Virtual Commissioning of machines with S7-PLCSIM Advanced, SIMIT & NX MCD – Getting Started

S7-PLCSIM Advanced V5.0 Upd2, SIMIT V11.1, NX MCD 2306, TIA Portal V18.0 Upd2

https://support.industry.siemens.com/cs/ww/en/view/109758943

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1 Introduction

Virtual commissioning with the digital twin

To perform virtual commissioning, an image of the real machine is required. This image is referred to as the digital twin of a machine.

By means of a digital twin, the interaction of individual components of a machine can be simulated and optimized in the virtual world – without the need for a real prototype. The virtual commissioning of a machine is therefore an efficient alternative to reduce the risk of errors and the workload required for real commissioning. This enables shorter market launch times as well as higher flexibility, efficiency and quality.

Purpose of this Getting Started

You become familiar with essential steps for performing virtual commissioning with the SIMATIC S7-PLCSIM Advanced, SIMIT and NX MCD based on a specific application example. You understand the principle of simulation so that you can transfer this knowledge to your individual task.

Advantages of Virtual Commissioning

Virtual Commissioning offers significant advantages: You can recognize in a very early development phase whether your machine is behaving the way you want it to.

You can optimize the machine and its behavior in any number of simulation processes.

You can check and optimize the following at an early stage:

- Construction of your machine
  - Before building or installing a prototype
  - While the machine is still set up for a different task
- Programming of your user program
- Motion sequences of your machine
- Interaction of mechanical components, electrical components and software in the machine

Furthermore, you can simulate error scenarios and optimize the behavior in the event of component defects. Commissioning of the real machine becomes significantly simpler.

Optimum introduction and effective use of Virtual Commissioning

The application example in this Getting Started shows the following:

- Introduction to virtual commissioning
- Illustration of coupling and interaction of different programs
- Sample projects for each program, which can serve as templates for your own applications

You gain insight into the functionality of the Virtual Commissioning setup with S7-PLCSIM Advanced, SIMIT and NX MCD, and can create your own simulations according to your requirements.

Target group

The target group of Virtual Commissioning with S7-PLCSIM Advanced, SIMIT and NX MCD includes:

- Programmers (special knowledge on PLCSIM Advanced, on TIA Portal or on SIMIT) who test their PLC program during development.
- Mechanical engineers (CAD special knowledge or machine knowledge) who test a machine using virtual commissioning.
- Electricians (special knowledge of creating circuit diagrams or designing electrical components in the machine) who have written the PLC program and test the PLC program against a digital twin.

Limitation

This Getting Started does not provide information on the following topics:

- Basics of TIA Portal configuration

  You can find additional information on this topic in the SIMATIC STEP 7 Basic/Professional V18 und SIMATIC WinCC V18 documentation (https://support.industry.siemens.com/cs/ww/en/view/109815056).
- Basics of the SIMIT coupling types

  You can find additional information on this in the SIMIT V11.1 manual (https://support.industry.siemens.com/cs/ww/en/view/109823650).
- Basics of CAD modeling

  You can find additional information on this in the NX2306 documentation (https://docs.sw.siemens.com/de-DE/documents/209349590/PL20221117716122093).

Knowledge of these topics is required to understand the application example in this Getting Started.

1.1 Overview

With S7-PLCSIM Advanced, you simulate your user program without real hardware.

For a comprehensive function test, the STEP 7 program is loaded into a simulated S7-1500 controller via SIMATIC S7-PLCSIM Advanced.

The SIMIT simulation software maps the behavior of active components (e.g. of drives or valves). In SIMIT, you can simulate error scenarios to analyze the behavior of the machine in a virtual space. SIMIT exchanges setpoints/actual values of the simulation via a coupling with MCD.

You also need the following programs for the virtual commissioning of this Getting Started:

TIA Portal, STEP 7 and WinCC Engineering

In the TIA Portal, you create your user program with STEP 7 and your screens for operating and controlling machines with WinCC on an HMI device.

Mechatronics Concept Designer (MCD)

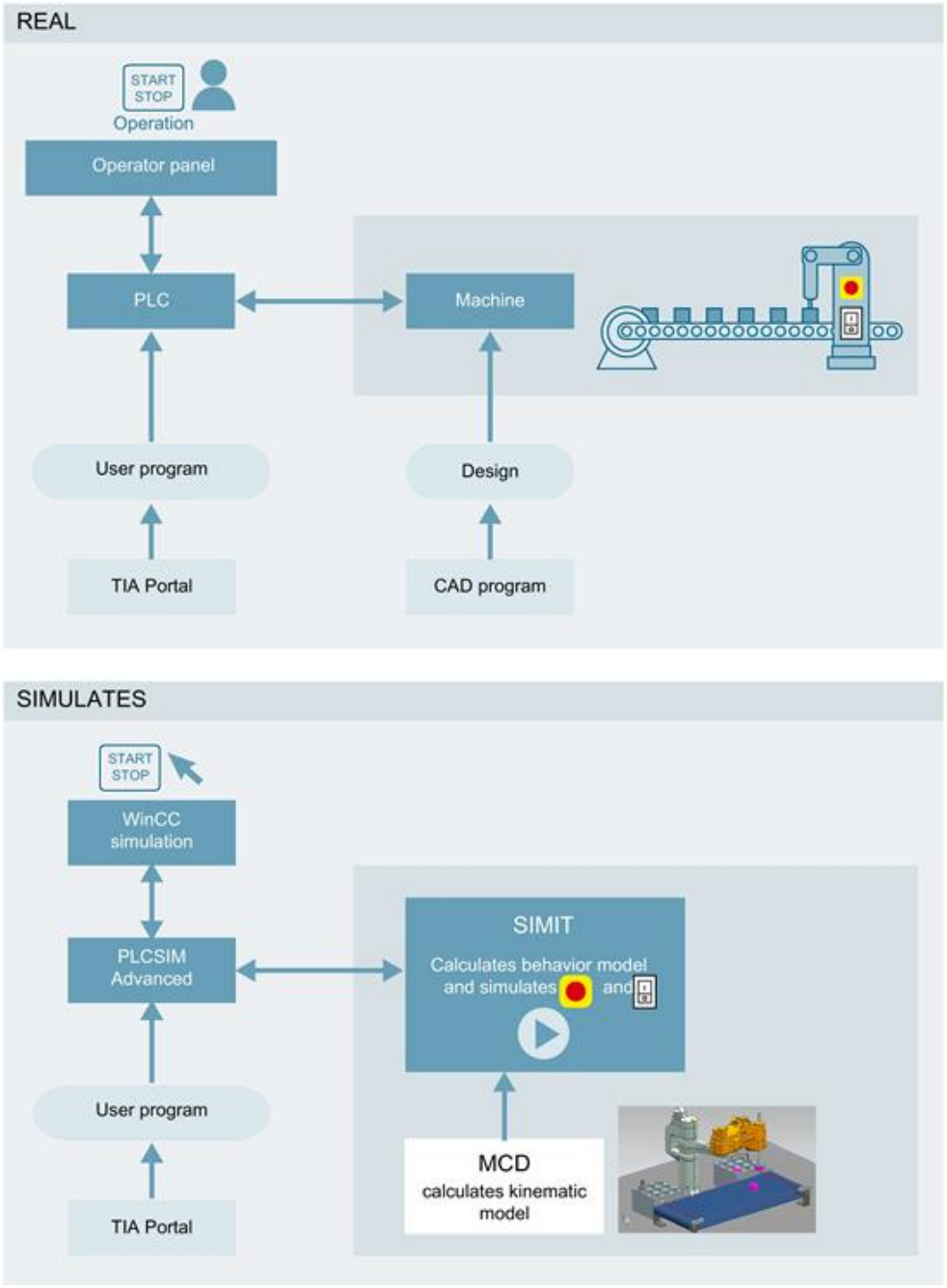
With MCD, you simulate and test the mechanical components of your machine in a virtual environment. MCD brings CAD data together with a physical engine: The CAD data is made kinematic.

The specification of the degrees of freedom of the different mechanical components defines the kinematics of the model.

1.2 Mode of operation

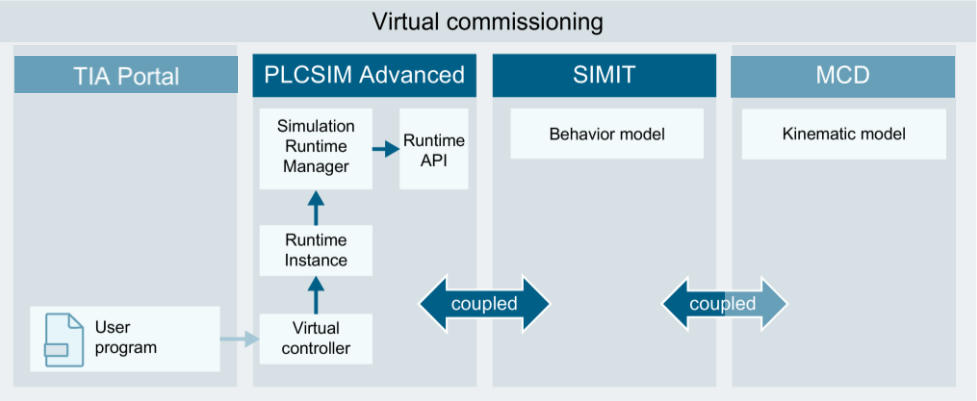
Comparison: Reality versus simulation

Figure 1-1 Commissioning procedure (reality vs. simulation)



How it works

Figure 1-2 Principle of virtual commissioning with S7-PLCSIM Advanced, SIMIT and MCD

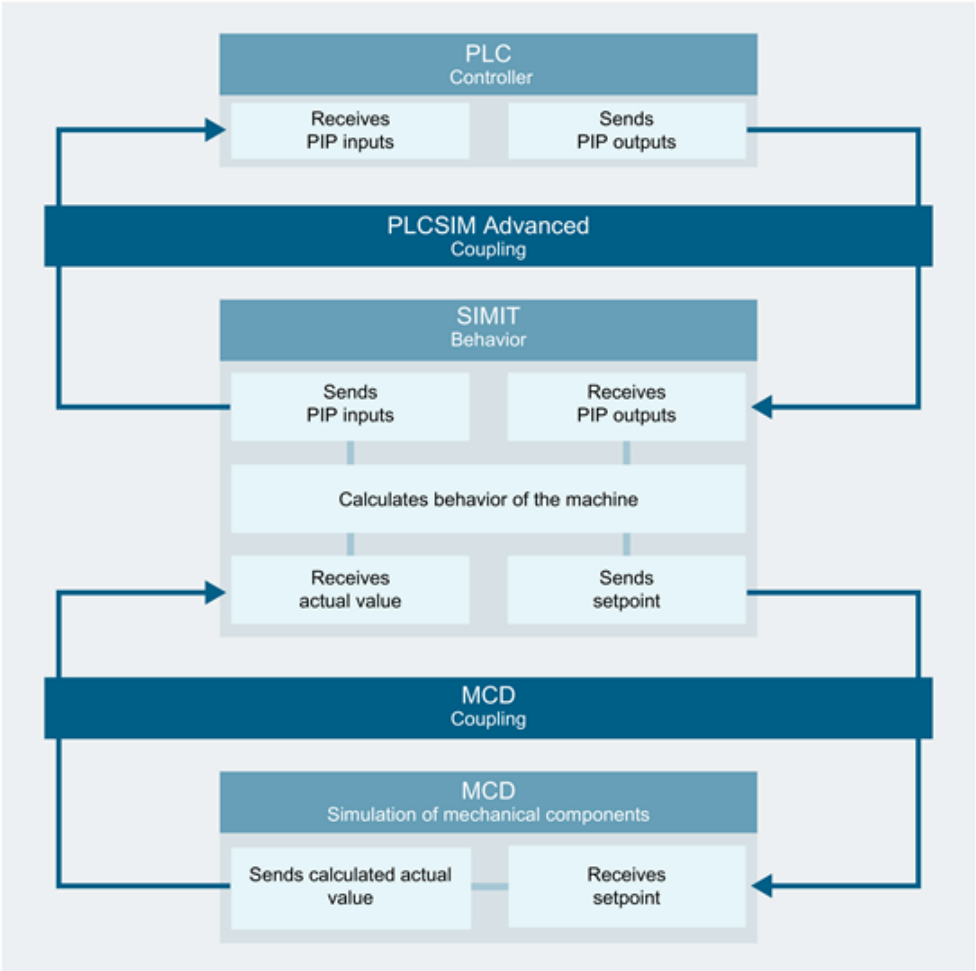


Interaction of the programs

The simulation is a signaling circuit of the coupled programs:

- SIMIT receives the PIP outputs (process image partition of the outputs) from the PLC.
- SIMIT sends setpoints (e.g. speed setpoints, position setpoints, binary signals) to MCD.
- MCD simulates the mechanical components based on the defined degrees of freedom and setpoints.
- MCD sends the calculated actual value (e.g. speed actual values, position actual values, binary signals) to SIMIT.
- SIMIT calculates the behavior of the machine using the drive block.
- SIMIT sends the PIP inputs (process image partition of the inputs) to the PLC.

Figure 1-3 Data exchange between PLC, SIMIT und MCD



Communication

- MCD and SIMIT exchange their data via the MCD coupling.
- SIMATIC PLCSIM Advanced and SIMIT exchange their data via the PLCSIM Advanced coupling.

1.3 Description of the digital twin

Machine of the application example

Using PLCSIM Advanced as stand-alone simulation system, you can simulate and test the created user program on a simulated controller. The Runtime API makes user interfaces available for access to the simulation runtime.

In this application example, local communication via the PLCSIM-Softbus is used for data exchange with the TIA Portal. With PLCSIM Advanced, distributed communication via a virtual Ethernet adapter is also possible.

The interface to SIMIT is realized via the PLCSIM Advanced coupling, which enables simple import of the inputs and outputs of the hardware to be simulated.

Automation task

For virtual commissioning, load a program into a simulated controller via PLCSIM Advanced. Through interaction with SIMIT and MCD, you validate the program in the context of the machine.

In the application example of this Getting Started, a robot takes a workpiece from the conveyor belt as soon as it has been recorded by a light barrier and places it in different positions in a box.

Components

The virtual model of the application example consists of:

- 1 SCARA with axes 1 to 3
- 1 conveyor belt
- 4 light barriers
- Workpieces (unlimited number)
- 2 boxes for storing the workpieces

Sequence

The application example proceeds as follows:

- The conveyor belt is activated until one of the two light barriers detects a workpiece.
- The robot takes the workpiece and places it in the box.
- A box is filled to the maximum with 9 workpieces. The robot changes to an empty box.

MCD simulates the mechanical components based on the defined degrees of freedom and setpoints and represents the simulated machine visually.

Tags, declarations, data types

The following input and output tags are defined for the communication of the controller with the transport system:

Table 1-1 Overview of variables

Tag	Declaration	Data type
ConveyorBelt_Actor_Interface_AddressIn	Input	PD_TEL1_IN
Axis1_Actor_Interface_AddressIn	Input	PD_TEL105_IN

Tag	Declaration	Data type
Axis2_Actor_Interface_AddressIn	Input	PD_TEL105_IN
Axis3_Actor_Interface_AddressIn	Input	PD_TEL105_IN
lightBarrierPickingPos	Input	BOOL
lightBarrierPlacingPos	Input	BOOL
boxPicked	Input	BOOL
lightBarrierBoxLeft	Input	BOOL
lightBarrierBoxRight	Input	BOOL
DI5-DI15	Input	BOOL
ConveyorBelt_Actor_Interface_AddressOut	Output	PD_TEL1_OUT
Axis1_Actor_Interface_AddressOut	Output	PD_TEL105_OUT
Axis2_Actor_Interface_AddressOut	Output	PD_TEL105_OUT
Axis3_Actor_Interface_AddressOut	Output	PD_TEL105_OUT
Axis3_ActualPosition	Output	REAL
enableVacuum	Output	BOOL
DQ0, DQ2-DQ15	Output	BOOL

Simulated hardware components

Table 1-2 Simulated HW components

Number	Component	Version	Article number
1	CPU 1517TF-3 PN/DP	V3.0	6ES7 517-3UP00-0AB0
1	MTP2200 Unified Comfort Pro	V18.0.0.0	6AV2 128-3XB27-0BX0
3	SINAMICS S120	V5.1	6SL3 040-1MA01-0AA0

1.4 Components used

You can find the programs listed below in the Siemens Industry Mall (https://mall.industry.siemens.com) with specification of the article numbers.

