

# SIEMENS

## SIMATIC

### Engineering Tools S7-PLCSIM V18 online help




#### Operating Manual

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indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
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# Preface

## 1.1 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit (<https://www.siemens.com/industrialsecurity>).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customers' exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (<https://www.siemens.com/cert>).

## S7-PLCSIM Overview

S7-PLCSIM supports the debugging and validation of PLC programs without requiring actual hardware. With simulated PLC instances in S7-PLCSIM, you can use STEP 7 debugging tools, including the watch table, program status, online & diagnostics functions, and other tools. S7-PLCSIM also operates in conjunction with S7-PLCSIM Advanced. You can also download from STEP 7 to simulated PLC instances that you started from the S7-PLCSIM Advanced control panel or from the S7-PLCSIM Advanced API.

S7-PLCSIM provides the following tools for simulated PLCs:

- Support for the latest hardware and firmware of the following product families:
  - S7-1500
  - S7-1500 R/H
  - S7-1200
  - ET200 SP
  - ET200 pro
- Multiple simulated PLC instances (Page 14)
- Simulation (SIM) tables (Page 19) for monitoring and modifying simulated PLC inputs, outputs, and data
- Simulation of interrupts to trigger supported event OBs (Page 23)
- Virtual time scaling (Page 16) for S7-PLCSIM Advanced instances
- The ability to connect to physical communication networks (Page 17) for S7-PLCSIM Advanced instances

S7-PLCSIM operates in conjunction with STEP 7 in the TIA Portal. You use STEP 7 to perform the following tasks:

1. Configure a PLC and any associated modules
2. Program your application logic
3. Start a simulation or download a PLC configuration and program to S7-PLCSIM

When S7-PLCSIM has a configured simulated PLC instance, you can use the online tools in STEP 7 to observe simulated program behavior.


## 2.1 Starting S7-PLCSIM

You can start S7-PLCSIM by any of the following means:

- S7-PLCSIM desktop icon
- S7-PLCSIM in the Start menu
- "Start simulation" command from STEP 7 for supported devices

### Starting S7-PLCSIM from STEP 7

To start simulating a PLC in your STEP 7 project, select your PLC in the project tree and choose one of the following methods:

- Click the "Start simulation" button on the main toolbar. 
- Right-click the PLC in the project tree and select "Start simulation" from the shortcut menu.

From the STEP 7 dialogs, you might need to perform some or all of these tasks:

- Select the PLCSIM PG/PC interface if you have not previously selected it.
- Answer prompts to enable simulation support if necessary.
- Answer the prompt about trusting the device.
- Click "Start search" to find a PLCSIM instance for the download.
- Click Load and Finish to complete the download

If S7-PLCSIM is not running, starting a simulation starts S7-PLCSIM with a new workspace (Page 9) containing the simulated PLC instance. The workspace name corresponds to the STEP 7 project name.

If S7-PLCSIM is already running, starting a simulation adds a new simulated PLC instance to the current workspace.

If the simulated PLC instance name in the workspace is the same as a running instance from another application such as S7-PLCSIM Advanced, S7-PLCSIM prompts you for handling of the instance name conflict. You can choose to remove the instance from the other workspace and start the simulation. If you do not want S7-PLCSIM to remove the other running instance, cancel the operation and resolve the instance name conflict manually.

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#### Note

If you start simulation from STEP 7 more than once for a PLC, you start multiple simulation instances (Page 14) for that PLC.

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## 2.2 S7-PLCSIM workspaces

S7-PLCSIM works with the concept of workspaces. A workspace can contain multiple simulated PLC instances (Page 14) and simulation views (SIM Views (Page 19)) that include SIM tables and events. With the workspace concept, you can group common simulation artifacts together. In this way, you can tailor your workspaces to different test scenarios, different parts of your process, or other logical arrangements of your simulated application. You can create, save, and reopen workspaces (Page 9).


