Simulation of a SIMATIC S7-1200 Controller with SIMIT SP

TIA Portal V16 / SIMIT V10.2 / S7-PLCSIM / S7-1200

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1 Introduction

1.1 Overview

In today's world, simulation is the state of the art for verifying, testing, commissioning, and maintaining automation software. Therefore, the simulation software must offer maximum flexibility in terms of connection to different PLCs.

There are two approaches to connecting PLCs to simulation environments:

- Hardware-in-the-loop (HiL): Here, this is simulated together with a real PLC

- Software-in-the-loop (SiL): Is a purely software-based solution approach. Here, simulation is performed in conjunction with an emulated PLC.

The simulation software SIMIT SP offers a variety of built-in possibilities for the connection of SIEMENS PLCs. Therefore, with the HiL approach, you can integrate Profinet- and Profibus-based control systems into the simulation by using the Simit UNIT. SIMIT SP SIMIT also offers you the option of integrating emulated PLCs natively. An overview of all couplings that SIMIT SP makes available to you is shown in the following table.

Table 1-1

Category	Coupling	Description
Emulated controllers	S7-PLCSIM	S7-PLCSIM for S7-Classic S7-300 or S7-400 family
	S7-PLCSIM Advanced	TIA Portal, S7-1500 family
	Virtual Controller	SIMATIC Controller type S7-300 or S7-400 (including R and H functionalities)
Hardware controller	SIMIT Unit	Hardware-in-the-loop setups based on PROFINET or PROFIBUS
Default	OPC UA	Client and server
	OPC DA	Client and server
	SHM	Shared memory, use of common system memory for data exchange
Co-simulation	Mechatronic Concept Designer	Direct coupling to NX-MCD, including synchronization mechanism
	gProms	Coupling for gPROMS software based on OPC UA

This application example shows you how you can also couple a SIMATIC S7-1200 Controller with the SIMIT SP simulation software using the SiL approach.

1.2 Functionality

SIMIT SP offers a wide range of coupling options for exchanging data with controllers or other applications. If these existing couplings are not sufficient, you can program additional couplings using a programming interface described by SIMIT SP and integrate them into SIMIT SP.

The coupling between SIMIT SP and an emulated SIMATIC S7-1200 controller is based on this mechanism: external coupling.

The emulation of the SIMATIC S7-1200 is handled by the S7-PLCSIM software integrated in the TIA Portal.

This application example helps you to integrate the developed external coupling into SIMIT SP and to use it in your simulation environment.

Figure 1-1
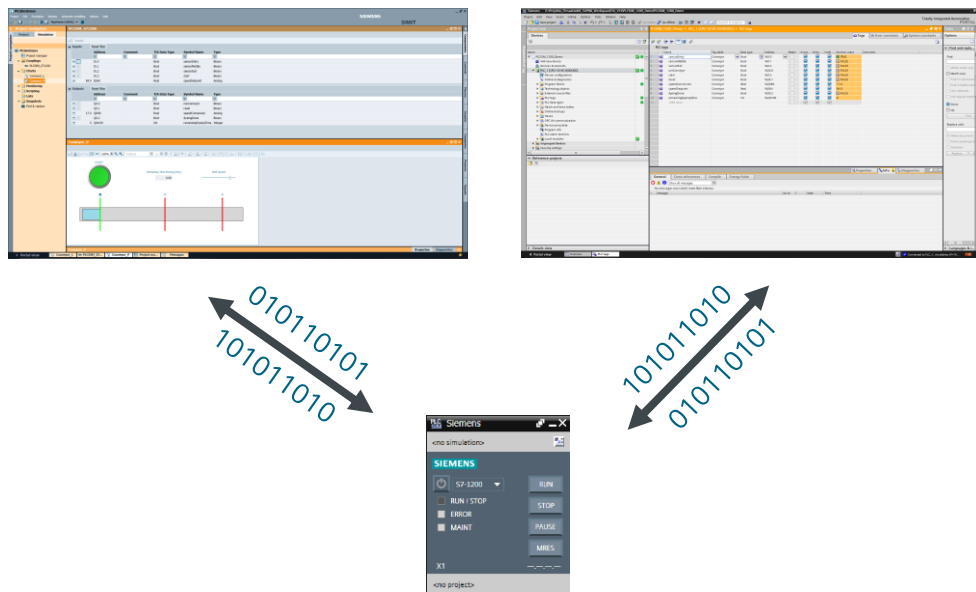
1.3   Components Used

The following hardware and software components were used to create this application example:

