" and group of the "Global_MLC_Variables" the variable "VA1" (following figure).
- Confirm with "OK".
- Complete the input of the name with <Enter> .

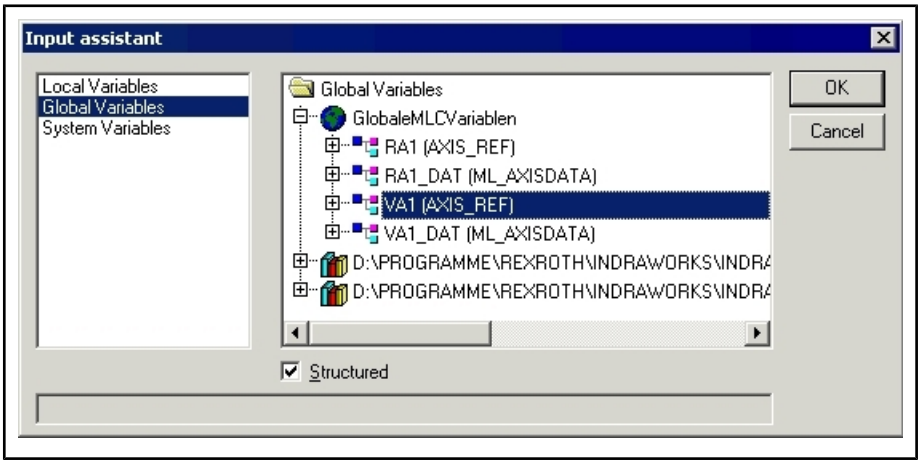


Fig.1-33: IndraLogic, selection of the axis instance at connection of a function block of type "MC_MoveVelocity"

To get a response wether the function block worked correct, the outputs "InVelocity", "CommandAborted" and "Error" should be connected.

Mark the area right beside the output "InVelocity" by a mouse click and select in the context menu (click right mouse button) "Assign Ctrl+A":

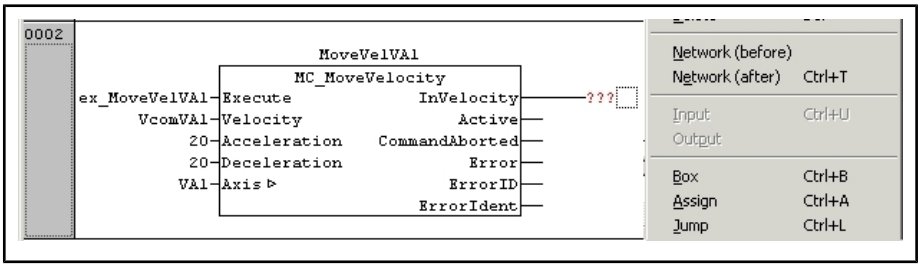


Fig.1-34: IndraLogic, assignment at the output of a function block

In the familiar way connect the output "InVelocity" of the block with a variable named "in_MoveVelVA1" of type BOOL:

- Mark the 3 question marks at output "InVelocity".
- Enter the name "in_MoveVelVA1" and complete with <Enter>.
- The opening window for the "variable declaration" can be confirmed with <Enter>.
- Add "ca_MoveVelVA1" to the "CommandAborted" output.
- Repeat this procedure for the "er_MoveVelVA1" output.

So the PLCopen-Block of type MC_MoveVelocity is sufficient connected according to the conceptual formulation:

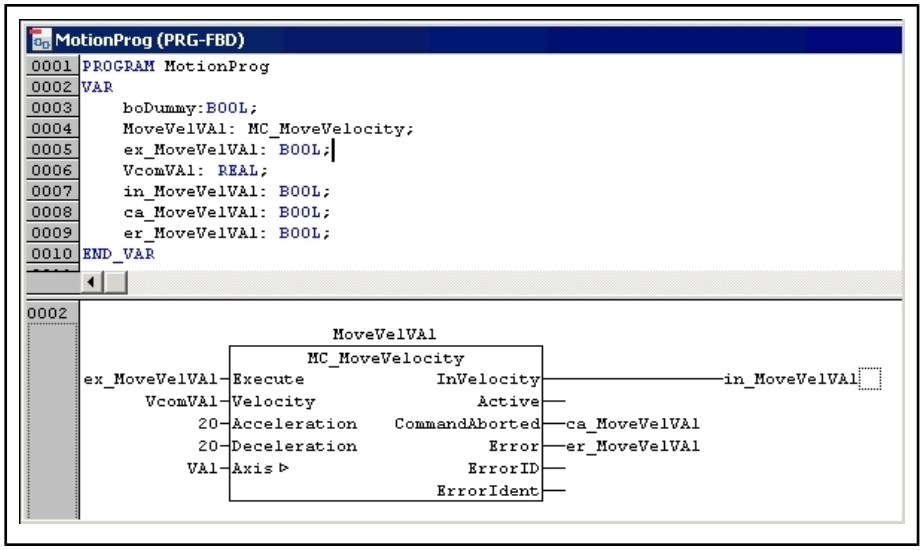


Fig.1-35: PLCopen-FB type "MC_MoveVelocity" is inserted and connected

Whenever you have completed a block, start a test compilation with function key <F11>. Subsequently remove possible existing errors immediately.

Furthermore generate an instance of the PLCopen-Block MC_Stop.

MC_Stop

Add a new network	
Insert MC_Stop and declare an instance "StopVA1"	
Connect inputs, and if necessary, declare input variables:	
	"Execute" → "ex_StopVA1" of type BOOL
	"Deceleration → "50" (rad/s²)
	"Axis" → "VA1" of type "AXIS_REF (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
Outputs	
	"Done" → "do_StopVA1" of type BOOL
	"Error" → "er_StopVA1" of type BOOL

Fig.1-36: Insert MC_Stop and declare an instance "StopVA1"

Actual velocity "VactVA1"

Finally a network to display the actual velocity of axis VA1 "VactVA1" (data type REAL) shall be implemented.

At least once in addition the current speed must be applied first in the Implementation. The data of all axes which a MLC can control are contained in the array AxisData:

ARRAY [1..16] OF ML_AXISDATA_SM

whereas the index must be used as axis number.

The variable is provided by the name

AxisData[1].rActualVelocity_i

for the virtual axis, axis number 1.

The input is supported by the Intellisense-Function. This means, that after the input of "." at "AxisData[1]." all available elements are displayed and available for selection.

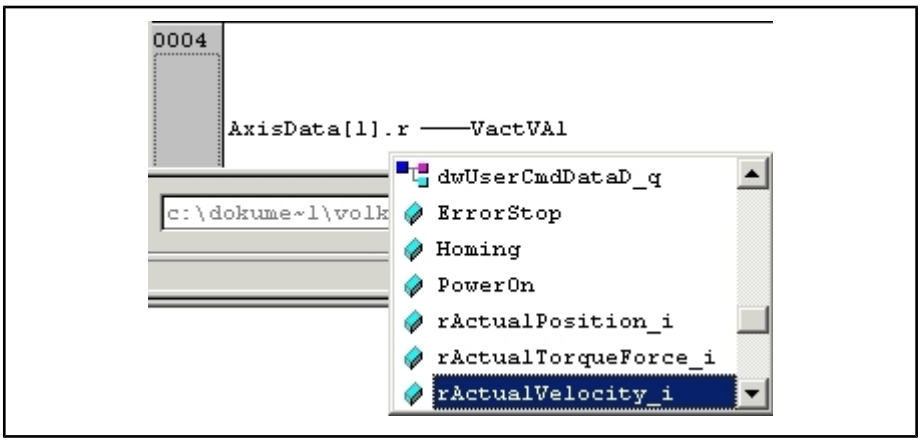


Fig.1-37: Selection of the direct variable "actual velocity"

So the implementation of the motion sequence according to the conceptual formulation is completed:

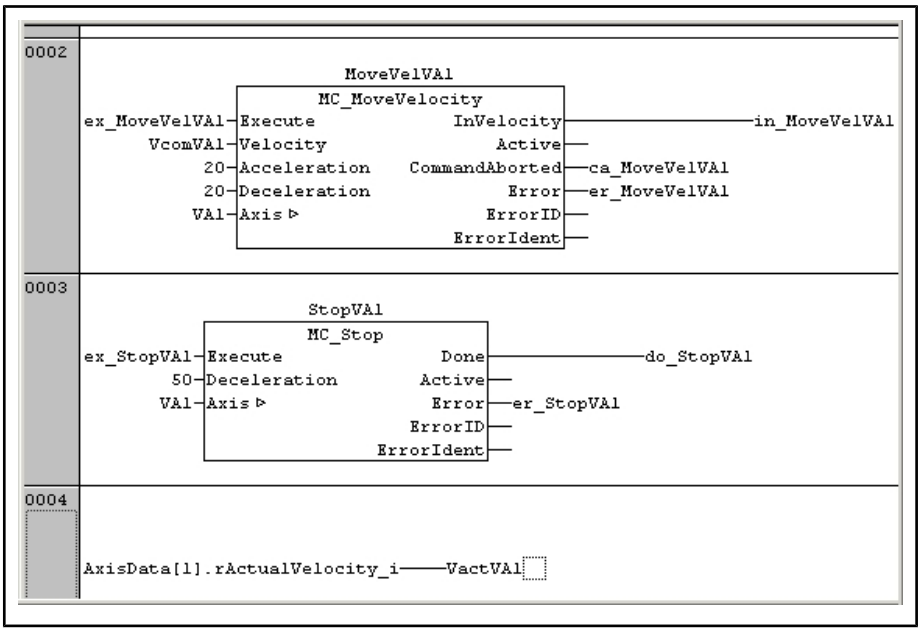


Fig.1-38: IndraLogic, implementation of virtual axis VA1

1.4.9 Download of the PLC-Subproject virtual axis VA1

The before implemented motion sequence must yet be compiled, transmitted to the control and started.

The compilation is reachable via menu entry Project/Rebuild All:

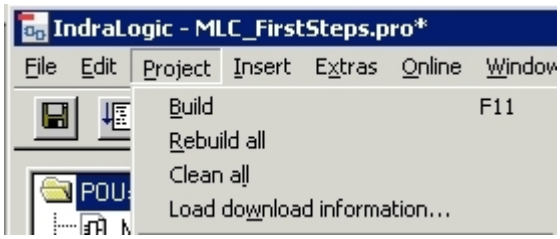


Fig.1-39: IndraLogic, compile implemented motion sequence

For transmission of the compiled data to the target control, select menu entry Online/Login (following figure).

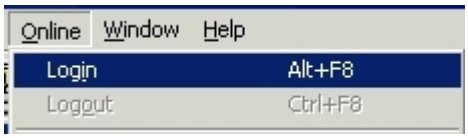


Fig.1-40: IndraLogic, transmit compiled data to control

If another program was processed in the control before, a query appears if your program shall be loaded. In this case confirm with "Yes":

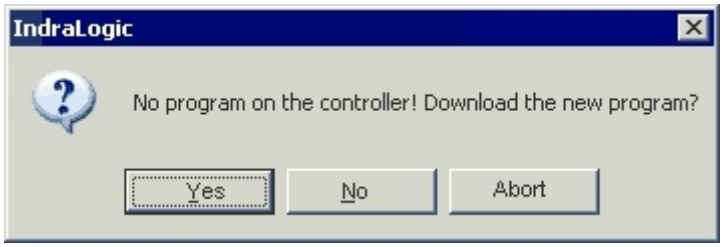


Fig.1-41: IndraLogic, query at the transmission

Start the processing in the control via Online/Run.

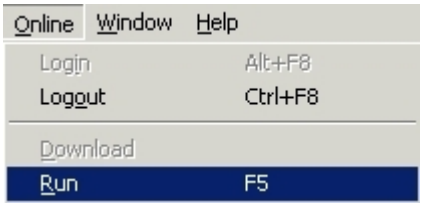


Fig.1-42: IndraLogic, start of the processing in the control

The motion sequence itself is activated by consecutively processing of the programmed function blocks.

To activate the processing of "MoveVelVA1" of type "MC_MoveVelocity", a positive edge at the "Execute"-Input of the block must occur.

Double-click with the left mouse button to the input variable "ex_MoveVelVA1". Now a "TRUE" is displayed behind "ex_MoveVelVA1" which displays the alternative value of "ex_MoveVelVA1" relating to the actual condition. Via Online/Write values Ctrl+F7 "ex_MoveVelVA1" is set to "TRUE" in the control. The thereby generated positive edge set the output "InVelocity" of function block "MoveVelVA1" to "TRUE".

The output "InVelocity" of the block is set to "TRUE" and the axis moves with 200 rpm.

If you set the variable "ex_StopVA1" at input "Execute" of function block "StopVA1" of type MC_Stop, the movement is stopped.