When you start S7-PLCSIM from the Start menu or desktop icon, S7-PLCSIM starts with no workspace.

### Workspaces and STEP 7

Note the following relationships between STEP 7 and S7-PLCSIM:

- If S7-PLCSIM is not running, starting a simulation from STEP 7 (Page 8) starts S7-PLCSIM and creates a workspace with the project name. The workspace contains one simulated PLC instance for the PLC.
- If S7-PLCSIM is running with no workspace, starting a simulation from STEP 7 creates a workspace with the project name. The workspace contains one simulated PLC instance for the PLC.
- If S7-PLCSIM is running with an open workspace, starting a simulation from STEP 7 adds a simulated PLC instance to the workspace for the PLC in the STEP 7 project. The workspace name might or might not be the same as the STEP 7 project name. Manage your STEP 7 projects and S7-PLCSIM workspaces to optimize organization.

## 2.3 Creating, opening, and saving S7-PLCSIM workspaces

If you have saved a previous S7-PLCSIM workspace, you can open it from the home page . S7-PLCSIM displays a list of previously saved workspaces that you can open. S7-PLCSIM opens the workspace, which contains the PLC simulation instances and simulation views that you created and saved.

You can perform the following workspace tasks from the home page:

- Create a workspace
- Open a workspace

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### Note

You cannot convert projects from previous releases of S7-PLCSIM to workspaces. Project formats from earlier versions and workspace files are not compatible.


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## 2.4 Differences between a simulated PLC and a physical PLC

### Creating a workspace

To create a new workspace, click the "Create workspace" button. You can select or create a folder for the new workspace. You can then create new simulation instances (Page 14) and SIM views (Page 19) in the new workspace.


### Opening a workspace

To open a previously-created workspace, click the open icon  next to the workspace that you want to open.

If there are no errors, S7-PLCSIM opens the workspace and displays the name of the workspace under "Current Workspace". You can then switch to the instance view  or a SIM view .

If a simulated PLC instance name in the workspace is the same as a running instance from another application such as S7-PLCSIM Advanced, S7-PLCSIM prompts you to handle the instance name conflict. You can choose to remove the instance from the other workspace and continue to open the workspace. If you do not want S7-PLCSIM to remove the other running instance, cancel the open operation and resolve the instance name conflict manually.

### Saving a workspace

Click the Save icon  to save your current workspace. Answer the prompt to save the workspace.

### Deleting a workspace

You can only delete a workspace from Windows File Explorer. Delete the folder that corresponds to the workspace you want to delete.

## 2.4 Differences between a simulated PLC and a physical PLC

### 2.4.1 Overview of differences

A virtual PLC can behave differently than a physical PLC.

Many CPU System Functions (SFCs) and System Function Blocks (SFBs) have limited behavior for simulation. Programs that rely on this functionality behave differently during simulation. Program dependencies on PLC clock times or specific hardware timing, for example, will behave differently in a Windows simulated PLC.

Also, programs that are highly dependent on timing might be difficult to debug with a simulation due to differences in timing between a software-based simulation and physical hardware.

## 2.4.2 Differences common to all supported PLCs

S7-PLCSIM differs from physical PLCs in the following areas.

### Diagnostics

S7-PLCSIM does not support all of the error messages written to the diagnostic buffer. For example, S7-PLCSIM does not simulate messages about bad batteries in the CPU, or EPROM errors. However, S7-PLCSIM simulates most program errors.

### Time-based performance

Because S7-PLCSIM is software running on a programming device under the Windows operating system, the scan cycle time and the exact time of actions in S7-PLCSIM are not the same as if PLC firmware performed those actions.

If your program is highly dependent upon the time that actions execute, do not evaluate your program based only on the time results of your S7-PLCSIM simulation.

### Access and copy protection

S7-PLCSIM does not simulate access protection or copy protection.