Table 1-2

Component	Quantity	Article number	Note
TIA Portal V16.0	1	6ES7822-1AA06-0YA5	-
S7-PLCSIM V16.0	1	-	-
SIMIT SP V10.2	1	6DL8913-0AK00-0AB5	-
S7-PLCSIM coupling V1.0	1	-	-

This application example consists of the following components:

Table 1-3

Component	File name	Note
Documentation	109794472_SIMIT_PLCSIM_S7_1200_DOC_v10_en.pdf	This document
TIA Portal V16 Project	109794472_SIMIT_PLCSIM_S7_1200_PROJ_v10.zip	TIA Portal sample project
SIMIT SP V10.2 Project	109794472_SIMIT_PLCSIM_S7_1200_DEMO_v10.zip	SIMIT SP sample project
S7-PLCSIM Coupling	109794472_SIMIT_PLCSIM_S7_1200_CODE_v10.zip	Folder with external coupling

2 Engineering

2.1 Installation

It must be installed in order to access to the coupling between S7-PLCSIM and SIMIT SP within SIMIT SP. To do this, you need to perform the following steps. SIMIT SP has not yet been started.

1. Navigate to the installation directory of SIMIT. This is normally "C:\Program Files (x86)\Siemens\Automation\SIMIT\SIMIT SF".
2. Within this directory, create the "Couplings" folder.

Note	If you are already using other external couplings in SIMIT SP, this step is obsolete.

3. Copy the folder "S7-PLCSIM_S71200" into the "Couplings" folder. The folder "S7-PLCSIM_S71200" is part of the application example.

Figure 2-1
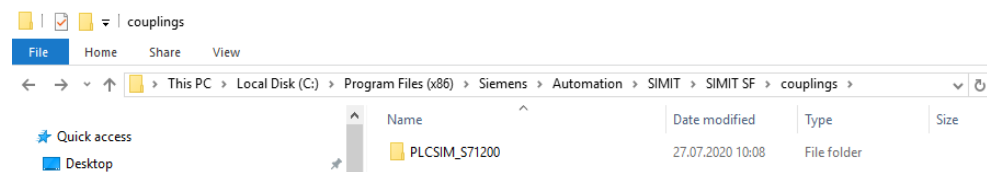
2.2 Operation

2.2.1 TIA Portal – Exporting a Tag Table

Before you start configuring the coupling, it is necessary to export the tag table from your TIA Portal project. To do this, open the TIA Portal project "S7-PLCSIMDemo.zap16" enclosed with the application example.

Display and export all tags contained in the project.

Note	If no suitable hardware has been configured for the address range of the tag, it is not possible to control the signal from the simulation

Figure 2-2

2.2.2 SIMIT – Coupling Configuration

The external coupling is available after the installation in SIMIT.
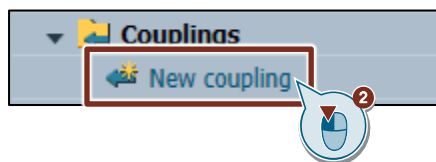To configure the coupling, start SIMTI SP.