This application example has been created with the following software components:

Table 1-3 Software components

Component	Article number
SIMATIC STEP 7 Professional V18.0 Upd1	6ES7822-1AA08-0YA5
SIMATIC WinCC Unified PC Simulation V18.0 Upd1	Delivery Release SIMATIC WinCC V18 https://support.industry.siemens.com/cs/ww/en/view/109813587
SIMATIC WinCC Unified Comfort Engineering V18.0 Upd1	
SIMATIC S7-PLCSIM Advanced V5.0 Upd2	6ES7823-1FA04-0YA5
SIMIT Engineering S V11.1	6DL8913-0AL10-0AB5
NX Mechatronics Concept Designer 2306	z.B. NX91113

You can find additional information and contact data relating to the MCD on the Internet (https://www.plm.automation.siemens.com/en/products/open/applications/mcad-software-components.shtml).

This application example consists of the following components:

Table 1-4 Components

Component	File name
Documentation	Manual_VirtualComissioningOfMachines_GettingStarted_V1.0.1_EN.pdf
TIA Portal Project	TIA_GettingStarted_V1.0.1.zap18
SIMIT Project	SIMIT_GettingStarted_V1.0.1.simarc
NX MCD Project	MCD_GettingStarted_V1.0.1.zip

2 Engineering

Note The higher the level of detail of the simulation, the greater the computing effort during the simulation.

2.1 Downloading the application example

1. Download the following ZIP file (contains files of the application example) to your PC:
   VirtualCommissioningOfMachines_GettingStarted_v1.0.1.zip
   (https://support.industry.siemens.com/cs/ww/en/view/109758943)
2. Unzip the .zip file.
   The following archives will be unpacked and saved on your PC

MCD_GettingStarted_V1.0.1.zip

1. Unzip the ZIP file.
2. The main assembly “!MAIN_ASM_GettingStarted_Solution.prt” must be opened with NX MCD.

Figure 2-1 Unzipped MCD_GettingStarted_V1.0.1.zip

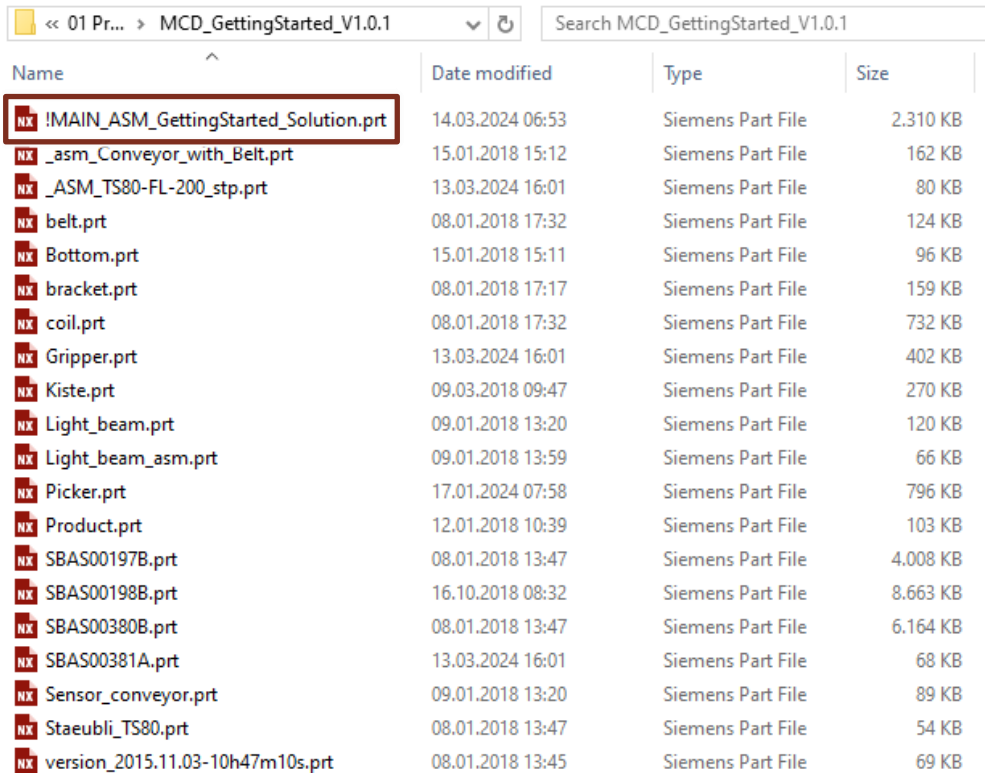
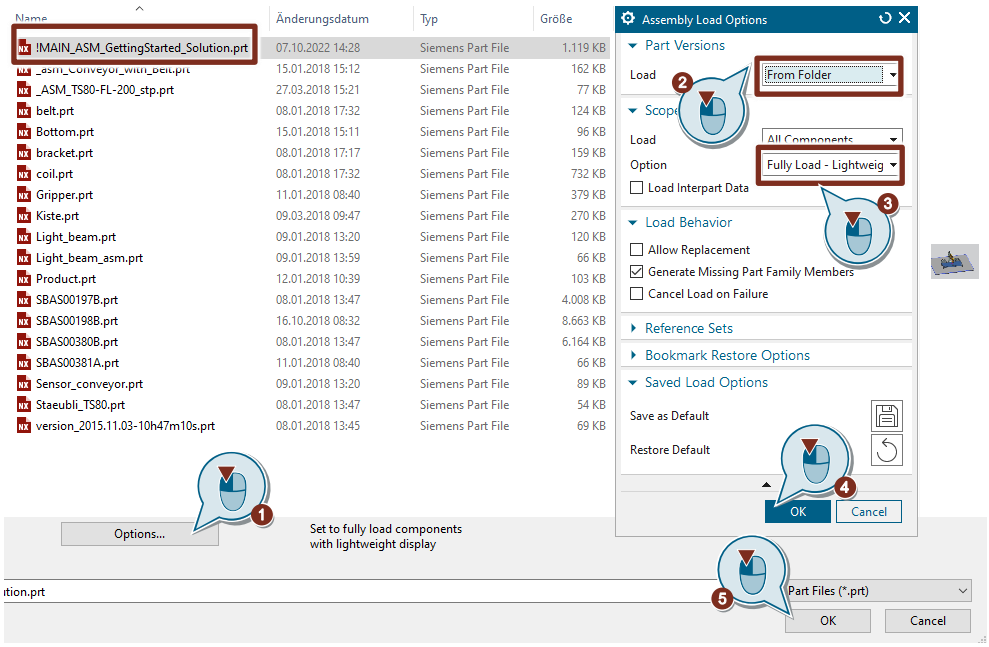


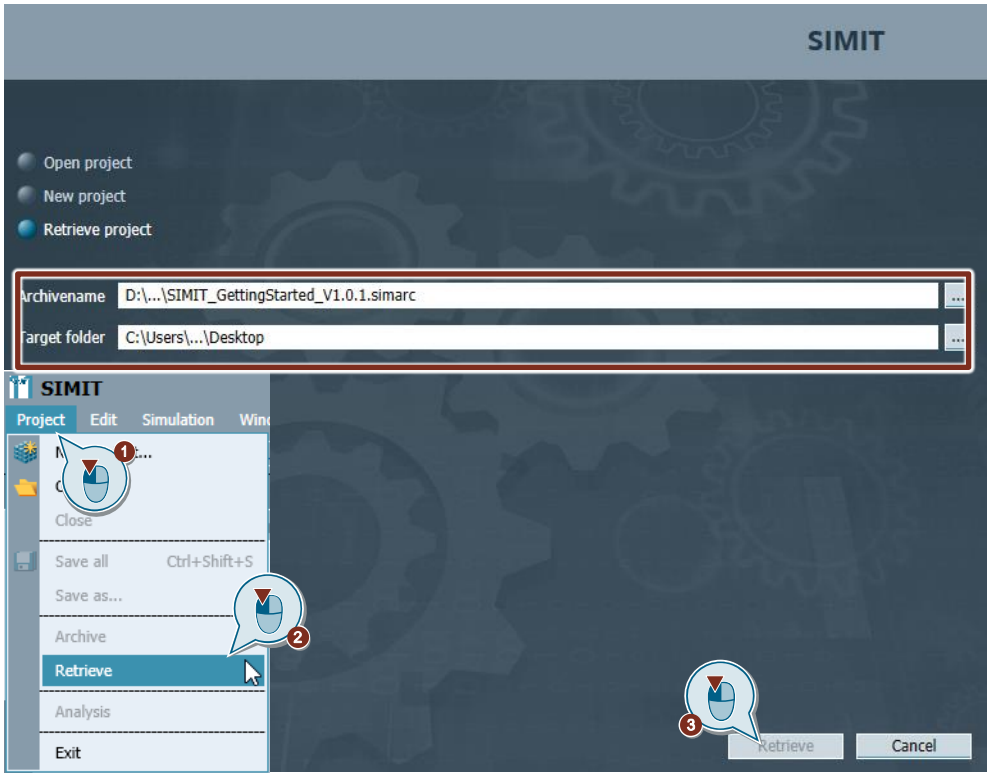
Figure 2-2 NX MCD Assembly load options



SIMIT_ GettingStarted_V1.0.1.simarc

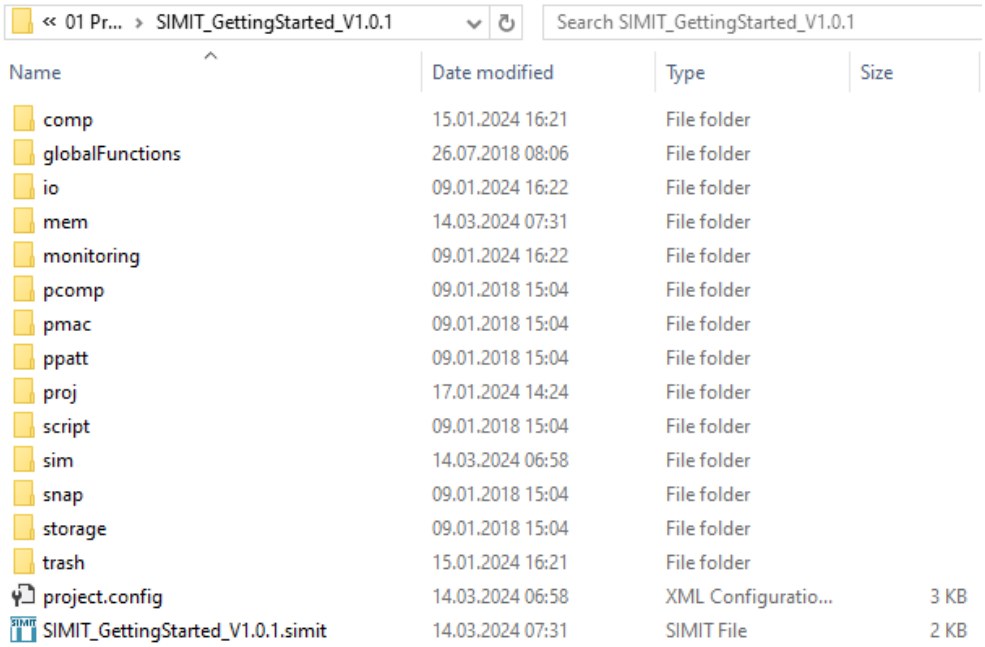
1. Retrieve the SIMIT archive.

Figure 2-3 Retrieving the SIMIT archive



2. Open the retrieved SIMIT project.

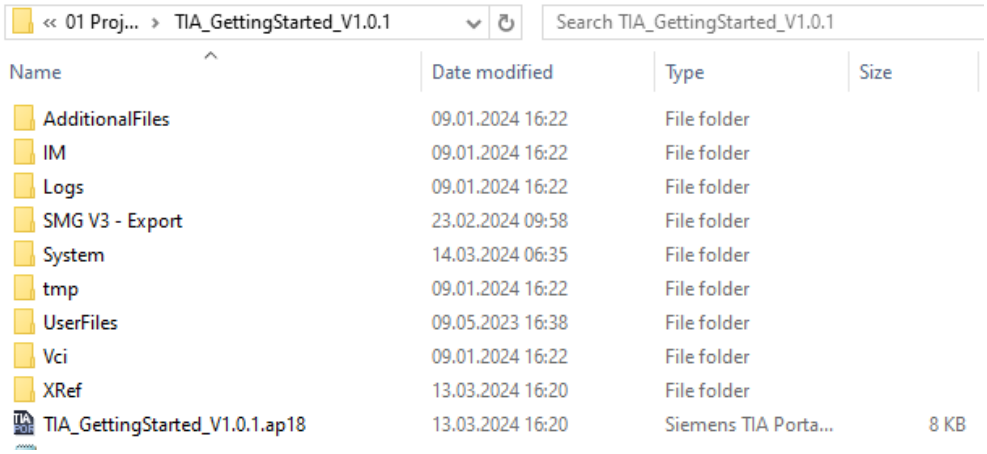
Figure 2-4 Retrieved SIMIT archive



TIA_GettingStarted_V1.0.1.zap18

1. Unzip the TIA Portal archive
2. Open the unzipped TIA Portal project

Figure 2-5 Unzipped TIA Portal archive



You have downloaded the files for the application example.

2.2 MCD model kinematics

The machine needs to have physical properties in order to be simulated. To equip the machine with physical properties, you need to kinematize it.

You can find information on kinematizing a machine or configuring in MCD in the "Configuring in MCD" section of the following document:

SIMOTION/SIMATIC: Virtual commissioning with hardware in the loop (https://support.industry.siemens.com/cs/ww/en/view/109758739)

2.3 Preparing the TIA Portal project

2.3.1 Requirements

To use the virtual commissioning setup, a controller must be programmed in the TIA Portal.

A TIA Portal V18 project "*.ap18" is included in the download for the application example in this Getting Started.

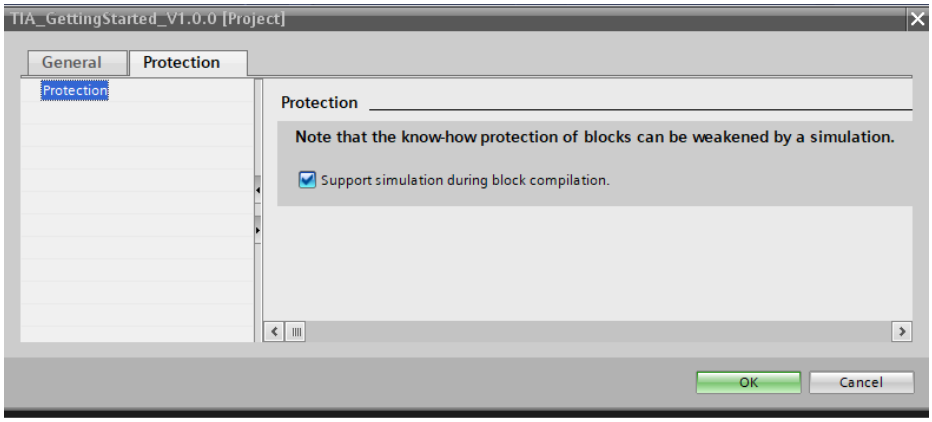
You have opened the "*.ap18" in the portal view in the TIA Portal.

2.3.2 Setting simulation support of the project

Set the TIA Portal project in such a way that it supports simulation.

1. Select the open project in the project navigation.
2. Select "Properties" in the shortcut menu of the project.
3. The dialog with the properties of the project opens.
4. Go to the "Protection" tab.
5. Select the check box "Support simulation during block compilation".
6. Confirm with "OK".

Figure 2-6 Enable simulation support of the TIA project



You have set simulation support for the TIA Portal project.

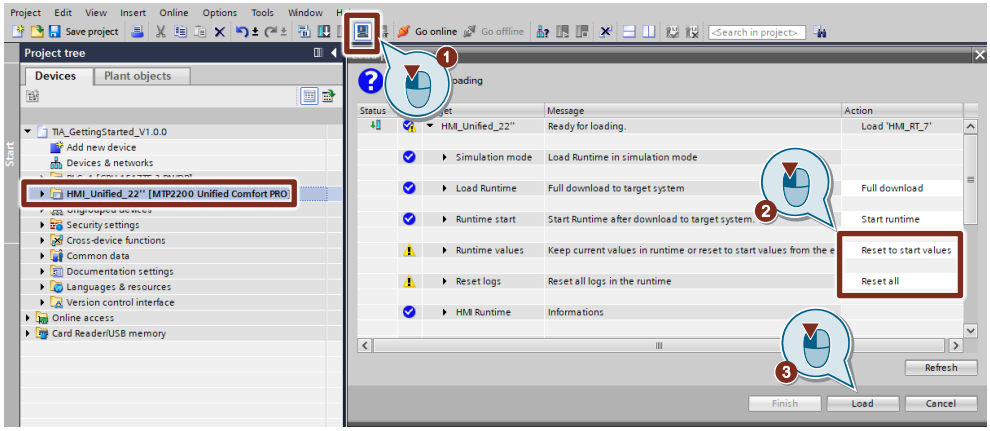
2.3.3 Starting HMI simulation

The application can be operated using the SIMATIC WinCC Unified Runtime.