### Know-how protection

You must enable simulation of know-how protected blocks to simulate them in S7-PLCSIM. To enable know-how protection for a block, follow these steps:

1. Right-click the project in STEP 7.
2. Select Properties.
3. From the Protection tab, select the check box "Support simulation during block compilation".

### Flashing LEDs

STEP 7 and other tools can only flash LEDs on physical PLCs. You cannot flash the LEDs on a simulated PLC from STEP 7 or any other tool.

### Features that require a memory card

S7-PLCSIM does not simulate CPU functionality that requires a memory card, such as data logging and recipes.

### Open and software controllers

S7-PLCSIM does not support simulation of software and open controllers.

## 2.4 Differences between a simulated PLC and a physical PLC

### Web server

S7-PLCSIM supports the Web server only when the communication mode (Page 17) is a TCP/IP mode.

### PROFIBUS

If your STEP 7 project contains PROFIBUS elements, S7-PLCSIM will not simulate the PROFIBUS elements, but simulates the remainder of your project.

You do not need to remove the PROFIBUS elements from your project before starting your simulation. Just be aware that S7-PLCSIM ignores the PROFIBUS elements.

### F-CPU simulation

To simulate an F-CPU, you must adjust the F-parameter F-monitoring time in your STEP 7 project before you download to S7-PLCSIM. This is due to the difference in timing between a software-based simulation and physical hardware.

To adjust the F-monitoring time, follow these steps:

1. In the STEP 7 Project tree, right-click your F-CPU and select "Properties".
2. In the Properties dialog, navigate to "Fail-Safe > F-parameter > Default F-monitoring time for central F-I/O".
3. Adjust the F-monitoring time from the default of 150 ms to a higher value.
4. Click OK.

You might need to repeat this procedure until you find an F-monitoring value that allows your F-CPU simulation to run without errors.

### Instruction support

S7-PLCSIM supports most instructions for the simulated S7-1200 and S7-1200F in the same way as for a physical PLC.

You can download all programs that successfully compile to the virtual PLC. However, some instructions call SFCs (system functions) or SFBs (system function blocks) that are only partially supported, and your simulation might not function as you expect.

For programs with partially supported instructions, S7-PLCSIM validates input parameters and returns outputs that are valid, but not necessarily what a real PLC with physical I/O would return. For example, S7-PLCSIM does not support the SIMATIC SD memory card, so program instructions that save data on a memory card do not actually save data when a simulation executes.

### 2.4.3 S7-1200: Technology support

S7-PLCSIM does not simulate the following technology features for the S7-1200:

- Counting, measurement and position detection
- PID Control
- Motion control

### 2.4.4 S7-1500, ET 200SP, and ET 200pro: Technology support

#### Technology support

S7-PLCSIM supports the following technology features for the S7-1500, S7-1500F, ET 200SP, and ET 200pro:

- Counting, measurement and position detection
- PID Control
- Time-based IO
- Motion control

For simulating technology modules and technology objects beyond testing your program, consider using S7-PLCSIM Advanced or SIMIT.

#### S7-1500R/H simulation differences

You can simulate the S7-1500R/H in RUN-Solo mode only. You can run only one instance of S7-PLCSIM for an S7-1500R/H.

## Working with simulated PLC instances

### 3.1 Starting a simulated PLC instance

If you started simulation from STEP 7 (Page 8), you already have PLC instances for each PLC simulation that you started.

#### Creating a new instance from the S7-PLCSIM library

You can also create PLC instances from the S7-PLCSIM library of PLCs.

To start a new simulation, select your device from the Library tab of S7-PLCSIM and click the "+" button to create an instance. S7-PLCSIM creates a new instance that is powered off. From the Properties tab, you can configure it as a Standard instance or an Advanced instance from the License type property.

Click the power button of the instance to power it on. The simulated PLC is unconfigured until you download a STEP 7 project (Page 15) to it.