1. Open the SIMIT archive "S7-PLCSIMDemo.simarc" contained in the application example.

Figure 2-3
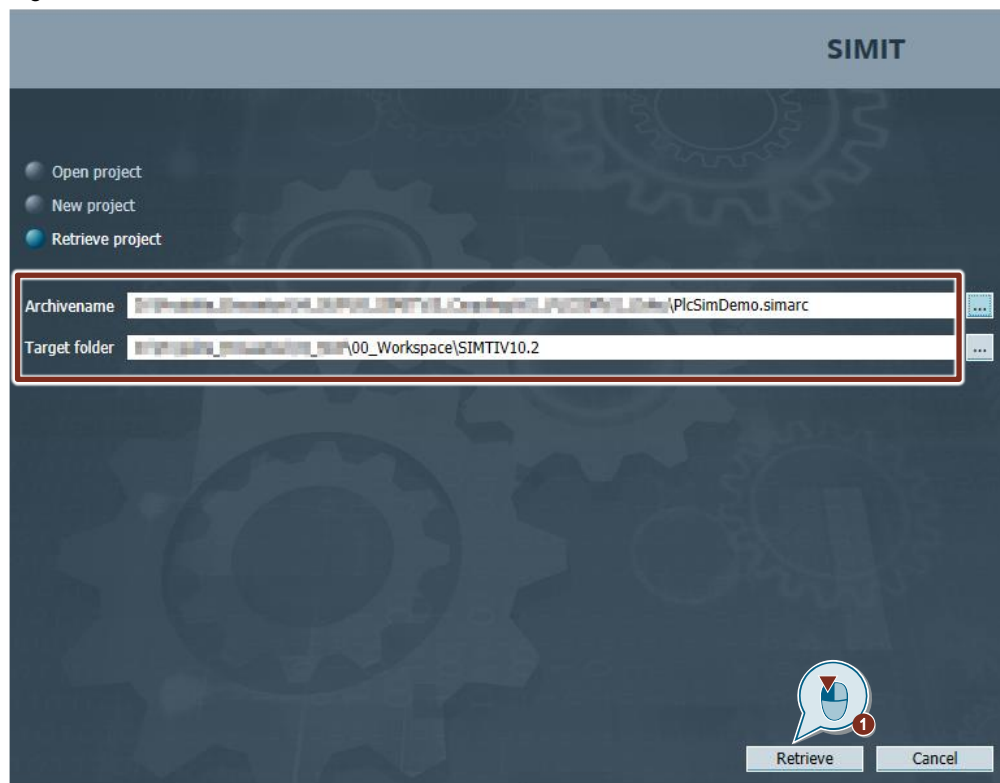
2. Create a new coupling in the opened simulation project.

Figure 2-4

3. Create the coupling "PLCSIMS71200" by selecting the coupling in the selection window and confirm the selection with OK.

Figure 2-5
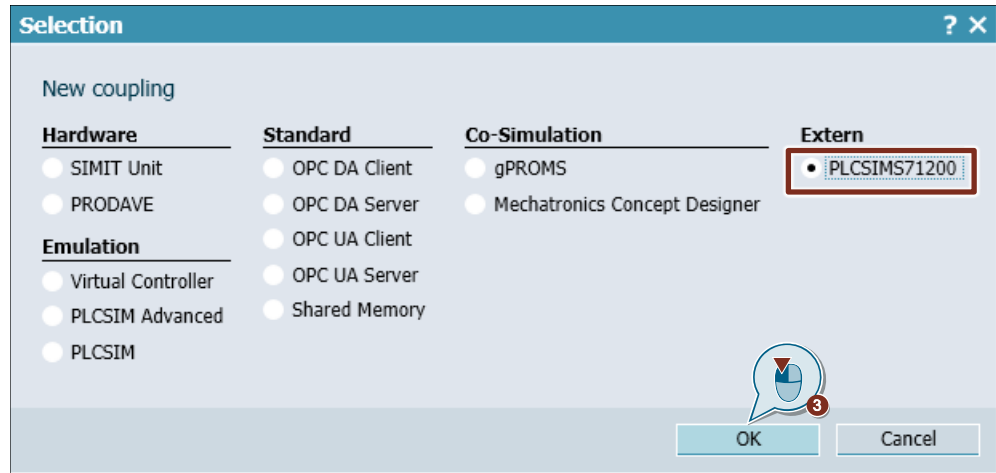
Note	The displayed name of the coupling is derived from the name of the folder located in the "Couplings" configuration directory.