To start the WinCC Unified Runtime, the TIA Portal HMI must be set into simulation first.

1. Call the shortcut menu in the TIA Portal by right-clicking on "HMI_Unified_22".
2. Click "Start simulation".

Figure 2-7 Starting HMI simulation



If the WinCC Unified Runtime has started, it can be reached via e.g., the Microsoft Edge Browser. After entering the address https://localhost or https://hostname, the IP of the configured access point automatically is shown. To run the WinCC Unified Runtime, the project must be started.

Figure 2-8 Start WinCC Unified Runtime project

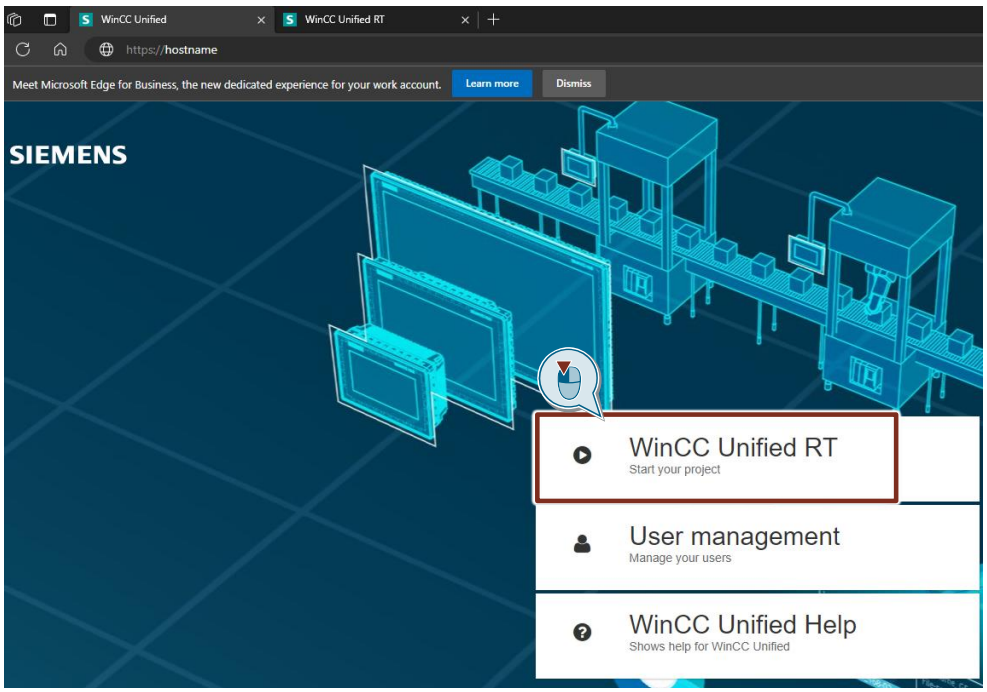
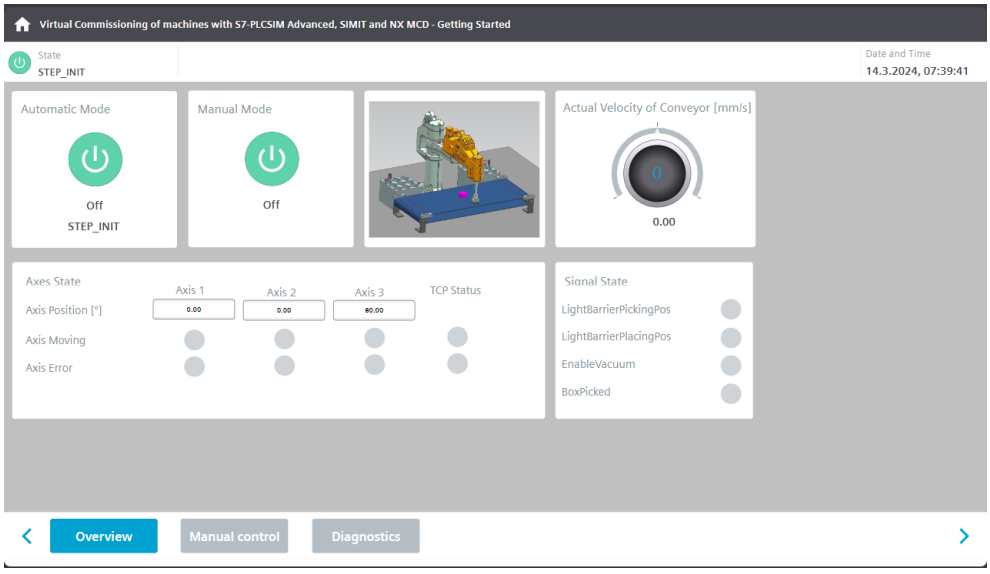


Figure 2-9 Simulation of WinCC Unified panel



You have started the simulation of the operator panel.

2.4 Preparing a SIMIT project

2.4.1 Overview

SIMIT contains the required couplings to the MCD and PLCSIM Advanced programs and simulates the behavior of the machine.

The following is simulated in this application example:

- SCARA robot with 3 positioning axes
  - 2 axes with simulation of PROFIdrive drives
    Transfer of control and status word
  - 1 axis with active simulation in the PLC
    Transfer of the actual position
- Conveyor belt with 1 speed axis
  Simulation of the PROFIdrive drive
  Transfer of control and status word
- Light barriers

SIMIT simulates the drives with separate drive blocks which adjust the communication and the state machine of a real drive. The state machine defines the transitions from one state to another. A state transition is triggered by a defined bit in the control word. The current status can be recognized by the status word.

You do not need to change the user program as compared to the real machine.

To enable SIMIT to communicate with the drive blocks, connect the inputs and outputs of the drive blocks with the required information of the PROFIdrive telegram.

NOTE Because the programs uses different base units, SIMIT converts the tags.

2.4.2 Creating a new SIMIT project

NOTE You start with a new project in SIMIT for this application example.
If needed, you can open a finished SIMIT project from the download folder.

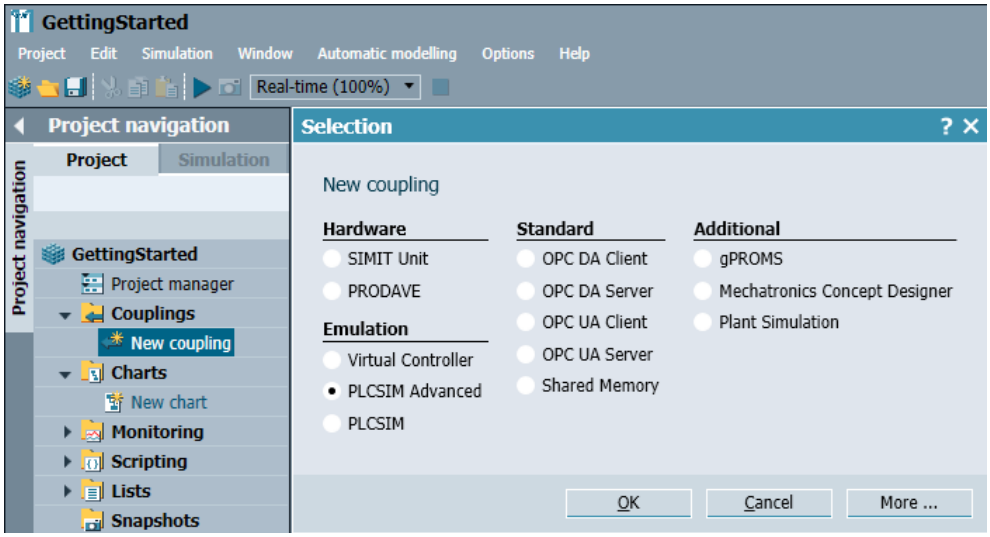
1. Open SIMIT.
2. Click "Create new project".
3. Enter the name and click "Create".
4. Click "Project view".

SIMIT has created a new project. The file has the extension *.simit.

2.4.3 Coupling SIMIT with PLCSIM Advanced

1. Make sure that the project is closed in the TIA Portal.
2. Double-click "New coupling".
3. Select "PLCSIM Advanced" and click "OK".

Figure 2-10 Creating a coupling between SIMIT and PLCSIM Advanced



4. In the "PLCSIM Advanced Import" window, navigate in the "TIA Portal project" line to the TIA project file.

NOTE

To use the direct TIA Portal project import of the PLCSIM Advanced coupling, SIMIT V11.1 must be started with admin rights. Otherwise, the direct import cannot be used due to the missing openness interface.

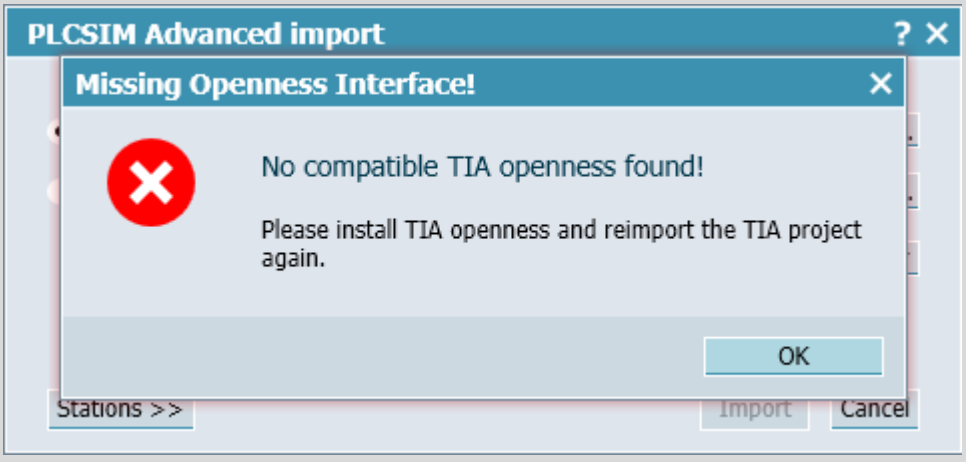
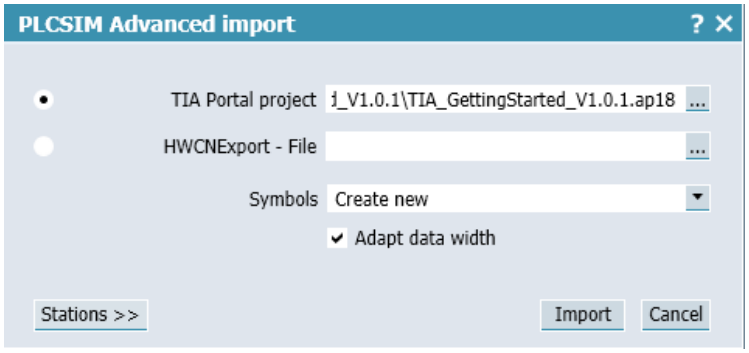


Figure 2-11 Import of the TIA Portal project



5. Select "Create new" from the "Symbols" drop-down list.

6. Select the "Adapt data width" check box.
7. Confirm the entries by clicking on "Import".

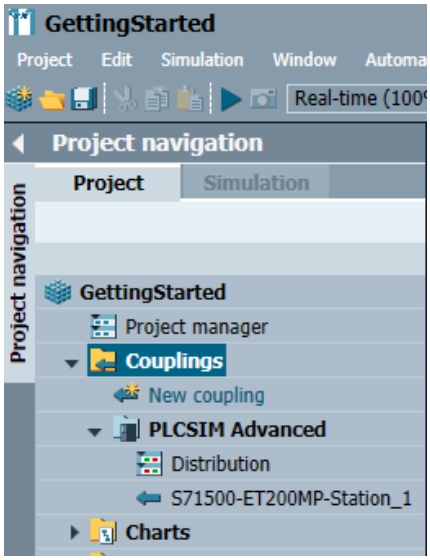
NOTE

With SIMIT you can also import HWCN-Export files.

The HWCN-Export.exe can be found in the installation directory e.g.: C:\Program Files (x86)\Siemens\Automation\SIMIT\SIMIT SF\data

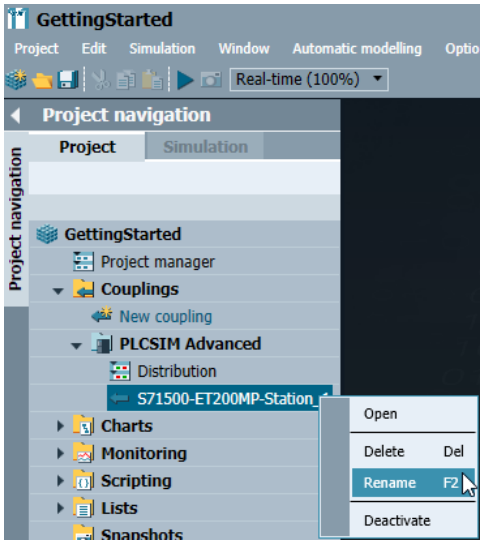
SIMIT has added the "PLCSIM Advanced" coupling in the project navigation.

Figure 2-12 Coupling between SIMIT and PLCSIM Advanced



1. Assign the new name "PLC" to the "S71500-ET200MP-Station_1" by right-clicking "Rename".

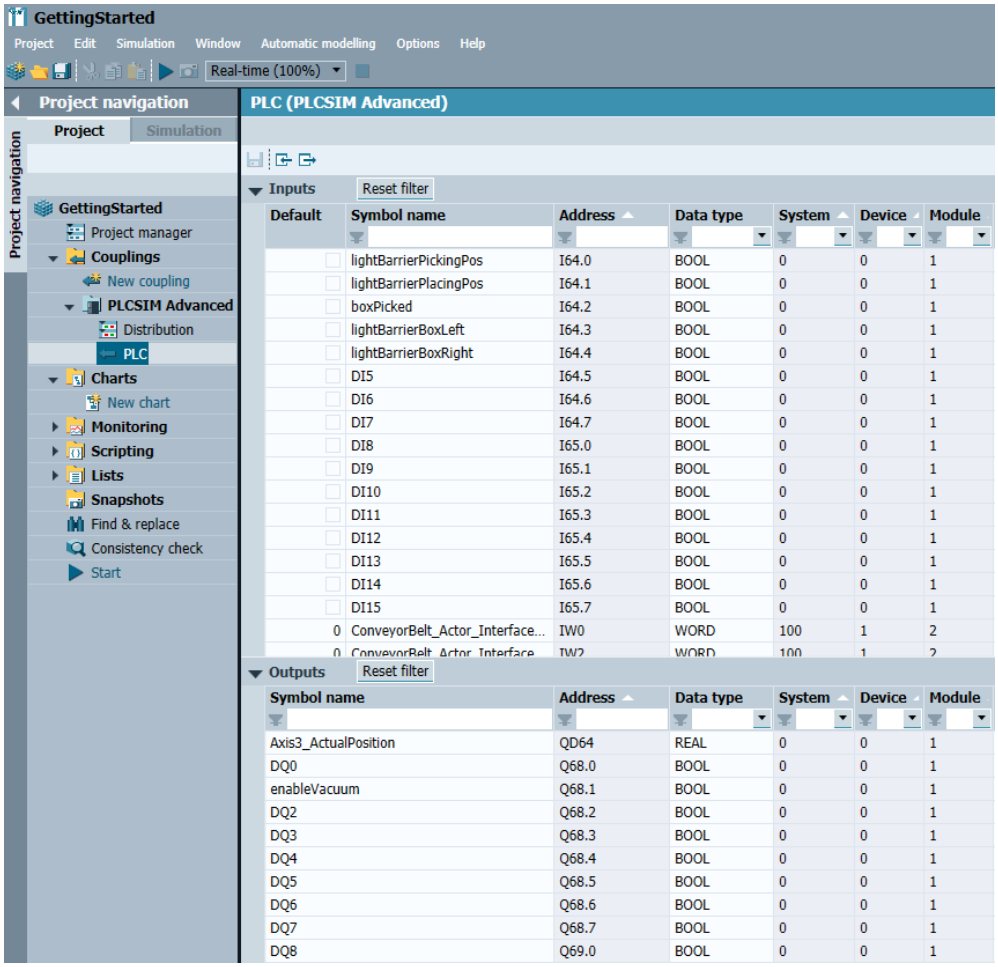
Figure 2-13 Rename the PLCSIM Advanced station



Inputs/outputs as tags

When you double-click on "PLC", a window with the inputs/outputs of the controller as tags appears in the work area.