#### Creating an instance from S7-PLCSIM Advanced

When you start a simulated PLC instance from the S7-PLCSIM Advanced Control Panel or the API, S7-PLCSIM loads that instance into the "Live instances in other workspaces" area. This area is visible from the "Live instances" tab of S7-PLCSIM. For S7-PLCSIM Advanced instances that are in other workspaces, you cannot create SIM views. You can download a STEP 7 PLC to it. After you have downloaded a PLC from STEP 7 into the instance, and the instance is powered on, you can change the operating mode or perform a MRES from S7-PLCSIM.

#### Features of simulated PLC instances

For each simulated PLC instance in the current workspace, you can use SIM views (Page 19) to interact with your simulated PLC and process values. SIM views provide the following features:

- SIM tables (Page 19) enable you to monitor and modify I/O points, memory values, and PLC tags.
- Event simulation (Page 23) enables you to simulate events and test your program's event interrupt OB code.

These features provide a means for you to test your program without physical I/O and to simulate events dependent on hardware. Your simulated instances are visible in the instance view of S7-PLCSIM. Click the instance icon to view them: . From the instance view, you can also set the communication mode (Page 17).

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**Note**

You can power on a maximum of two simulated PLC standard instances and two advanced instances.

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## 3.2 Downloading a PLC from STEP 7 to a simulated PLC instance

If S7-PLCSIM is running, you can download a PLC from STEP 7 to a powered on simulated PLC instance in S7-PLCSIM. The instance can be a standard instance in your workspace or an S7-PLCSIM Advanced instance in other workspaces.

Select the PLC in your STEP 7 project and download the device to S7-PLCSIM using one of the following methods:

- Right-click the PLC and select "Download to device" from the context menu.
- Click the "Download to device" button from the STEP 7 toolbar.
- Select "Download to device" from the Online menu.

Download both the hardware configuration and software initially. After the initial download, STEP 7 downloads the changes on subsequent downloads.

From the STEP 7 dialogs, you might need to perform some or all of these tasks:

- Select the PLCSIM PG/PC interface if you have not previously selected it. Select PLCSIM if you are using the Softbus communication mode (Page 17) and Siemens PLCSIM Virtual Ethernet Adapter if you are using the TCP/IP communication mode.
- Answer prompts to enable simulation support if necessary.
- Answer the prompt about trusting the device.
- Click "Start search" to find an S7-PLCSIM instance for the download.
- Click Load and Finish to complete the download.

If you get download errors about blocks that cannot be simulated, follow these steps to enable simulation support:

1. Right-click the project in STEP 7 and select Properties.
2. From the Protection tab, select "Support simulation during block compilation."

On the first download, STEP 7 downloads to the unconfigured, simulated PLC instance at the default IP address that was powered on first. The download might go to a live instance in "other" workspaces or to an instance in your workspace. You might need to use S7-PLCSIM Advanced to remove the instance from "other" workspaces. This will force STEP 7 to download to an unconfigured, powered-on instance in your S7-PLCSIM workspace.

### 3.3 Virtual time scaling

On future downloads, STEP 7 will load to the powered on S7-PLCSIM instance with the IP address of the PLC in STEP 7. If no instance exists with that IP address, STEP 7 will download to another powered on unconfigured instance.

## 3.3 Virtual time scaling

Virtual time scaling is available for simulated PLC instances with the Advanced license type in the Properties tab of the instance. Virtual time scaling is not available for Standard simulated PLC instances or S7-PLCSIM Advanced instances in "other" workspaces.

A simulated PLC instance uses two types of internal clocks for the simulation: A virtual clock and a real clock. The virtual clock is always the basis for the user program. It is used by components that are relevant for running the STEP 7 user program, such as cyclic OBs, cycle time monitoring, minimum cycle time, virtual system time and time calculations. Also, the time between two cycle control points is measured in virtual time.

The virtual time can be accelerated or slowed for test purposes.

The real clock always runs unchanged. It is used by components that are not subject to control processes, for example, communication with STEP 7.