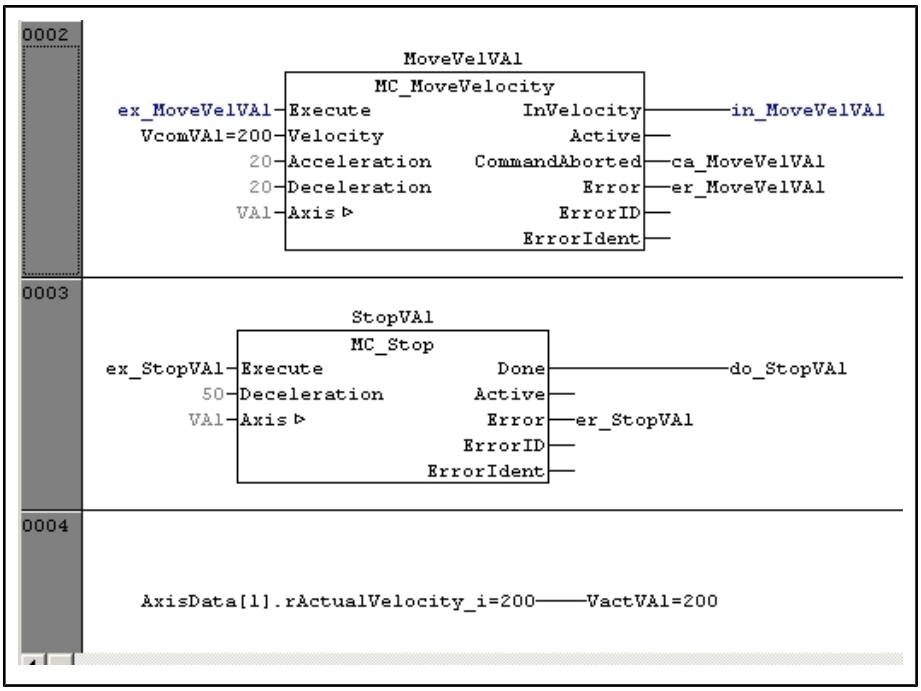


Fig.1-43: IndraLogic, after forcing of "Execute", "MC_MoveVelocity" and prepared forcing of "Execute", "MC_Stop"

1.4.10 Recording of the movement of axis VA1 (Trace)

IndraLogic supply a trace tool to record movement sequences. With the help of this tool

- the axis velocity "VactVA1",
- for MoveVelVA1 (MV_MoveVelocity)
  - "ex_MoveVelVA1" (Execute)
  - "in_MoveVelVA1" (InVelocity)
  - "ca_MoveVelVA1" (CommandAborted)

and

- for "StopVA1" (MC_Stop)
  - "ex_StopVA1" (Execute)

shall be recorded.

For that purpose, the trace recording must be configured at first:

Project navigator ▸ Ressources ▸ Sampling Trace, click with right mouse button into the working area or <shift>+<F10> for "Trace Configuration".