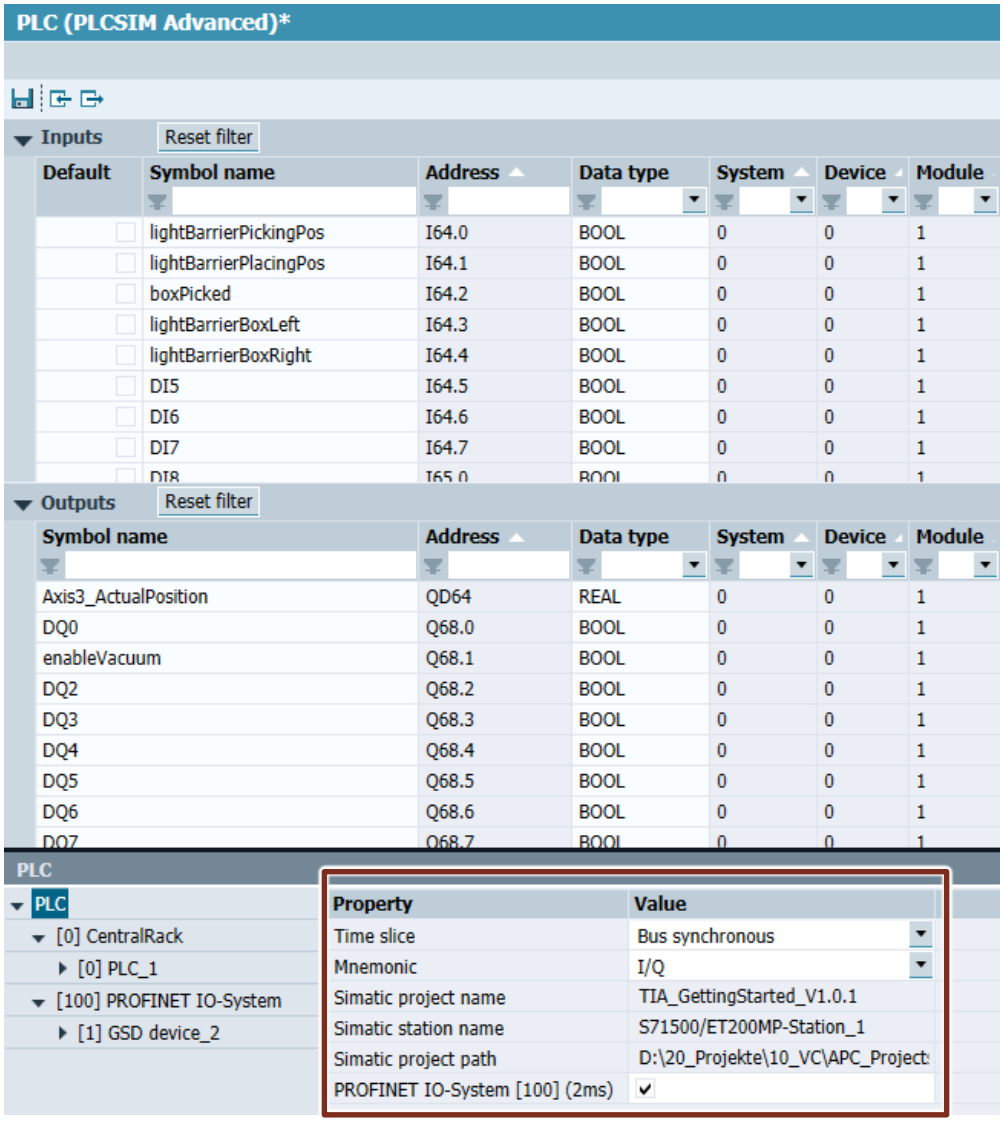
Figure 2-14 Inputs/outputs of the controller



Setting the time slice for the PLCSIM Advanced coupling

1. Select the time slice “Bus synchronous”.

Figure 2-15 Settings of the PLCSIM Advanced coupling



2.4.4 Coupling SIMIT with MCD

1. Double click "New coupling".
2. In the "Selection" window, select the "Mechatronics Concept Designer" coupling and click "OK" (Figure 2-16).
3. SIMIT adds the "Mechatronics Concept Designer" coupling to the project.
4. Rename the coupling for a shorter coupling name to "MCD".
5. Double-click the new MCD coupling so that it opens in the work area (Figure 2-17).
6. Switch to the NX MCD project and click the "Allow connection" button in the Simit Toolbar and insert the MCD coupling identifier (Figure 2-18 and Figure 2-19)
7. Switch to the SIMIT project and click the "Receive signals from MCD" button in the MCD link in the work area. (Figure 2-20)
8. Switch to the NX MCD project and click the "Send signals to SIMIT" button in the Simit Toolbar. (Figure 2-21)

NOTE

As of SIMIT V10.2, the Mechatronics Concept Designer (MCD) project is no longer started by SIMIT. The new coupling mechanism is supported by a toolbar "Simit" implemented in the MCD toolbar.

If NX MCD is already installed, the new Simit Toolbar will be implemented in NX MCD during SIMIT V11.0 installation. The system environment variable "UGII_BASE_DIR" points to the selected NX MCD version. If different NX MCD versions are installed in parallel, pay attention to the system environment variable to implement the Simit Toolbar in the correct version.

If NX MCD is installed after SIMIT, the Simit Toolbar can be installed after the successful NX MCD installation using the SIMIT installation file. The value in the system environment variable "UGII_BASE_DIR" must also be observed here.

Figure 2-16 Creating a coupling between SIMIT and MCD

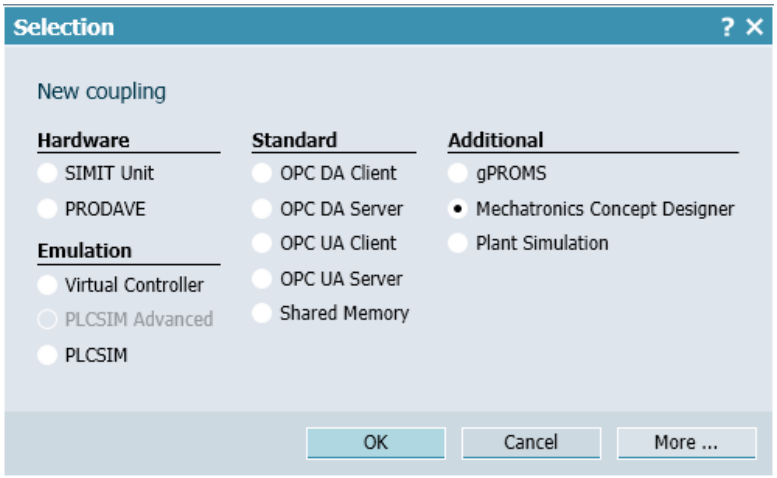


Figure 2-17 SIMIT: Workspace MCD coupling

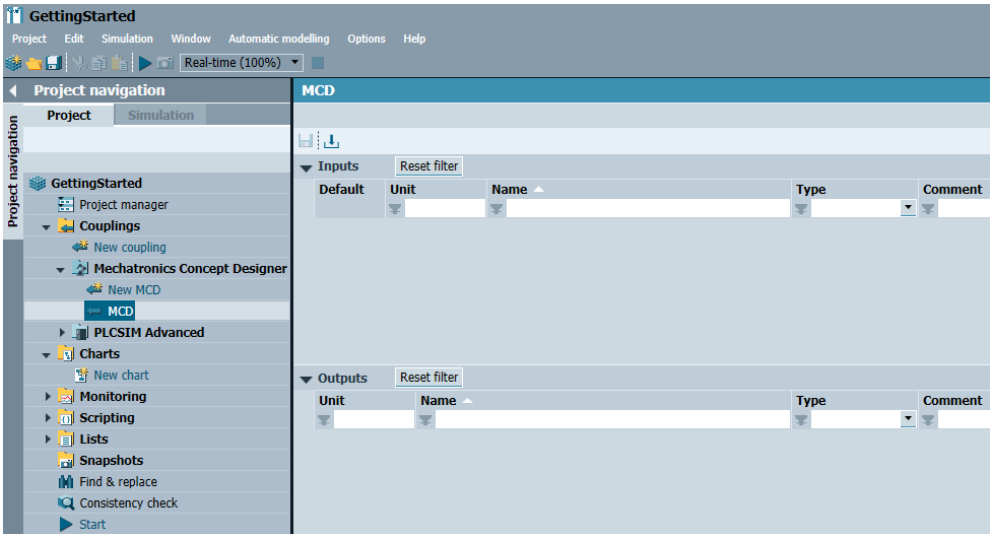
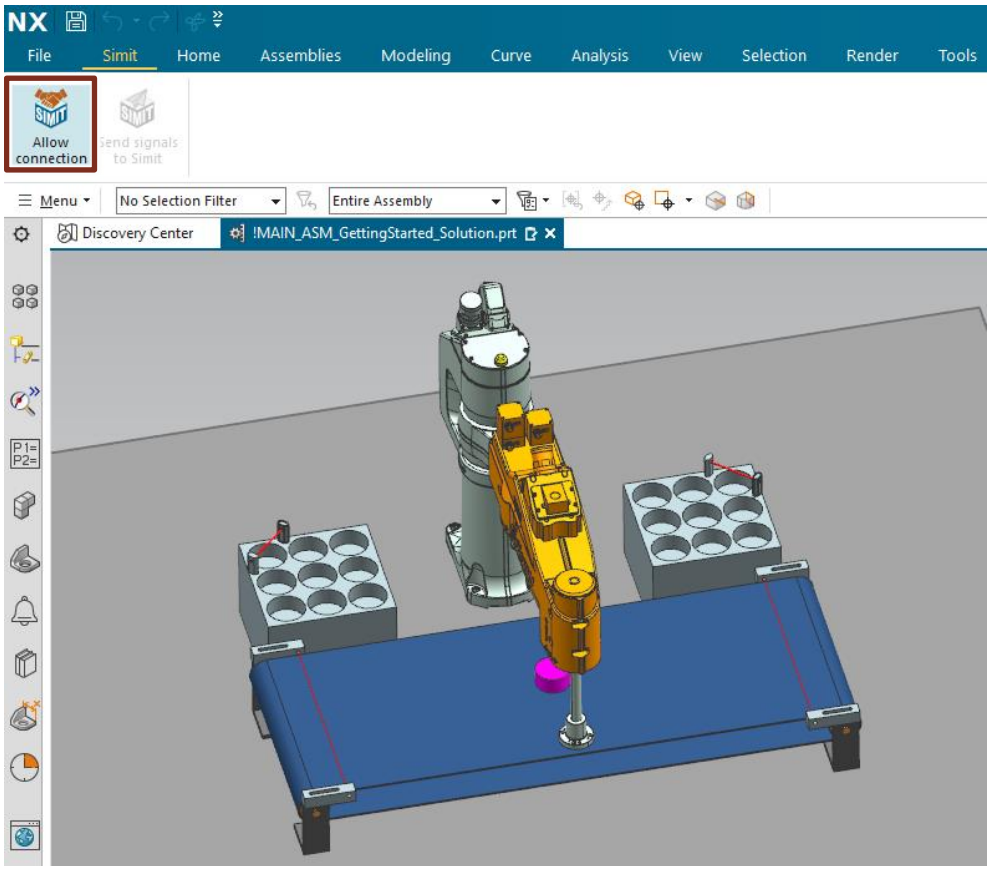


Figure 2-18 NX MCD – Allow Connection



NOTE The Mechatronics Concept Designer coupling in SIMIT V11.1 is able to connect and synchronize with any running NX MCD instance. In the NX MCD instance, permission to import SIMIT signals must be granted for reading the signals into SIMIT via the Simit Toolbar. After the project has been successfully read out, the coupling is created.

Figure 2-19 MCD Coupling Identifier

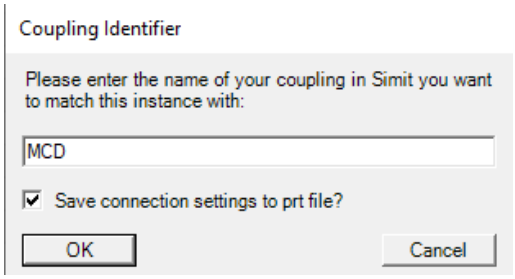


Figure 2-20 SIMIT: Receive signals from MCD

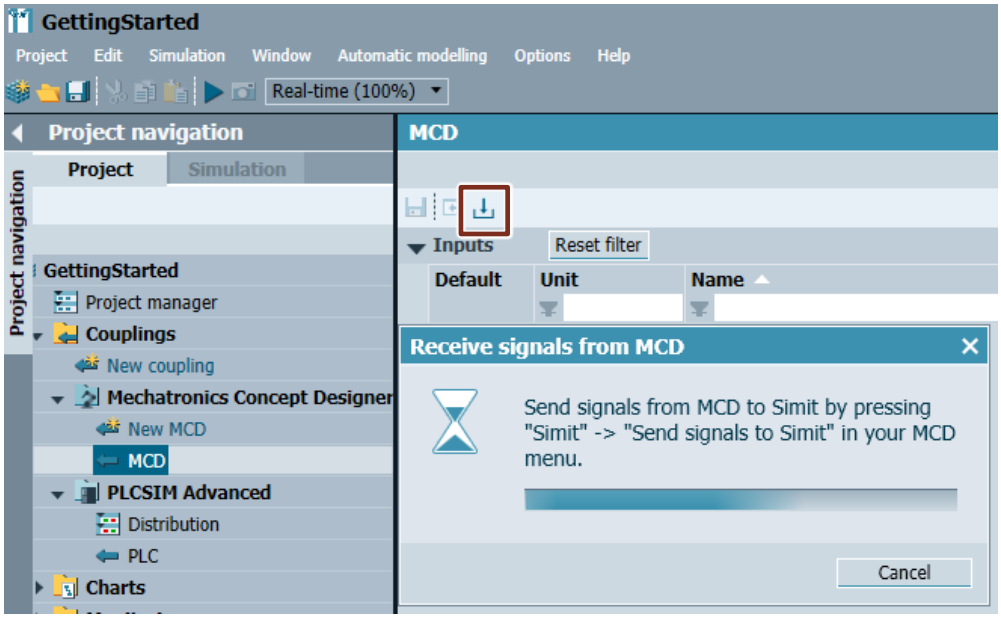
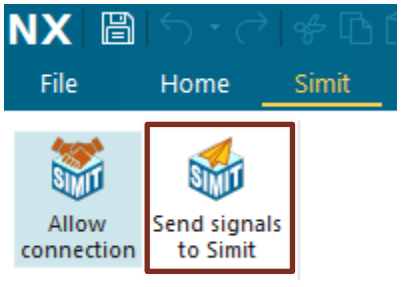


Figure 2-21 MCD: Send signals to Simit



The inputs and outputs of the linked MCD instance appear in the SIMIT work area.

You have added the "MCD" coupling in SIMIT and linked it to the selected NX MCD instance.

NOTE

SIMIT V11.1 can also be linked to a NX MCD PLAYER instance.

Please note that reading out the MCD project with a full NX MCD license is recommended.