4. After you have created the coupling, it opens automatically. Click the "Import" button in the opened coupling.

Figure 2-6

5. Select the Excel file exported in 2.2.1 and load the PLC tags to SIMIT.

Figure 2-7

6. Save the coupling.

Figure 2-8

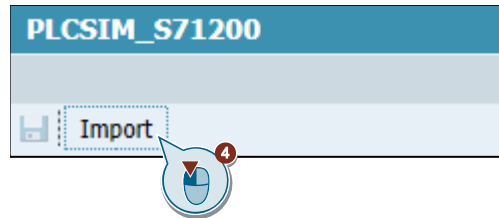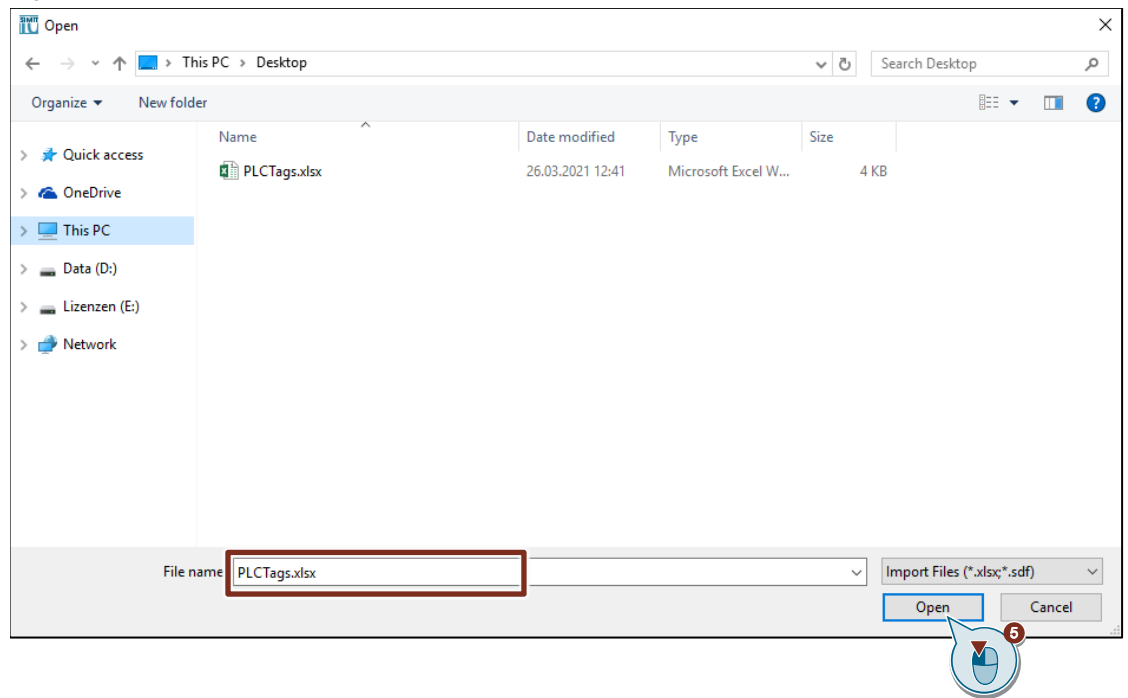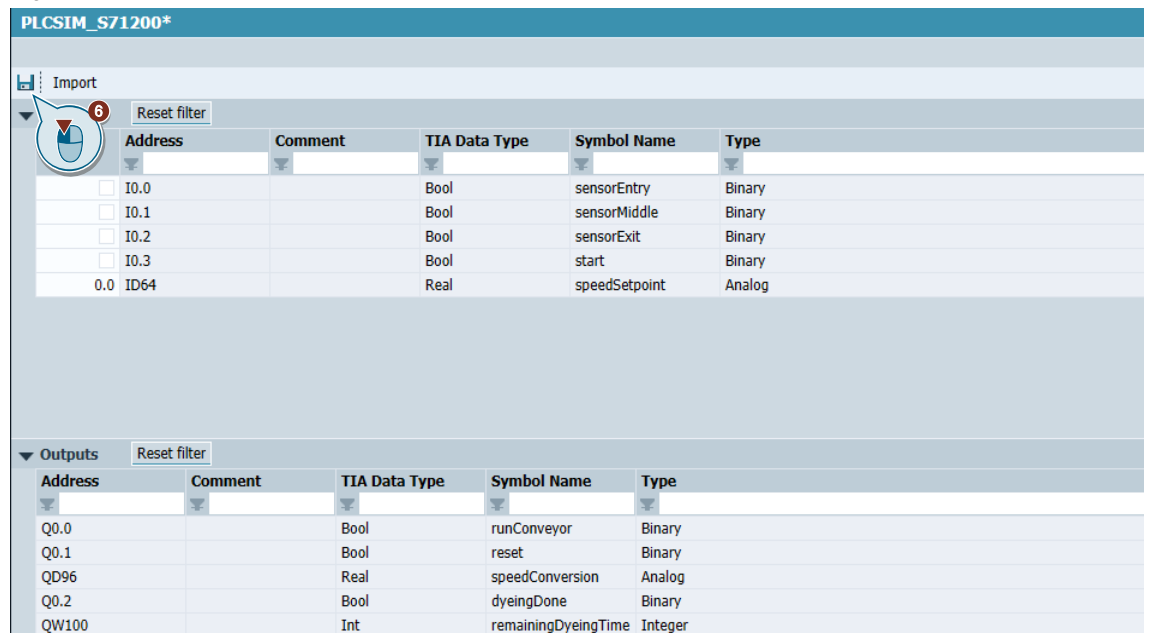7. Start the simulation