### Interruption of the process

Since S7-PLCSIM runs in a Windows environment, Windows might temporarily suspend the process corresponding to the simulated PLC instance. In such a case, both the virtual and the real clock stop in the simulated PLC instance. They only continue to run when Windows resumes processing.

### Virtual system time

When you start S7-PLCSIM, the virtual system time of the simulated PLC instance starts with the system time of Windows.

The virtual system time is based on the virtual clock. If you use a scaling factor, the system time runs correspondingly faster or slower.

### Scaling factor

Using a scaling factor, you can speed up or slow down the virtual clock of the simulated PLC instance for testing and debugging. Speeding up the virtual clock could be useful, for example, in testing time of day interrupt behavior. Slowing down the virtual clock can be useful, for example, when testing motion OBs without error conditions.



To set the scaling factor, select a virtual scaling factor from the dropdown list, or select Custom to enter a custom value. S7-PLCSIM displays the scaling factor next to the dropdown selector.

- The default is 1. The course of the virtual time corresponds to the course of real time.
- **Fast forward:** A scaling factor greater than 1 accelerates the virtual clock.  
Example: Scaling factor 2.0 → The virtual time is running twice as fast.
- **Slow motion:** A scaling factor less than 1 decelerates the virtual clock.  
Example: Scaling factor 0.5 → The progress of the virtual time slows down to 50%.

## 3.4 Cycle time settings

From the properties of your simulated PLC instance, you can adjust cycle times. The simulated PLC uses your configured cycle time settings.

From the Cycle Time Monitoring properties, you can configure the following settings:

- Use downloaded maximum cycle time
- Disable scan cycle monitoring
- Specify maximum cycle time in milliseconds

The downloaded maximum cycle time refers to the cycle monitoring time in the device configuration in STEP 7 for the PLC.

Note that the Windows operating system clock is not a real-time system clock. Windows cannot duplicate the precise behavior of a CPU's clock.

## 3.5 Communication modes

You can choose one of the following communication modes:




- S7-PLCSIM Softbus (internal only): This mode allows for local simulated communication.
- TCP/IP (single adapter): This mode allows for local communication to a physical communication network over a single network adapter. Only S7-PLCSIM Advanced simulation instances can use this mode.
- TCP/IP multi adapter: This mode allows for local and distributed communication to a physical communication network over one or more network adapters. Only S7-PLCSIM Advanced simulation instances can use this mode.

The mode you select applies to all simulated PLC instances. All existing instances must be powered off to change the communication mode from S7-PLCSIM Softbus to a TCP/IP mode. If you set the mode to TCP/IP mode, you can only power on S7-PLCSIM Advanced instances.

## 3.6 Scan control

Pausing and running one scan at a time can be useful for debugging your program. You can set scan control features from the Live Instances tab of your workspace.

Scan control provides the following features:

	Pause the scan If the simulated PLC instance is in STOP mode, pausing the scan puts it in RUN mode and pauses the scan.
	Run a single scan when the scan is paused.
	Resume running the scan normally when the scan is paused.

Setting the simulated PLC instance to RUN mode causes the PLC scan to run normally.

## 3.7 Removing a simulated PLC instance

You can remove instances from S7-PLCSIM that are powered off:

1. From the instance view, click the Properties tab for a powered off instance.
2. From the Properties display, click the trash can icon next to the instance name.

# Working with SIM views


## 4.1 Introduction to SIM views

For each simulated PLC instance, you can use SIM views to interact with your simulated PLC and process values. SIM views provide the following features:

- SIM tables (Page 19) enable you to monitor and modify I/O points, memory values, and PLC tags.
- Event simulation (Page 23) enables you to simulate events and test your program's event interrupt OB code.

A workspace can contain one or multiple SIM views. Each SIM view can contain multiple SIM tables and event instances up to a total of 32 objects per view. You bind each SIM table to a specific simulated PLC instance. You can later change the binding of an existing SIM table to another simulated PLC instance.