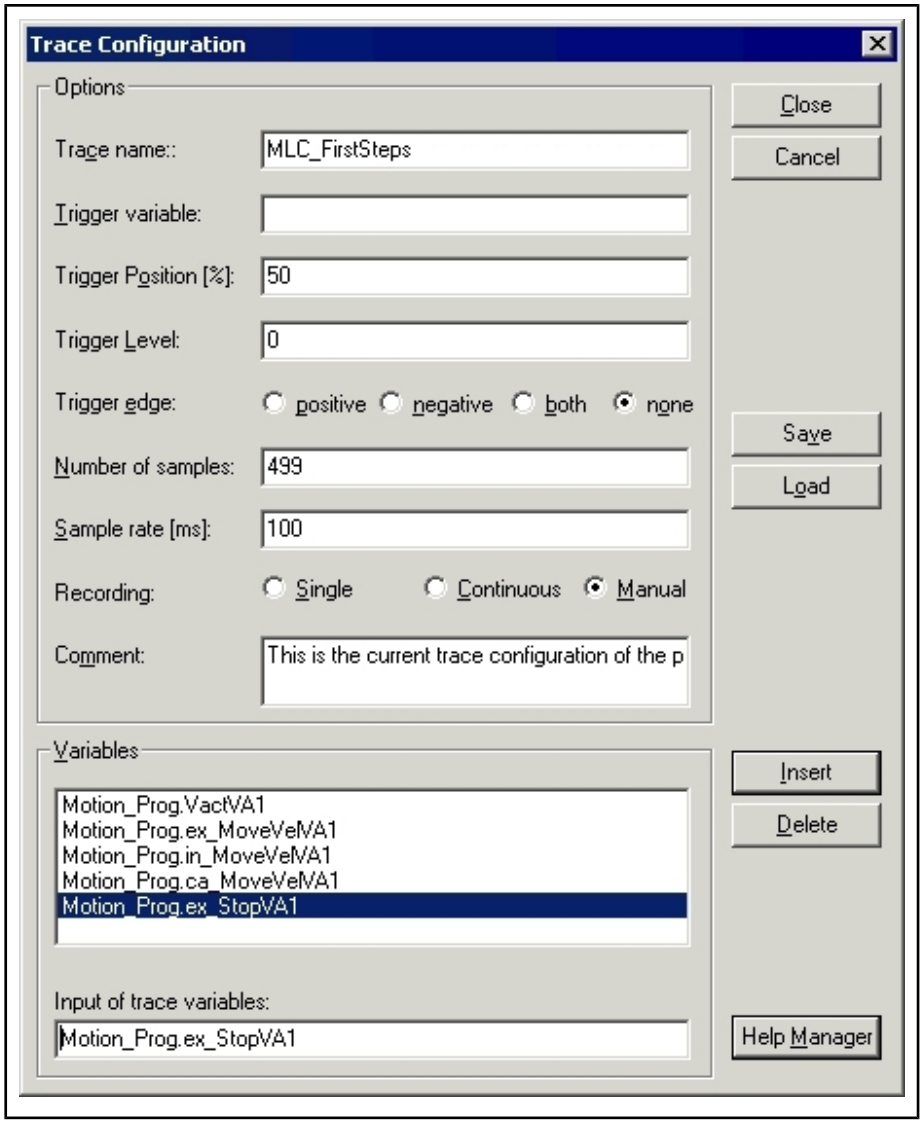


Fig.1-44: Configuration of the trace recording

The product of number of measurings (max. 499) and sample rate gives the available measuring time.

The variables are indicated by the input help (see figure above). They may be displayed in any order. The recording is started and stopped manually. The result is shown below.

The order of the variables to display in the following window must be forced manually.