Figure 2-9
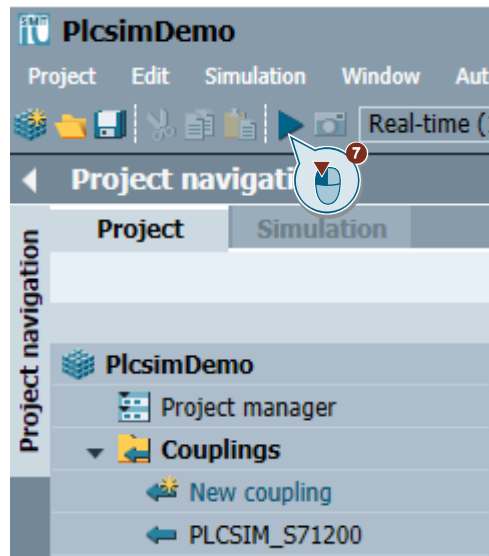
Note SIMIT SP starts the S7-PLCSIM instance for you in the background.
No S7-PLCSIM instance must be started in advance.

Note A maximum of two S7-PLCSIM instances can be started.

2.2.3 TIA Portal – Downloading the Automation Program

After the initial configuration, or after each change in your automation project, you must download the project.

Proceed here as usual.

Note After a S7-PLCSIM instance has been started, the PG/PC interface S7-PLCSIM is statically defined.

Note The configuration of the S7-PLCSIM instance is stored persistently.

2.2.4　　SIMIT – Controlling the Simulation

Now open the simulation diagram "Conveyor_P" in your SIMIT project "S7-PLCSIMDemo". On this, you will find an operating screen for a conveyor belt.

Start the conveyor belt to test the external coupling.

The conveyor belt works as follows:

An object is transported from the left side (the entrance of the conveyor belt) to the right side (the exit of the conveyor belt). There are three light boxes on the conveyor belt: at the entrance, in the middle, and at the end of the conveyor belt. If the light barrier at the input is triggered, the start button (1) can be pressed. The conveyor belt is started and runs until the middle light barrier is triggered. The object will now be dyed. The remaining time (2) until the dyeing process is completed is displayed in SIMIT. As soon as the dyeing process is completed, the conveyor belt starts again and the object moves towards the exit. The conveyor belt runs until the object has left the conveyor belt.