### Adding SIM views

Click the  icon to open the SIM view editor. By default, S7-PLCSIM provides one SIM view in a tabbed display of SIM views. To create additional SIM views, click the "+" next to the last SIM view tab. To access the properties of a specific SIM view, click the SIM view tab and click Properties.

## 4.2 SIM tables

### 4.2.1 Creating and editing SIM tables

A SIM table can contain tags, I/O addresses, and memory addresses that you want to monitor and modify for a specific simulated PLC. SIM tables are similar to STEP 7 watch tables.

### Adding SIM tables to a SIM view

Within each view, you can add up to eight SIM tables. From the Library tab on the right side of S7-PLCSIM, click "+" next to "SIM Table" to create a table. From the Properties tab of the right side of S7-PLCSIM, you can configure these settings:

- PLC binding, Instance name  
The binding establishes that this table can monitor and modify tags and addresses for the simulated PLC instance that you selected.
- Views  
Here you select the columns you want for this SIM table:
  - Name
  - Address
  - Display Format
  - Monitor/Modify State
  - Consistent Modify
  - Comment
- Tag loading  
You can select and load any or all tags from the simulated PLC that correspond to these areas:
  - Input
  - Output
  - MemoryWhen you click the "Load Selected Tags" button, S7-PLCSIM loads these tags into your current SIM table.

### Adding tags and addresses directly to a SIM table

The SIM View has a Tags tab to assist with entering tags into a SIM table. To enter PLC tags or Data block tags into a SIM table, follow these steps:

1. Select the SIM table in the SIM view.
2. Select the Tags tab on the right side of S7-PLCSIM.
3. Select the instance name that corresponds to the PLC binding for the SIM table.
4. Select Area tags that you want to see:
  - Input
  - Output
  - Memory
  - DB

S7-PLCSIM displays the PLC tags and DB tags for your instance and area selection.

5. Click any tag to add it to the selected SIM table. If a tag name is truncated, hover over it to see the full name.

You can also enter memory or IO addresses as well as tag names into a SIM table row. If you have nested tag structures in STEP 7, you can only add tags up to the first level.

### Adding rows to a SIM table

Click the + sign at the bottom of a SIM table to add rows. S7-PLCSIM adds a row below the row that you have currently selected. If you have not selected a row or if you have selected multiple rows, S7-PLCSIM adds the new row at the bottom.

### Deleting rows from a SIM table

You can select rows and click the trash can symbol at the bottom of a SIM table to delete the rows that you selected.

### Editing SIM table rows

You can edit tag names, display formats, and comments for any row.

You can move rows up or down using the arrow keys at the bottom of the SIM table.

---

#### Note


Adding or deleting tags to a SIM table stops monitoring (Page 22) if the SIM table is monitoring. Editing actions such as deleting or moving rows also stops monitoring.

---

## 4.2.2 Monitoring and modifying values in a SIM table

You can continually monitor values and modify one or more values for up to three SIM tables simultaneously.

### Stopping monitoring of a SIM table

To stop monitoring a SIM table, click the  button

### Starting monitoring of a SIM table

To start monitoring a SIM table, click the  button. If you have stopped monitoring a SIM table or have powered off a simulated PLC instance, use this button to resume monitoring.

---

#### Note

##### Binding of a SIM table to a simulated PLC instance


Each SIM table is bound to a specific simulated PLC instance. You established this binding when you created the SIM table (Page 19). You might have stopped, started, or deleted simulated PLC instances since you created the SIM table. If the PLC name from the STEP 7 project appears in red in your SIM table, the table is not bound to a simulated PLC instance. Note that both former and past simulated PLC instances can exist for the same PLC name in STEP 7. Correct the binding in the SIM table properties to restore the binding of the table to the correct simulated PLC instance.