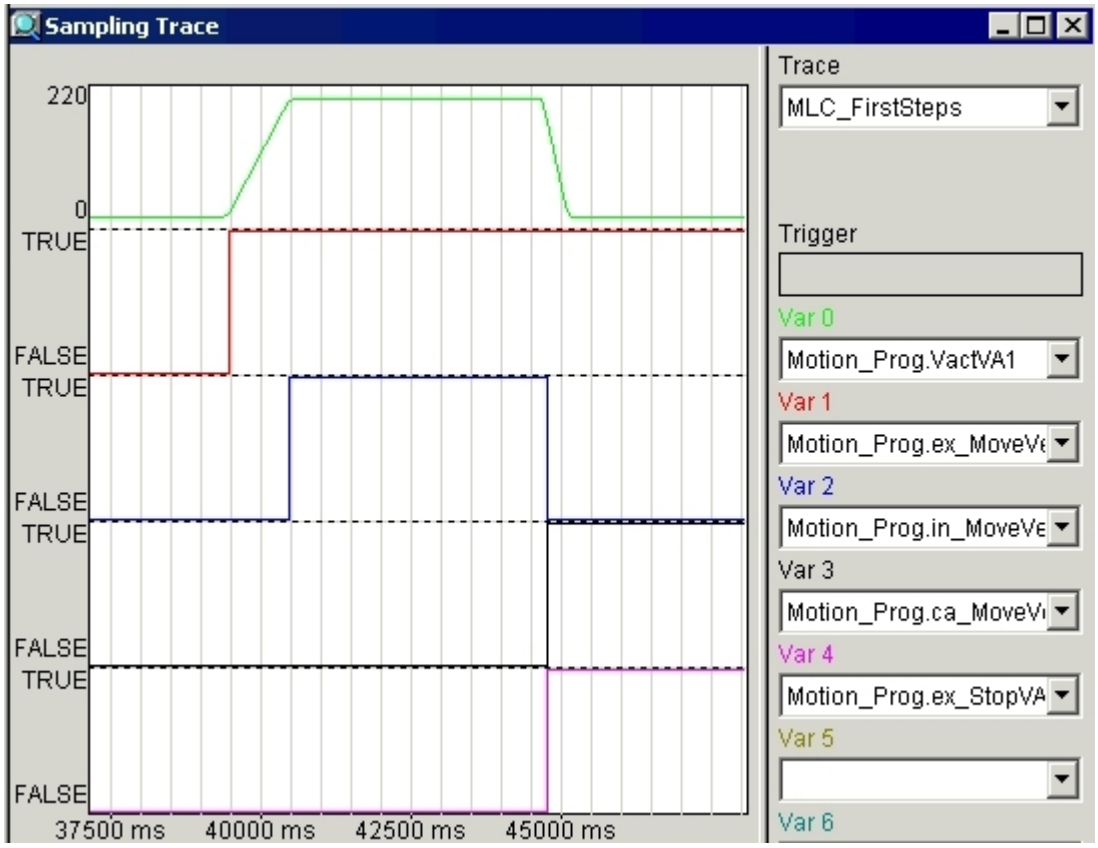


Fig.1-45: Trace recording for the virtual axis VA1

You can see, that the virtual axis acts analog to a real axis with the same parameter (compare velocity characteristics, acceleration with 20 rad/s² and decelaration with 50 rad/s²).

1.4.11 Programming of the real axis RA1

From this point you need "real" drives!

The use of a real axis requires at first an instance of the PLCopen-Block MC_Power.

Next an instance of MC_GearIn and MC_GearOut are required.

The real axis may then be stopped by an instance of MC_Stop.

The programming take place analog to section "Programming the virtual axis VA1", page 13.

MC_Power

Add new network	
Insert MC_Power and declare an instance "PowerRA1"	
Connect inputs, and if necessary, declare input variables:	
	"Enable" → "en_PowerRA1" of type BOOL
	"Axis" → "RA1" of type "AXIS_REF" (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
Outputs	

	"Status" → "st_PowerRA1" of type BOOL
	"Error" → "PowerRA1" of type BOOL

Fig.1-46: Insert MC_Power and declare an instance "PowerRA1"

MC_GearIn

Add new network	
Insert MC_GearIn and declare an instance "GearInRA1"	
Connect inputs, and if necessary, declare input variables:	
	"Execute" → "ex_GearInRA1" of type BOOL
	"RatioNumerator" → "5"
	"RatioDenominator" → "10"
	"MasterFineadjust" → "20" (%)
	"Master → "VA1" of type "AXIS_REF (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
	"Slave → "RA1" of type "AXIS_REF (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
Outputs:	
	"InGear" → "ig_GearInRA1" of type BOOL
	"CommandAborted" → "ca_GearInRA1" of type BOOL
	"Error" → "er_GearInRA1" of type BOOL

Fig.1-47: Insert MC_GearIn and declare an instance "GearInRA1"

MC_GearOut

Add new network	
Insert MC_GearOut and declare an instance "GearOutRA1"	
Connect inputs, and if necessary, declare input variables:	
	"Execute" → "ex_GearOutRA1" of type BOOL
	"Slave" → "RA1" of type "AXIS_REF" (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
Outputs	
	"Done" → "do_GearOutRA1" of type BOOL
	"Error" → "er_GearOutRA1" of type BOOL

Fig.1-48: Insert MC_GearOut and declare an instance "GearOutRA1"

MC_Stop

Add new network	
Insert MC_Stop and declare an instance "StopRA1"	
Connect inputs, and if necessary, declare input variables:	
	"Execute" → "ex_StopRA1" of type BOOL
	"Deceleration → "50" (rad/s²)
	"Axis" → "RA1" of type "AXIS_REF" (already declared variable from range "Global Variables" and group "Global_MLC_Variables")
Outputs	

	"Done" → "do_StopRA1" of type BOOL
	"Error" → "er_StopRA1" of type BOOL

Fig.1-49: Insert MC_Stop and declare an instance "StopRA1"

Actual velocity "VactRA1"

Finally a network to display the actual velocity of axis RA1 "VactRA1" shall be implemented.

For that purpose the actual velocity must first of all be used at least once in the implementation. The velocity is supplied as a global variable in

AxisData[2].rActualVelocity_i,

Type REAL, for the real axis, axis number 2.