After the object has left the conveyor belt, the simulation is reset.

Furthermore, it is possible to change the speed of the conveyor belt (3). A slider is available in the simulation for this purpose.

Figure 2-10
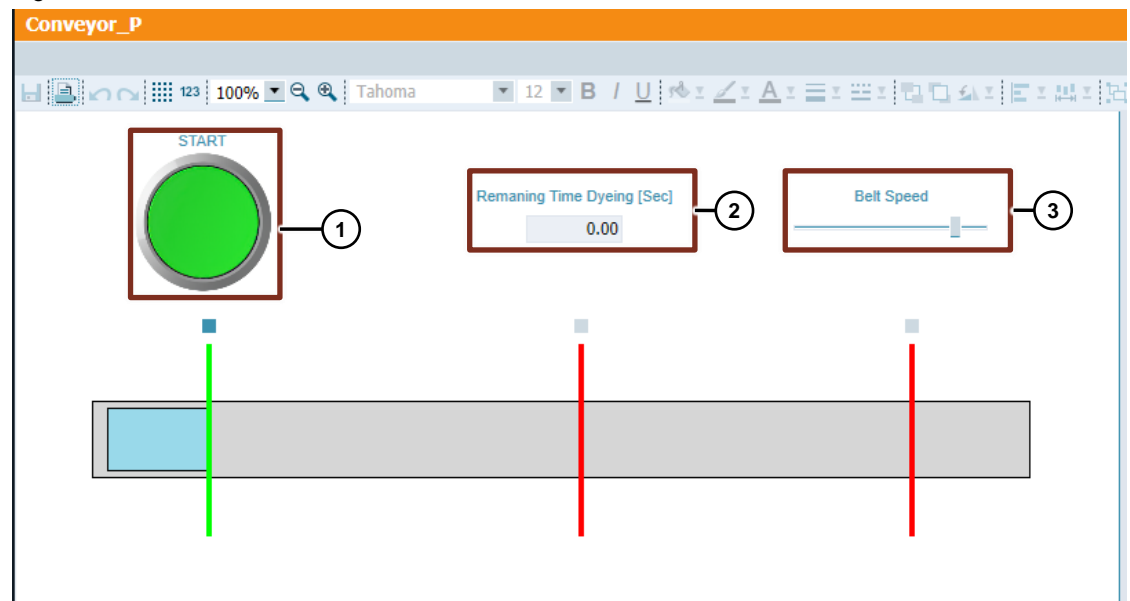
| Note | You have already loaded the automation project for the conveyor belt shown in Section 2.2.3 to the emulated SIMATIC S7-1200. |

| Note | Furthermore, you can observe all tags and the automation logic in the TIA Portal as usual. |

3 Restrictions for S7-PLCSIM

A maximum of two S7-PLCSIM instances can be started on one PC.

Note	Here, not only the instances started by SIMIT SP are counted, but all instances running on the PC.

S7-PLCSIM for the S7-1200 does not simulate the following technology modules and technology objects.

- Count
- PID
- Motion control

More details about the limitations of S7-PLCSIM can be found in the S7-PLCSIM Manual.

4 Appendix

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4.3 Links and literature

Table 4-1

No.	Subject
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/en/view/109794472
\3\	SIMIT Simulation Platform – Overview https://support.industry.siemens.com/cs/ww/en/view/109746429
\4\	Application example: First Steps with SIMIT V10.0 and STEP 7 (TIA Portal). https://support.industry.siemens.com/cs/ww/en/view/109767324
\5\	TIA Portal – An Overview of the Most Important Documents and Links – Controller https://support.industry.siemens.com/cs/ww/en/view/65601780

4.4 Change documentation

Table 4-2

Version	Date	Change
V1.0	04/2021	First version