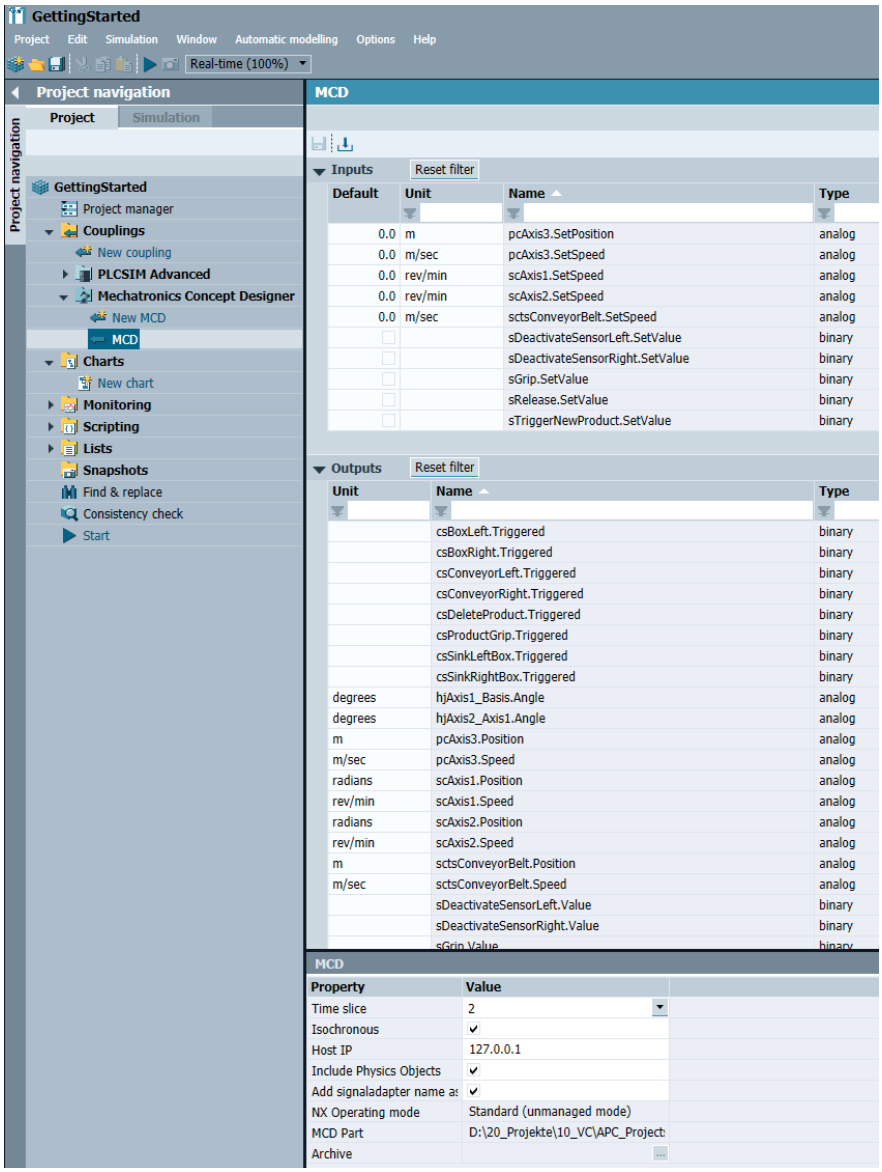
If an MCD PLAYER instance has only been read out with an MCD PLAYER license, the physics objects are missing in the coupling. Only signals are shown in the coupling.

An MCD coupling, which was created with a full MCD license (physics and signal objects), can easily be used with an MCD PLAYER instance.

Setting the time slice for the MCD coupling

9. Select the „Isochronous“ check box for time slice 2.

Figure 2-22 Setting the bus synchronization of the time slice



10. Save the MCD coupling.

NOTE

The MCD coupling can be adjusted via the coupling properties. All physics objects in the coupling can be hidden using the "Import physics objects" selection. Accordingly, only signals are displayed and processed in the coupling. The MCD coupling can be archived if necessary. This results in a copy of the MCD project in the SIMIT project.

The NX operating mode can be used to select whether the NX MCD model is in a “Managed” or “Unmanaged” mode. This setting is necessary for an interaction with Teamcenter.

Setting the units of the signals from MCD

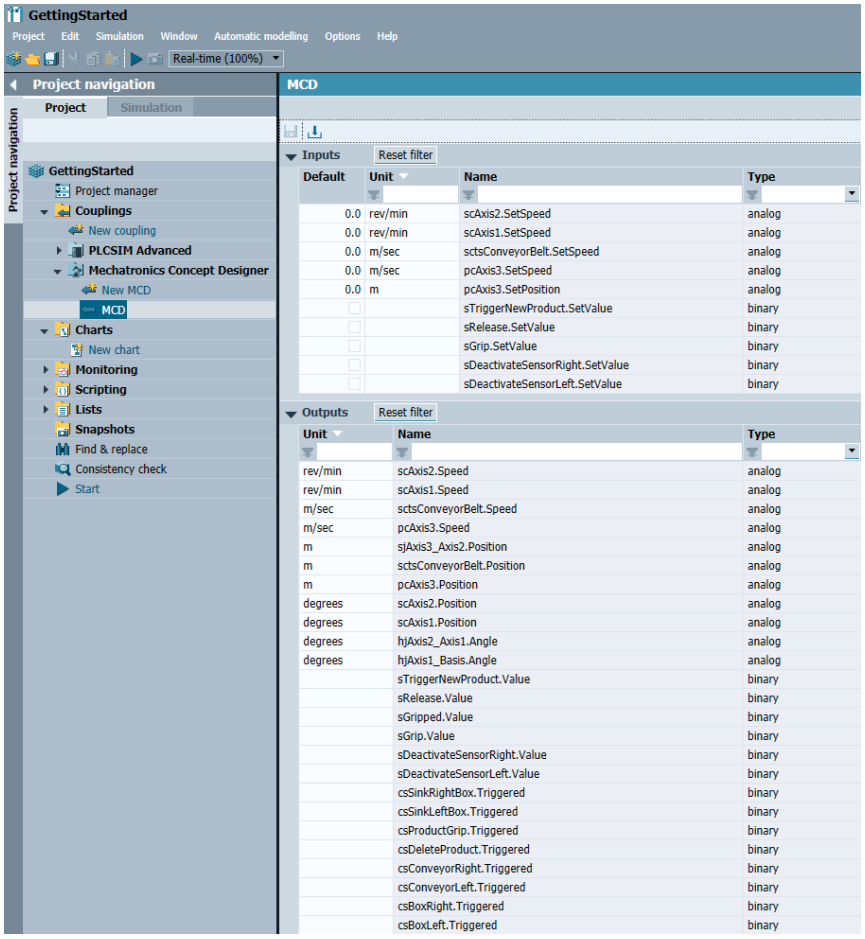
The units for the signals from the MCD must be set as they are used in the charts. Conversions are thus avoided. The units used are defined by the blocks which are called in the charts.

- Actual and setpoint speed (NIst and NSoll) at the "ProfiDrive2" block are specified in 1/min.
- "Gx_XIst" at the "SensorProcessRotatory" block is specified in degrees.
- Position values of "Axis 3" are defined as mm in the TIA Portal and are converted to m in the "ControlAxisV10" chart.
- The speeds of "Axis 3" and "ConvoyerBelt" are transferred to MCD in m/sec.

In the "Project navigation", double-click on "Couplings > MCD" and set the correct units for all signals.

The following screenshot shows the correct units for all signals of this application example.

Figure 2-23 Adjusting the units of the MCD signals



2.4.5 Setting the time slice of the project manager

Make sure that the following values are identical:

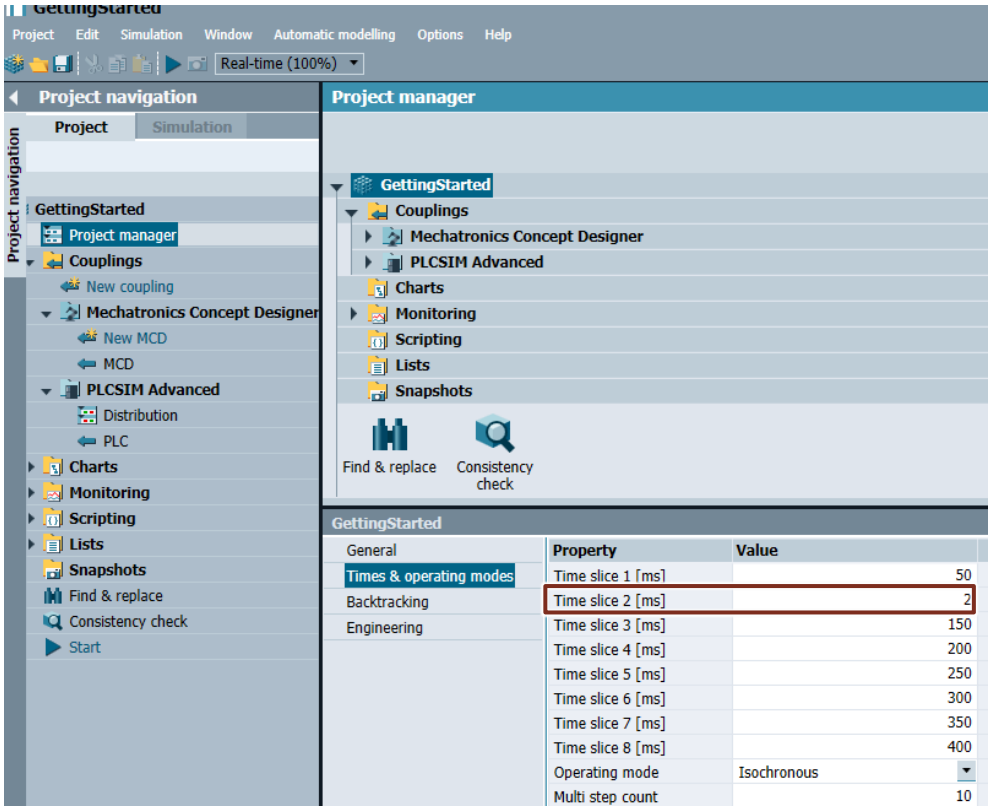
- Time slice cycle of the project manager in SIMIT
- Application cycle of the controller in the TIA Portal

If necessary, correct the value for the time slice cycle of the project manager in SIMIT.

Time slice cycle of the project manager in SIMIT

The following figure shows the time slice cycle of the project manager in SIMIT.

Figure 2-19 Adjusting the time slice of the project manager



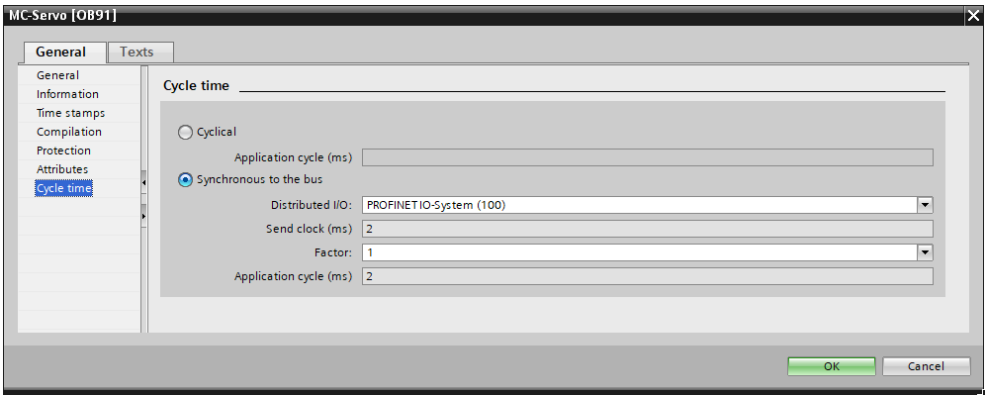
Application cycle in the TIA Portal

You call the application cycle of the controller in the TIA Portal as follows:

1. Double click on the "PLC_1" device in the TIA Portal project navigation.
2. Double-click on "Program blocks".
3. Right-click on the "MC-Servo" organization block.
4. Click "Properties".
   The "MC-Servo" window opens.
5. Click on the "General" tab.
6. Click on "Cycle time".
7. Make sure that "1" is selected in the "Factor" drop-down list.

The value for the controller is displayed in the "Application cycle" line.

Figure 2-20 Adjusting the cycle time in TIA portal



2.4.6 Using SIMIT according to your own requirements

You will find an overview of the possibilities for using SIMIT according to your own requirements on Page 32.

2.5 Creating a SIMIT behavior model

NOTE

SIMIT behavior models can be created by the Simulation Model Generator automatically. The actual version and documentation can be found on SiePortal. https://support.industry.siemens.com/cs/ww/en/view/109780391

2.5.1 Modelling the drive behavior

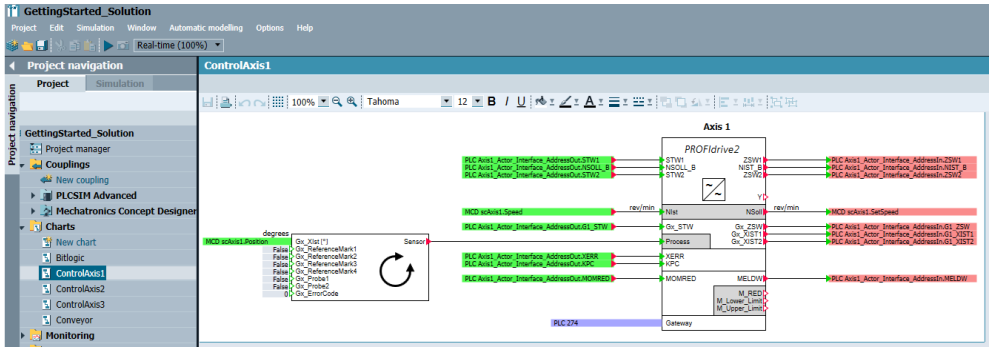
In the following sections, you will learn how to model the drive behavior in SIMIT according to your requirements.

You can find additional information about the library on Page 42.

SIMIT chart of the axes of the application example

Under "Charts" you will find the individual components of the project. By double-clicking, the workspace shows the chart editor of the particular axis of the Getting Started application example.

Figure 2-24 SIMIT diagram of axis 1



2.5.2 Creating charts for the axes

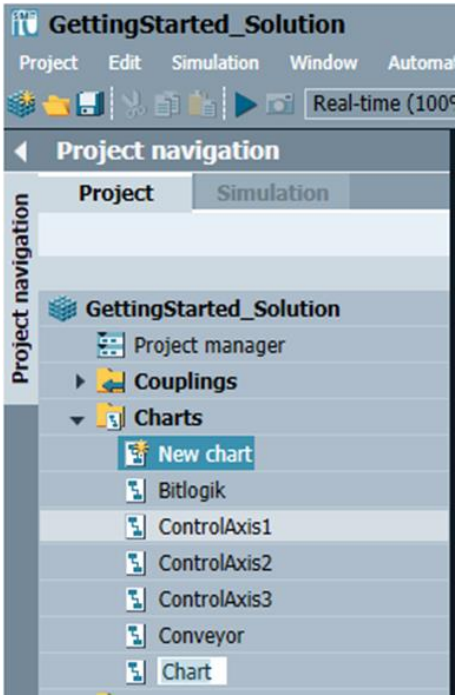
1. Double-click "New chart".

   SIMIT adds a new chart called "Chart" to the list of charts.

NOTE

You can change the name of the chart.

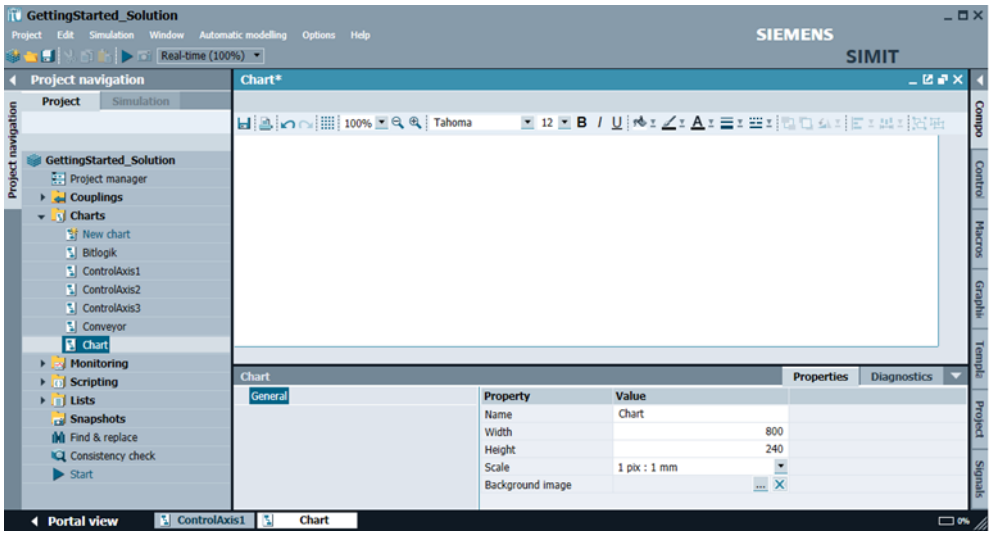
Figure 2-25 Creating a new chart in SIMIT



2. Double-click the new chart "Chart".

The chart editor for "Chart" appears in the work area.

Figure 2-26 Empty workspace of the new chart



3. Assemble the drive components of axis 1. You can find additional information on Page 32.
4. Adapt the properties of the components. You can find additional information on Page 34.
5. Interconnect the signals. You can find additional information on Page 40.
6. Repeat the axis 1 procedure for axis 2.
7. Interconnect axis 3. You can find additional information on Page 41.