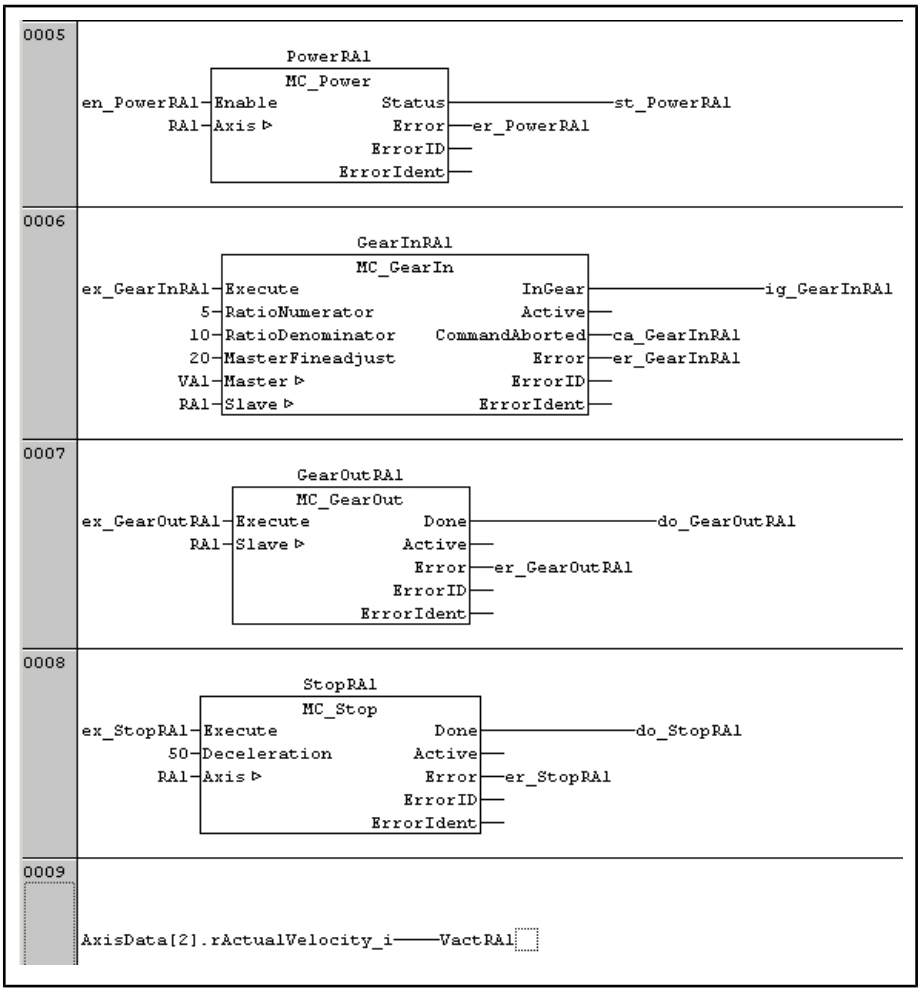


Fig.1-50: IndraLogic, implementation of the real axis

1.4.12 Download of the PLC-Project

The loading procedure is analog to section "Download of the PLC-Subproject virtual axis VA1", page 18.

The new project overwrites the old one without query.

The further working order is as follows:

- Switch on "ex_PowerRA1" (MC_Power)
- Switch on "ex_GearInRA1" (MC_GearIn)

The estimated **g**ear **t**ransmission **r**atio of the gear unit results to:

gtr= (RatioNumerator / RatioDenominator) * (1+ MasterFineadjust)

So at VactVA1 = 200 rpm follows VactRA1 = 120 rpm

☞ MasterFineadjust value in "%"!

If MC_GearIn is in "InGear", the velocity of "VcomVA1" of the virtual axis may be changed; the real axis follows.

- Switch off "ex_GearInRA1" (MC_GearIn)
- Switch on "ex_GearOutRA1" (MC_GearOut), the synchronism is suspended, switch off "ex_GearOutRA1"
- Switch on "ex_StopRA1" (MC_Stop)

After stopped axis RA1, "ex_StopRA1" (MC_Stop) and then "ex_PowerRA1" (MC_Power) may be switched off.

1.4.13 Recording the motion of both axes (Trace)

The trace tool has been used analog to section "Recording of the movement of axis VA1 (Trace)", page 20, to visualize the run-up of the virtual axis and the synchronisation. The following figure shows the according sequences:

FirstSteps - IndraMotion MLC

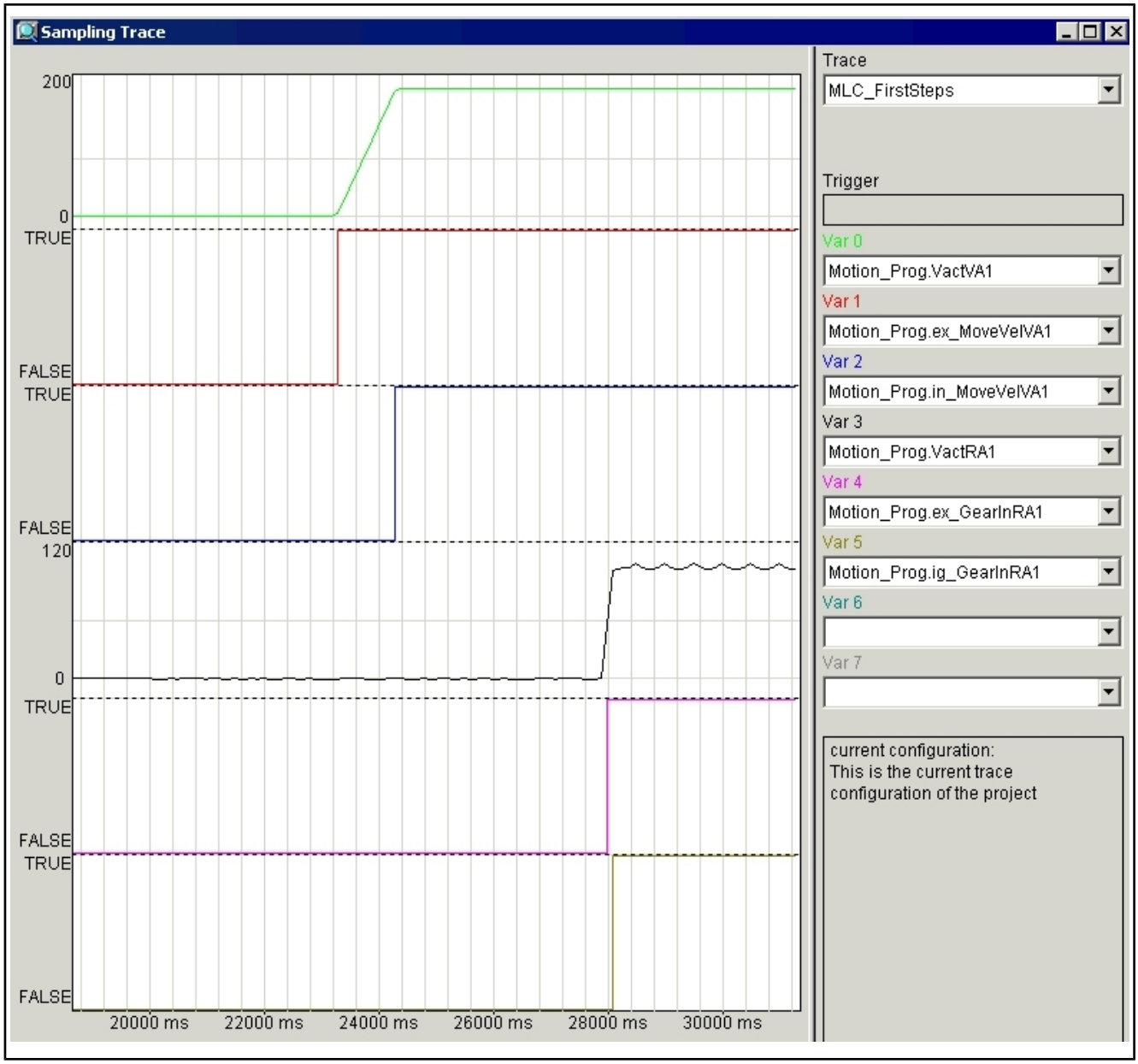


Fig.1-51: Trace recording for both axes

2 Service & Support

2.1 Helpdesk

Our service helpdesk at our headquarters in Lohr, Germany, will assist you with all kinds of enquiries.

Contact us:

- By phone through the Service Call Entry Center,
  Mo - Fr 7:00 am - 6:00 pm CET
  +49 (0) 9352 40 50 60
- By Fax
  +49 (0) 9352 40 49 41
- By email: service.svc@boschrexroth.de

2.2 Service Hotline

Out of helpdesk hours please contact our German service department directly:

+49 (0) 171 333 88 26

or

+49 (0) 172 660 04 06

Hotline numbers for other countries can be found in the addresses of each region (see below).

2.3 Internet

Additional notes regarding service, maintenance and training, as well as the current addresses of our sales and service offices can be found on

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Outwith Germany please contact our sales/service office in your area first.

2.4 Helpful Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone / fax numbers and e-mail address so we can contact you in case of questions

Index

Notes

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