---

### Modifying values in a SIM table

To modify a single value in a SIM table, enter a value in the "Monitor/Modify State" cell that you want to modify. When you press Enter, S7-PLCSIM modifies the value for the current scan cycle.

To modify values for multiple tags or addresses, follow these steps:

1. Display the "Consistent Modify" column for your SIM table.
2. Select the "Consistent Modify" check box beside each value that you want to modify. Enter a modify value for each of the cells that you selected.
3. Click the  button to modify all selected values immediately.

If you are monitoring the SIM table, the SIM table continues to update values while you are modifying values.

You can hover over any name in the Name column to see the full name.

### SIM table behavior when you download a project from STEP 7

When you download a program from STEP 7, S7-PLCSIM displays in red any tags or addresses in your SIM table that are not in the project that you downloaded or that correspond to unsupported data types. For unsupported data types, you can use a watch table in STEP 7 for monitoring and modifying.

## Forced addresses

Forced values from STEP 7 supersede S7-PLCSIM operations. Be aware that forced values might alter the behavior of your simulation.

## 4.3 Event simulation

### 4.3.1 Event simulation overview


S7-PLCSIM enables you to create event instances for simulating the following events:

- Hardware interrupt (OB 4x)
- Diagnostic error interrupt (OB 82)
- Pull or plug of module (OB 83)
- Rack or station failure (OB 86)

S7-PLCSIM responds to event triggers in the same way a physical CPU would respond. When an event trigger occurs, the STEP 7 program executes the OBs that correspond to the events. STEP 7 updates the diagnostic status of the CPU, and the new status is visible in both S7-PLCSIM and in STEP 7.

### 4.3.2 Configuring events

To create a new event, follow these steps:

1. From the left side of the PLCSIM user interface, click the  icon to open the SIM views.
2. Select an existing SIM view or create a new SIM view.
3. From the Library tab on the right side of PLCSIM, click "+" next to "Event" to create an event instance.
4. From the Properties tab on the right side of PLCSIM, you can configure these settings:
  - Event name
  - PLC Binding - Instance name of the simulated PLC instance for this event
  - Event category - which of the four event categories (Page 23)
  - Event configuration: Module logical address (LADDR) - logical address of the module from the module's device configuration, which is the LADDR parameter (Page 24) for the event interrupt OB

### 4.3.3 Configuring LADDR

Every event type that S7-PLCSIM supports requires a module logical address (LADDR) parameter. Configuring LADDR is the same for all event types.

#### Configuring the LADDR parameter

The LADDR parameter is a 16-bit unsigned decimal integer.

In the configuration of your event, select or enter the module logical address (LADDR) for your device. The integer corresponds to the device's Hardware Identifier in STEP 7. In STEP 7, you can find the Hardware Identifier in the System Constants of the Properties in the Device Configuration.

When you rename racks, stations, or modules in TIA Portal and then download, you see updated device names in the LADDR parameter.

### 4.3.4 Simulating a pull or plug of modules event

Add a pull or plug of modules event (OB 83) and configure the common event parameters. (Page 23)

#### Cause

Configure the Cause parameter in the event properties as one of the following:

- IO module removed
- IO submodule removed
- IO submodule plugged in
- Wrong IO submodule plugged in
- IO submodule plugged in with error

### 4.3.5 Simulating a rack or station failure event

Add a rack or station failure (OB 86) event and configure the common event parameters. (Page 23)

#### Cause

Configure the Cause from one of the following drop-down menu selections:

- Rack or station error resolved
- Rack or station error occurred



### 4.3.6 Simulating a hardware interrupt event

Add a hardware interrupt event (OB 4x) and configure the common event parameters.  
(Page 23)

#### Channel

Channel corresponds to the IChannel parameter in STEP 7 for the module that triggers the hardware interrupt. From the event instance in the SIM view, click the Channel to select one of the following for Cause:

- Rising edge
- Falling edge
- Limit 1 Overrun
- Limit 1 Underrun
- Limit 2 Overrun
- Limit 2 Underrun

### 4.3.7 Simulating a diagnostic error interrupt event

Add a diagnostic error interrupt event (OB 82) and configure the common event parameters.  
(Page 23)

#### IO State

To configure the IO State parameter, select one or more of the following from the drop-down menu:

- Good
- Maintenance required
- Maintenance demanded
- Error

If you select "Good" for the IO State, then you are simulating the event with no errors. If you do not select "Good", you can select any, or all, of the other IO states.