See also

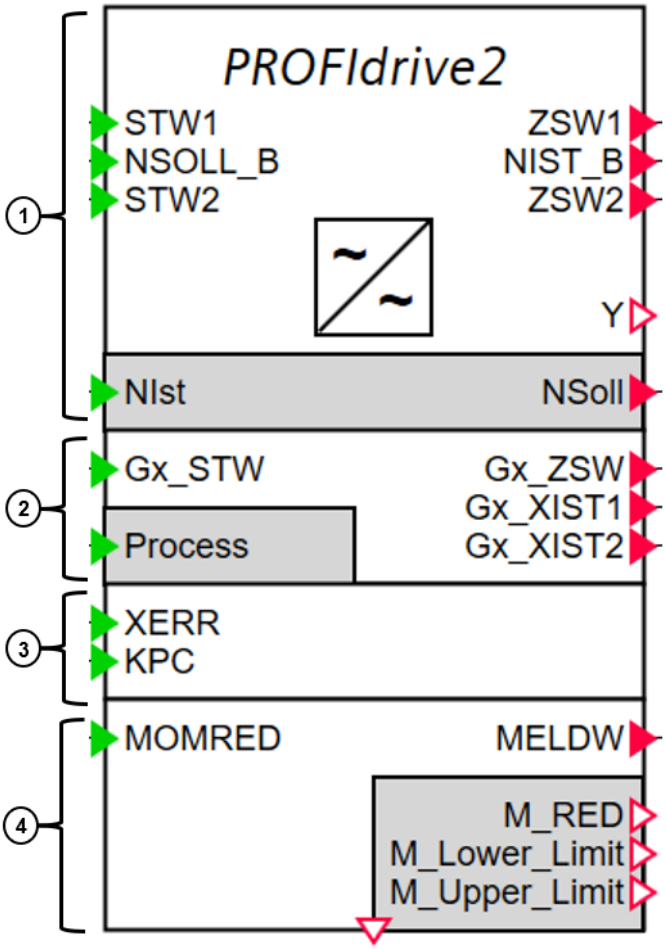
- Setting properties of the PROFIdrive block on Page 38.
- Interconnection of axis 1 and 2 on Page 41.
- Structure of the drives on Page 34.
- Interconnection of axis 3 on Page 41.

2.5.3 Structure of the drives

Drives of SCARA axes 1 and 2

The simulated drives of axes 1 and 2 of the application example are assembled in a modular fashion of the following components:

Figure 2-27 Structure of the PROFIdrive telegram 105



① "PROFIdrive2" component: Control/status word and speed setpoint/actual speed

② "Sensor" component: Encoder connection

③ "DynamicServoControl" component: Drive-internal position controller

④ "SiemensMomentumReduction" component: Torque reduction

The group of blocks as shown above represents the behavior of a PROFIdrive drive as an example for PROFIdrive telegram 105.

SCARA axis 3

Axis 3 represents the stroke axis of the SCARA robot and is switched to simulation in the TIA Portal. With this, PLCSIM Advanced calculates the position of the axis.

- The drive must not be simulated with a PROFIdrive block.
- The PLC simulates the axis.
- SIMIT transfers the result of this simulation (actual position) to MCD.
- MCD transfers the actual position to a PositionController.
- The PositionController represents the position.

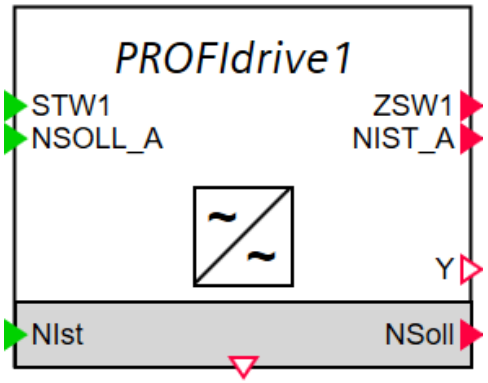
SCARA axis 4

The SCARA axis 4 (rotation of gripper) is not used in this application example. It is therefore not included in this chart.

Drive of the conveyor belt

The simulated drive of the conveyor belt consists of a PROFIdrive1 block and has the following structure:

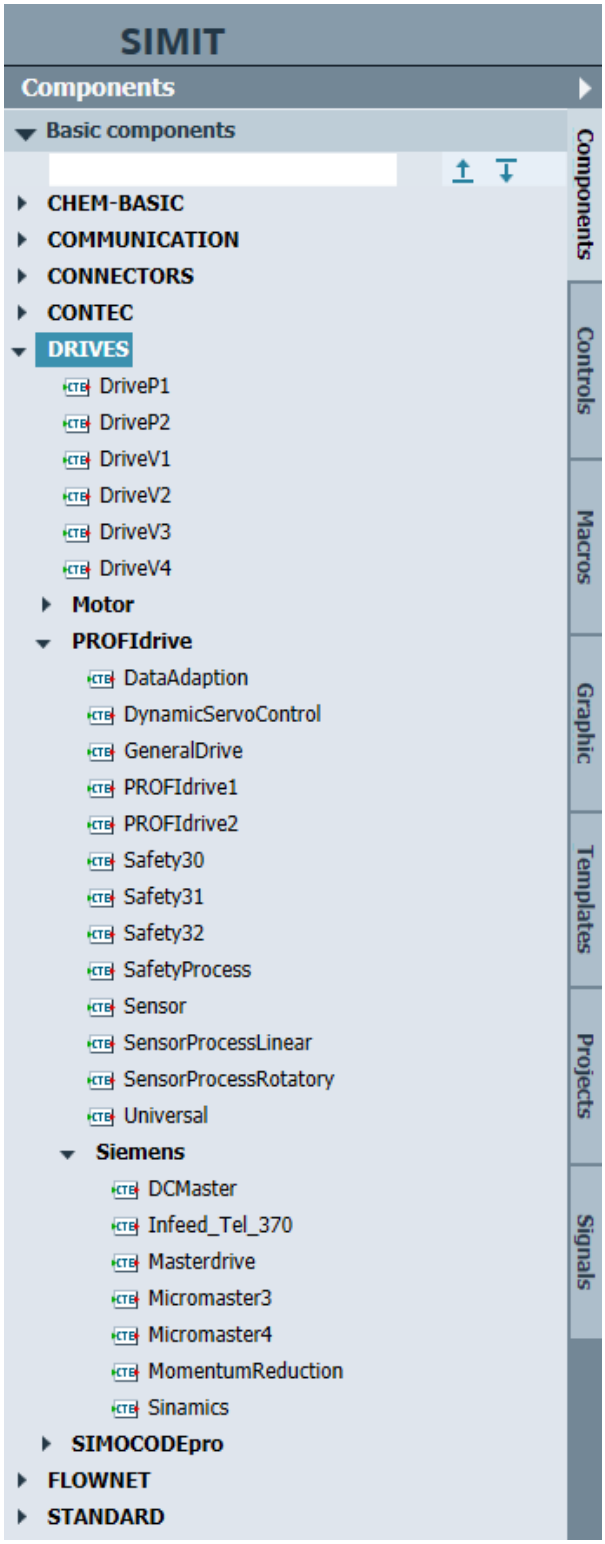
Figure 2-28 Structure of a PROFIdrive1 block



Components of SCARA axes 1, 2 and of the conveyor belt

You can find the components used in the SIMIT library, on the right-hand side in the "Components" task card with open "Basic components" pane.

Figure 2-29 Components of the SIMIT library



2.5.4 Setting properties of the PROFIdrive block

Consistency of parameters

NOTE

In order for the simulation to work smoothly with the PROFIdrive block, the parameters in SIMIT must match the TO-parameters in the TIA Portal.

You can find the parameters in the TIA Portal project navigation under [Device] > Technology objects > [TO name] > Configuration > Basic parameters.

In this example the data adaption of drive parameters is active. The drive parameters will be set during runtime automatically.

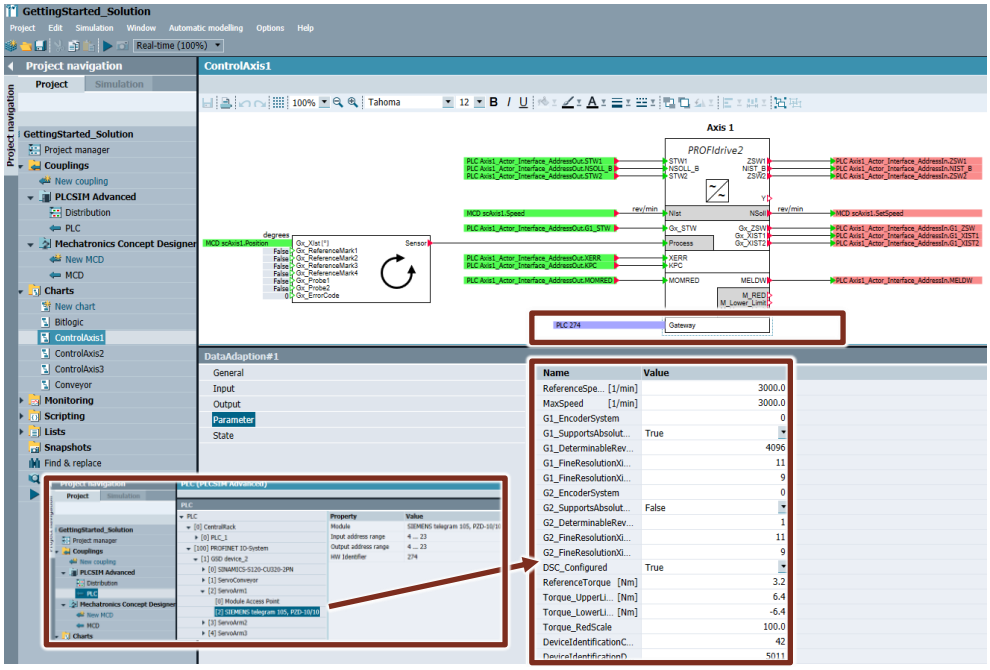
To open the parameters in TIA Portal, proceed as follows:

1. In the TIA Portal project navigation, open the drop-down list of "PLC_1".
2. Click on the relevant TO under "Technology objects".
3. You can see the parameters in the detail view.

Setting properties of the PROFIdrive block

1. Go to charts and click on the PROFIdrive block of the respective axis.
2. Click on the line "Parameters" in the property window.
3. Check the preset parameters of the following blocks and change them if necessary, so that the properties in SIMIT correspond to the TO parameters in the TIA Portal:
    - "PROFIdrive2"
    - "SensorProcessRotary"
    - "Sensor"
4. Insert the drive parameters additionally in the „Gateway“ component for data adaption. The drive parameters will be automatically set in the TIA Portal technology object during runtime.
    - Usage of S7-PLCSIM Advanced V4.0 (Figure 2-30)
    - Usage of S7-PLCSIM Advanced V5.0 (Figure 2-31)

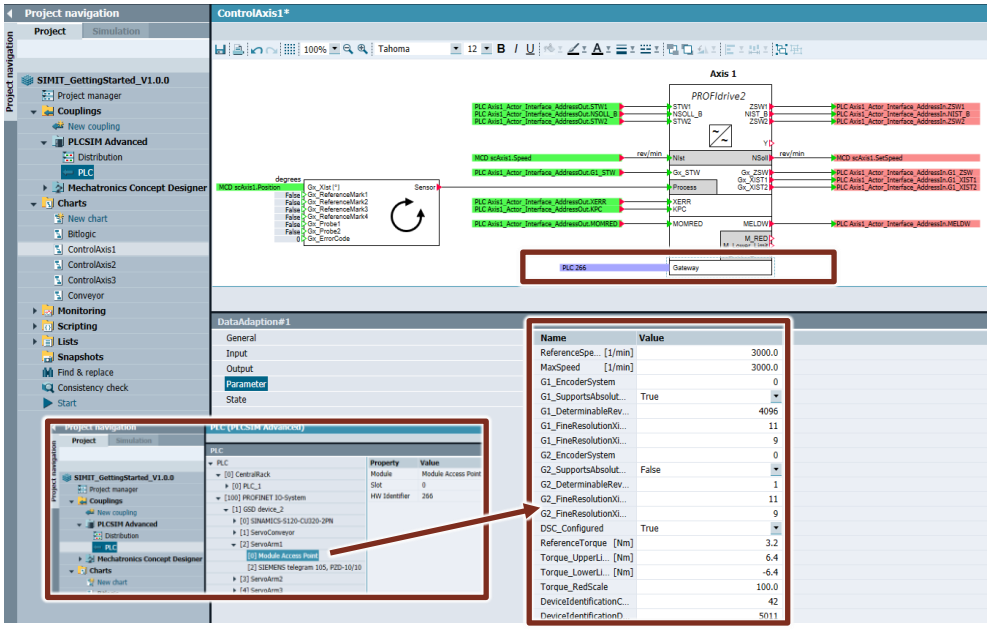
Figure 2-30 Setting the properties of the PROFIdrive block (data adaption) with S7-PLCSIM Advanced V4.0



NOTE

In case of using S7-PLCSIM Advanced V4.0, the HW-ID of the axis PROFIdrive telegram is used for establishing the connection of the Gateway component in SIMIT.

Figure 2-31 Setting the properties of the PROFIdrive block (data adaption) with S7-PLCSIM Advanced V5.0



NOTE

In case of using S7-PLCSIM Advanced V5.0, the HW-ID of the axis Module Access Point is used for establishing the connection of the Gateway component in SIMIT.

2.5.5 Connecting signals

Connection of the signals is shown based on the example of the PROFIdrive2 block of axis 1.

1. Open the "Signals" task card on the right-hand side, next to the SIMIT work area.
2. Filter the signals, if necessary.

NOTE

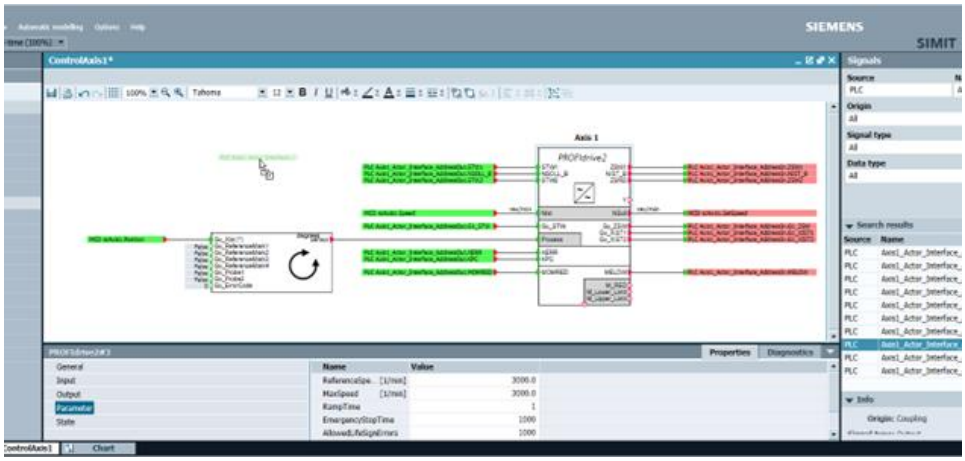
Filtering distinguishes between upper and lower case (case sensitivity).

3. Insert the desired signal into the chart editor using drag-and-drop. You can find additional information on this in the sections Interconnection of axes 1 and 2 (Page 41), Interconnection of axis 3 (Page 41) and interconnection of the conveyor (Page 41).

NOTE

Keep the <Shift> key pressed while dragging the signal.

Figure 2-32 Adding and connecting signals in diagrams

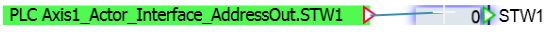
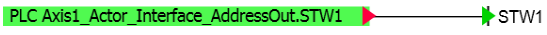


4. Connect signals to the components.

NOTE

- Input connectors have a red background.
- Output connectors have a green background.

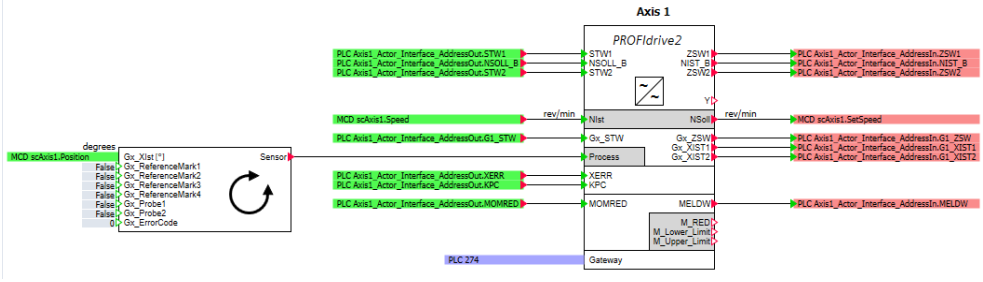
Signal not connected to component	PLC Axis1_Actor_Interface_AddressOut.STW1 0 STW1

Drag connection from signal to component with the mouse	
Signal connected to component	

Interconnection of axes 1 and 2

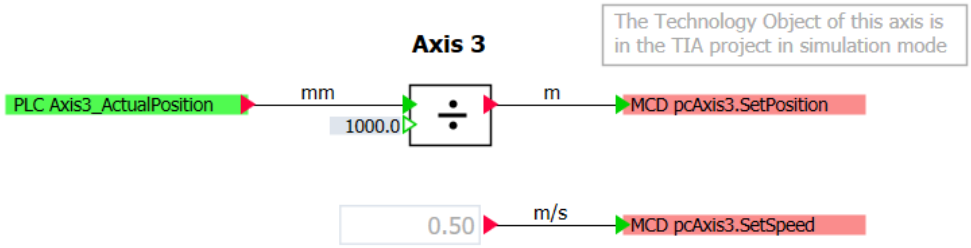
NOTE The display of the drive components, signals and connections is adapted to the page format of this Getting Started for a better overview.

Figure 2-33 Interconnection of signals / SIMIT components of axes 1 and 2



Interconnection of axis 3

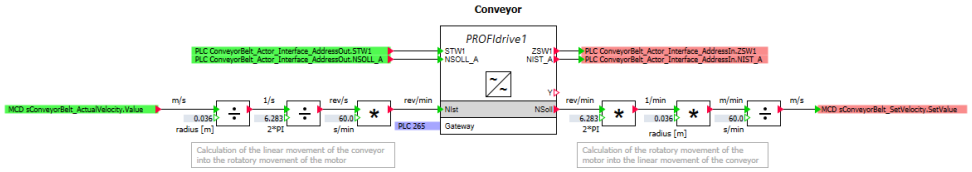
Figure 2-34 Interconnection of signals / SIMIT components of axis 3



Interconnection of the conveyor

Hinweis The display of the drive components, signals and connections is adapted to the page format of this Getting Started for a better overview.

Figure 2-35 Interconnection of signals / SIMIT components of the conveyor



2.5.6 Modeling the behavior for signals

Figure 2-36 Bitlogic (Signal connections / Create product / Deactivate light barriers)

Error test

Test the behavior of the machine in the event of a failure/defect of the right-hand light barrier

1. Start the simulation. You can find additional information on Page 46.
2. Switch a light barrier off or on.

NOTE In the SIMIT chart "Bitlogic", the two gray squares in "Deactivate Sensors - Failure Test" function as buttons. The light barriers can be turned off and on with a click during the simulation.

In the simulation, you will see the behavior of the machine in the event of a failure of a light barrier.

2.5.7 Using the component library

You can find the library in the right-hand pane in SIMIT. You can choose between components and controls, for example.

- You can find a large number of elements in the standard library that you can use for your behavior model.
- In the project library, you will find blocks that you stored in the project folder under "…\pcomp".

Figure 2-37 Components

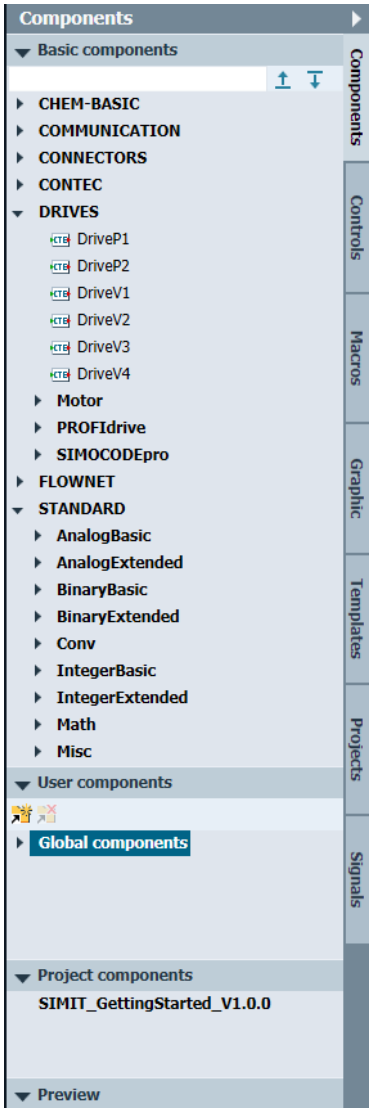
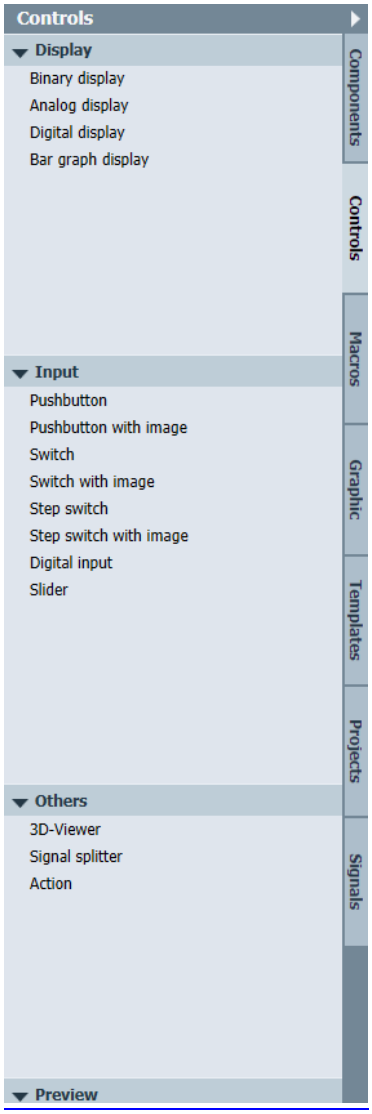


Figure 2-38 Controls



Procedure

1. Open the task card of the library and a substructure if necessary.
2. Use drag-and-drop to move the desired block into the chart.

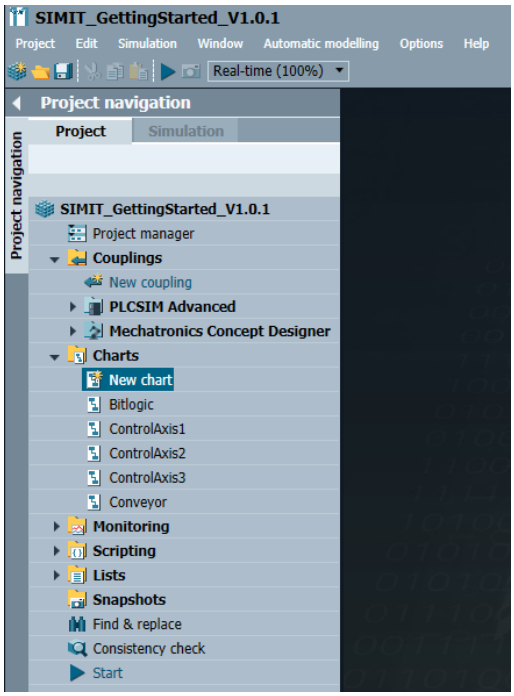
3 Operating the digital twin

You have prepared the simulation. You can find additional information on Page 13.

3.1 Preparing the simulation in SIMIT

1. Open the *.simit file for the application example in the project view.

Figure 3-1 Loaded SIMIT project



3.2 Preparing the simulation in MCD

1. Start NX MCD and open the „GettingStarted_Solution“ with the .prt file „!MAIN_ASM_GettingStarted_Solution.prt“. Page 13.
2. Click „Allow Connection“ in the Toolbar “simit” Figure 3-1.
3. Insert the name of the SIMIT-MCD coupling (MCD) in the „Coupling Identifier“ Figure 3-2.

Figure 3-1 NX MCD – SIMIT Allow connection

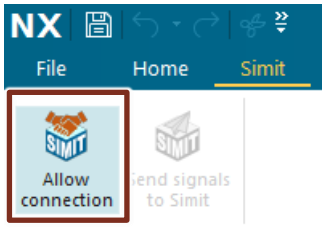
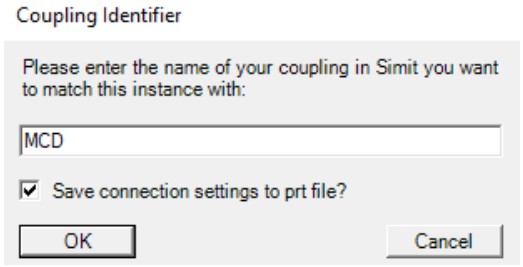


Figure 3-2 MCD Coupling Identifier

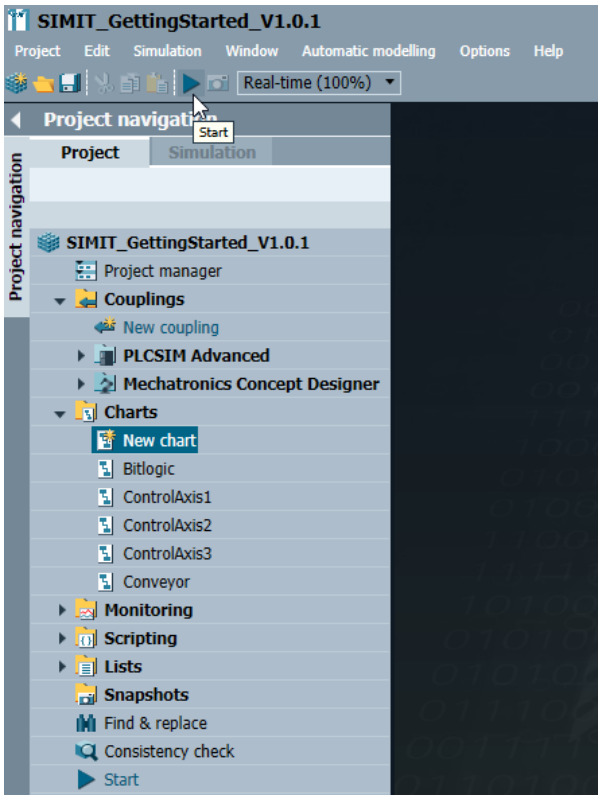


NOTE If the “Save connection settings to prt file?” checkbox is selected, the settings will be saved to the prt file. The message will not pop up anymore.

3.3 Starting the simualtion

Click „Start“ to start the simulation.

Figure 3-3 Start SIMIT simulation



SIMIT changes from the blue color scheme to the orange color scheme.

MCD switches to simulation mode.

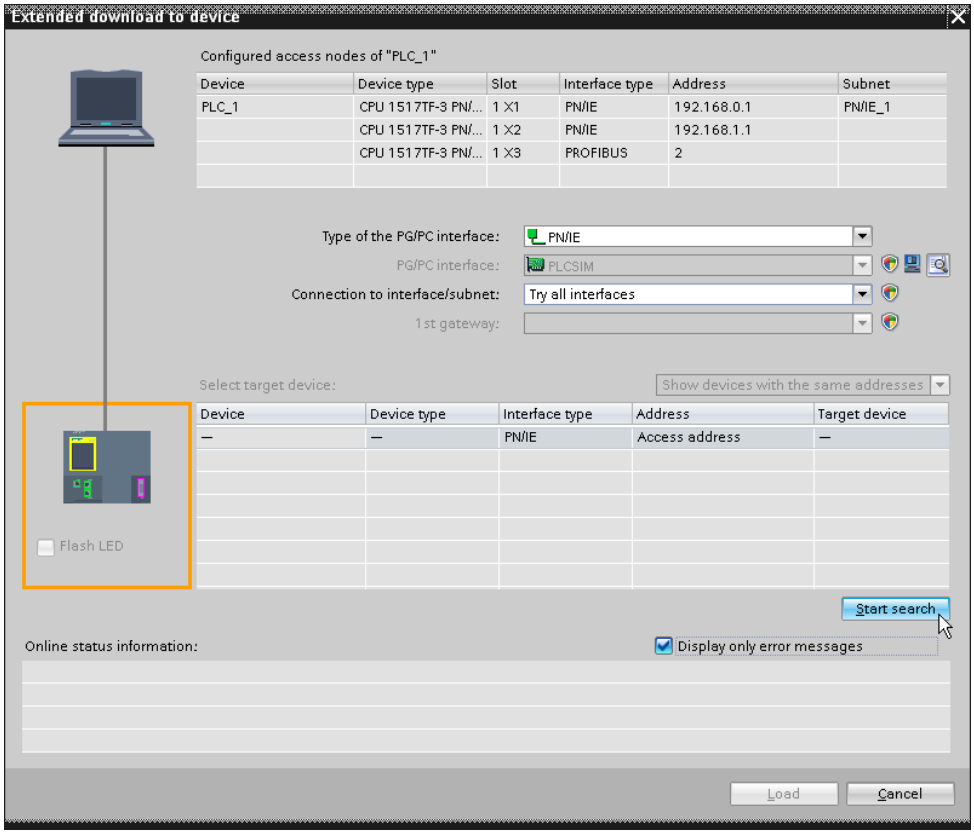
A S7-PLCSIM Advanced instance is created and set to the "Run" operating state if the TIA Portal project has been downloaded before.

You have connected SIMIT online to the simulated PLC.

3.4 Compiling and loading to device

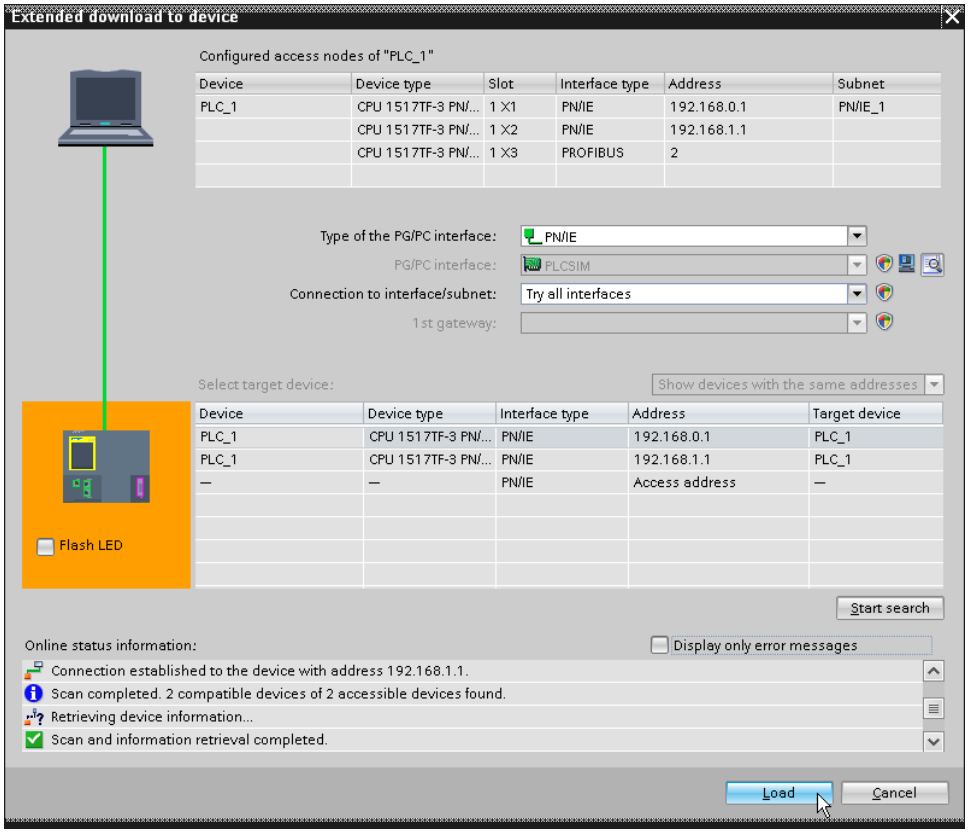
1. Compile the hardware and software of the PLC_1 device in the TIA Portal.
2. Start "Download to device" for the PLC_1 device.
3. Set the following parameters in the "Extended download" window.
   - Type of the PG/PC interface: PN/IE
   - PG/PC interface: PLCSIM
   - Connection with interface/subnet: Try all interfaces
4. Click "Start search".

Figure 3-3 Setting the interface between PG and controller



5. Select the "PLC_1" in the list "Select target device" with the address 192.168.0.1.

Figure 3-4 Compiling the hardware / software and downloading to the controller



NOTE

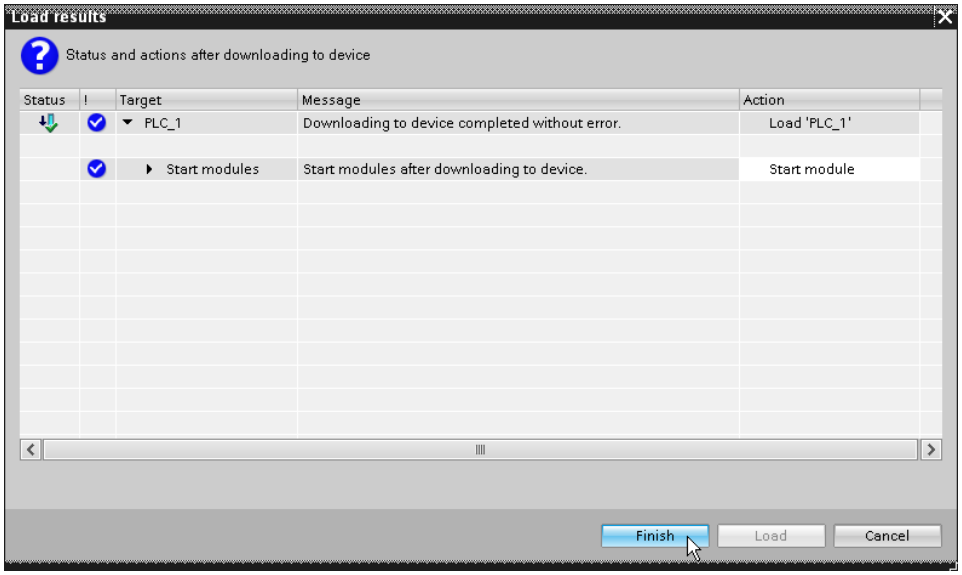
TIA Portal saves the connection.

You only need to enter the settings in the "Extended download" window once. The TIA Portal establishes the connection automatically during the next "Download to device".

The "Load preview" window appears.

6. Click "Load".
7. Select "Start module" in the "Action" column in the "Load results" window.

Figure 3-5 Finish downloading process and starting module



8. Click "Finish".

The window closes.

The TIA Portal project is loaded into the instance of PLCSIM Advanced. This completes the loading process in the TIA Portal. You have compiled PLC_1 and downloaded it to the device; in this case, the simulated controller in PLCSIM Advanced.

Checking the download of the user program into the PLCSIM Advanced instance (optional)

After a successful download, the PLCSIM Advanced Control Panel shows an active instance with green LED ("RUN").

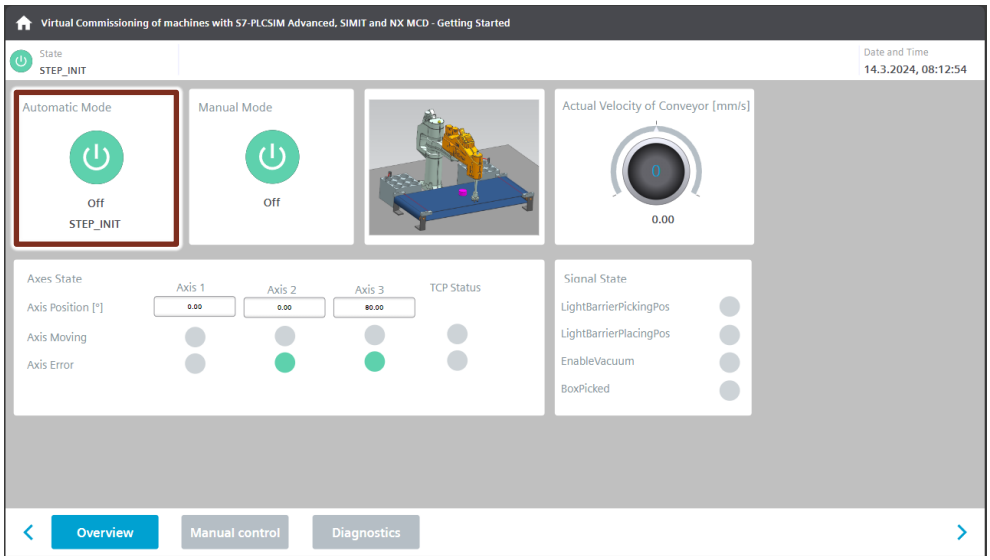
3.5 Operating simulation via the HMI

The GettingStarted project can be operated in automatic mode and manual mode.

3.5.1 Automatic mode

The automatic mode can be started directly.

Figure 3-6 Starting the automatic mode via the HMI



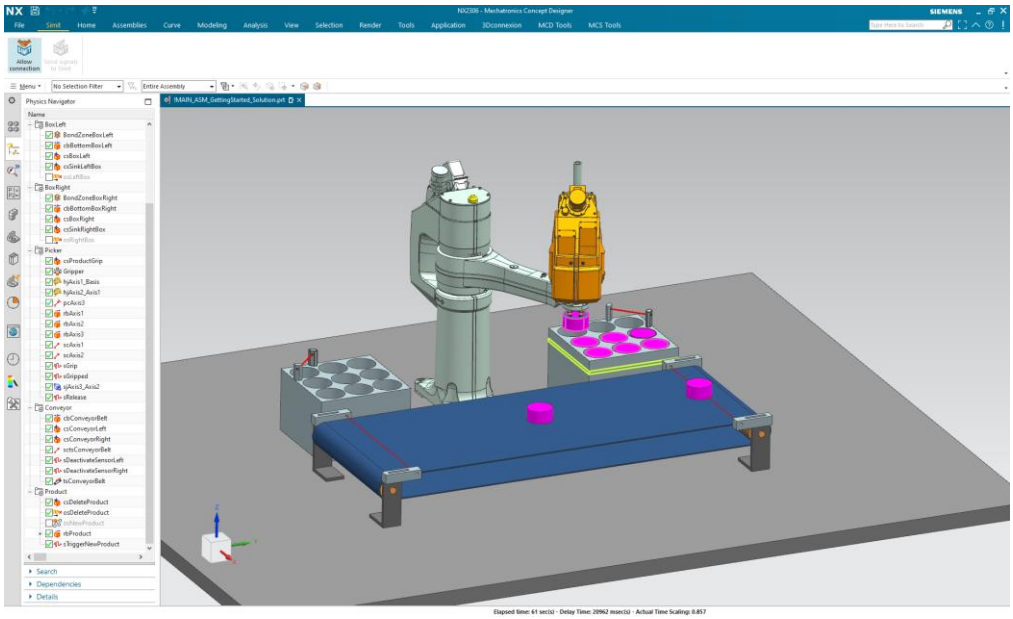
The operator panel starts with the “Overview” page.

1. Click Automatic Mode "ON/OFF".

The color of the button changes from green (OFF) to red (ON).
The automatic mode is active.

The MCD simulation starts.

Figure 3-7 The MCD simulation is started



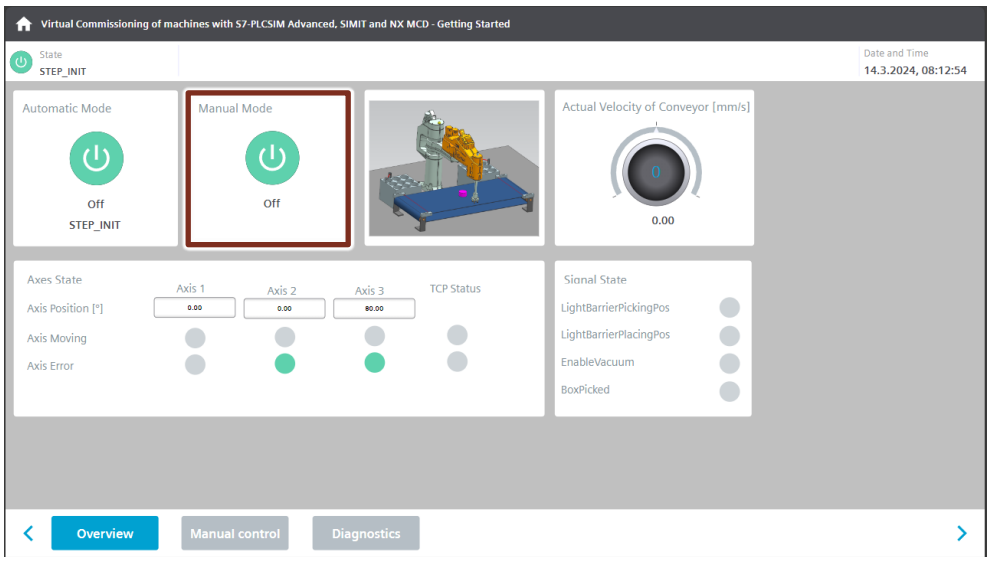
Stopping the simulation

Click on the "ON/OFF" button on the operator panel to stop the simulation.
The color of the button changes from red (ON) to green (OFF).
The movement simulation of the machine stops in the MCD program window.

3.5.2 Manual mode

To start the manual mode, the automatic mode must be stopped.

Figure 3-8 Starting the manual mode via the HMI

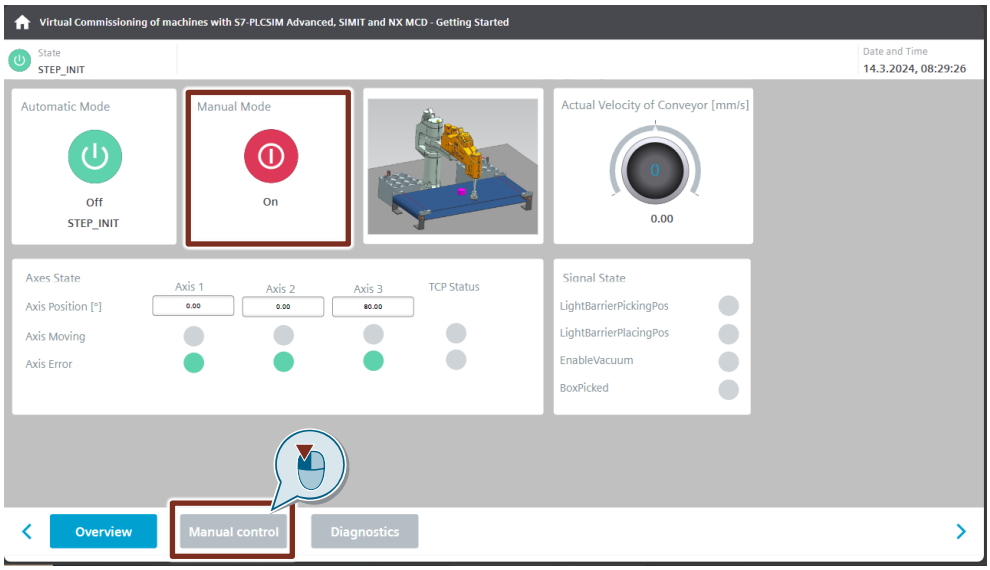


The operator panel starts with the “Overview” page.

1. Click Manual Mode "ON/OFF".

The color of the button changes from green (OFF) to red (ON).
The manual mode is active.

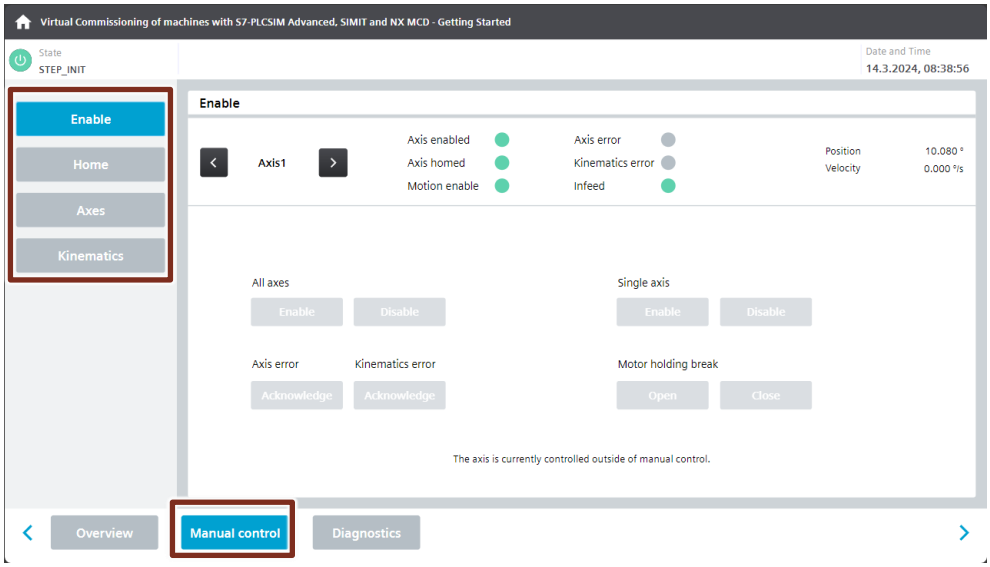
Figure 3-9 Manual control



In the manual control enables the following possibilities:

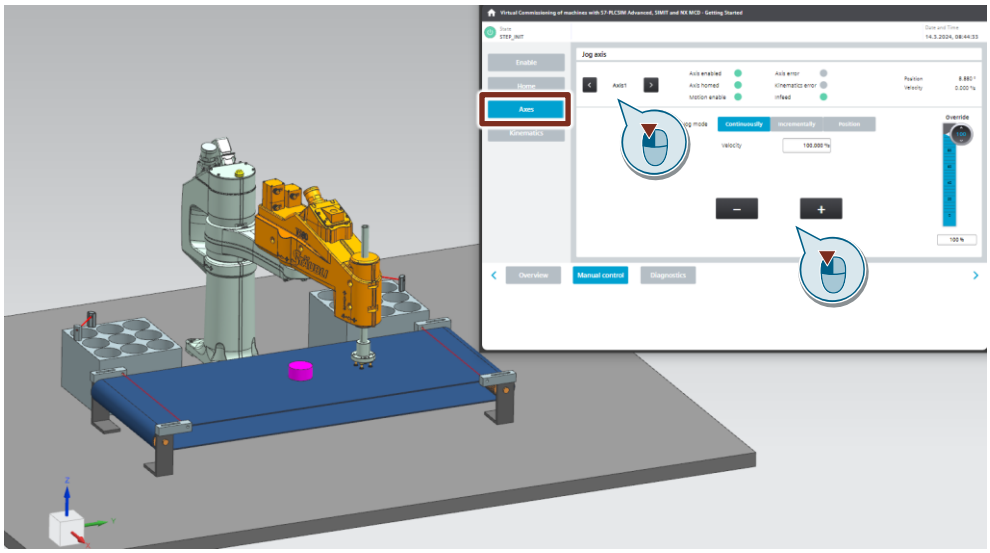
- Enable/Disable Axis
- Home Axis
- Jog Axis

Figure 3-10 Manual control



Via the Axes screen, all axes can be selected and jogged separately.

Figure 3-11 Manual control - Axes



NOTE To switch from manual mode to automatic mode, the axes must be disabled in manual mode and the manual mode must be deactivated first.

4 List of abbreviations

Table 4-1 Abbreviations

Abbreviation	Explanation
API	Application Programming Interface
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CTE	SIMIT Component Type Editor, see SP, with which you can design blocks and integrate them into the SIMIT project library
HMI	Human Machine Interface
MCD	Mechatronics Concept Designer, part of the Siemens program NX
NX	Trade name of the Siemens CAD program
PID	Proportional Integral Derivative
PLC	Programmable Logic Controller
PLCSIM Advanced	Trade name of the Siemens program with which you can create simulated controllers for simulation of S7-1500 and ET 200SP controllers and use them for comprehensive function simulation
PLM	Product Lifecycle Management
SCARA	Selective Compliance Assembly Robot Arm
SHM	Shared Memory
SIMATIC	"*Si*emens" and "Auto*matic*": Trade name for Siemens products in automation technology, control technology and the manufacturing execution level
SIMIT	See CTE and SP
SP	SIMIT Simulation Platform, see CTE
STW	Control word, see ZSW
TIA Portal	"Totally Integrated Automation" Portal.
TO	Technology object
ZSW	Status word, see STW

5 Appendix

5.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that’s tailored to the customer’s specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" APP. The app is available for iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

5.2 Industry Mall

The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:
mall.industry.siemens.com

5.3 Application support

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5.4 Links and literature

Table 5-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109758943

5.5 Change documentation

Table 5-2

Version	Date	Modifications
V1.0.0	10/2023	First version (without SIMATIC Machine Simulator), NX MCD 2306, SIMIT V11.1, S7-PLCSIM Advanced V5.0 Upd2, TIA Portal V18.0 Upd2
V1.0.1	03/2024	Update of projects and documentation (NX MCD: Gripper, BondZone; SIMIT: Signal connection; TIA Portal: Manual Mode)