## Channel

The Channel corresponds to the Channel parameter in STEP 7 for the module that triggers the diagnostic error hardware interrupt. For each event instance in S7-PLCSIM you can add up to four channels. If you need more channels, configure additional diagnostic error interrupt events for the additional channels.


To add a channel, click the + sign in the event instance. Click the channel to configure its properties:

- Channel number: channel number from 0 to 63
- Error Type: Limitoverrun or Wirebreak
- Severity: MaintenanceRequired or MaintenanceDemanded
- Direction: Incoming or Outgoing

## Deleting channels

You can delete channels by selecting the channel from the event instance and clicking the trash can icon.

### 4.3.8 Triggering events

To trigger an event, click the trigger symbol  for the event instance. When you trigger an event, the STEP 7 program calls the OB associated with the event for the event type (IO state).

# Simulating motion control

## 5.1 Motion control overview

S7-PLCSIM supports downloading STEP 7 projects that contain motion control elements.

---

**Note****S7-1200 motion control projects**

S7-PLCSIM does not support motion control for S7-1200 CPUs.

---

### Technology modules and simulation

S7-PLCSIM simulates a real CPU, but not configured, connected technology modules or other I/O devices.

It is possible to download a project with technology modules for operation of motion control. However, the built-in logic of the technology modules is not part of the simulation. Therefore, S7-PLCSIM cannot simulate the associated motion control instructions.

### Motion control simulation limitations

In general, your simulation results might be limited if any of the following are true:

- Your project uses very short cycle times
- Your project has a hardware configuration with a large number of devices
- Your project uses a large number of technology objects

The behavior of your simulation also depends on the type of technology object(s) you use.

## 5.2 Simulations and homing mode

With a real CPU, homing is set directly and the state reference is set correspondingly. The hardware inputs are not evaluated in simulation.

## 5.3 Isochronous mode not possible error

When simulating motion control, you might receive an error message that isochronous mode is not possible.

### Example scenario

The TO OutputCam is configured with TM Timer DIDQ in a distributed ET 200SP high feature interface module.

### Observation

When TO is activated with MC-OutputCamEnable, Alarm Number 113 displays a message that isochronous mode is not possible.

### Cause

The configured output for the cam or cam track technology object or the input for the technology object measuring input cannot be used in isochronous mode.

### Solution

To avoid the error, make these configuration changes in the STEP 7 project:

- Configure the I/O in the device configuration as isochronous I/O.
- Make sure that the organization block MC\_Servo [OB91] is called synchronously with the bus system.

## 5.4 Motion OB overruns

An overload occurs when events that originate from the same source occur faster than they can be processed. S7-PLCSIM does not process motion OB overruns.

## 5.5 Simulation deactivates MC-PreServo and MC-PostServo

S7-PLCSIM does not simulate the operations of the motion OBs MC-PreServo and MC-PostServo for Standard simulated PLC instances.

## 5.6 Technology objects not loaded

If your motion project contains too many technology objects, your motion program might not download to S7-PLCSIM.

## 5.7 Upgraded projects containing MC-Servo (OB91) and MC-Interpolator (OB92) blocks

You cannot load a motion control project that contains the blocks MC-Servo (OB91) and MC-Interpolator (OB92) to S7-PLCSIM.

To enable simulation, delete these blocks and then recompile your project. When you recompile, the properties of blocks OB91 and OB92 reset to the default values. You can then load your motion control project to S7-PLCSIM.

## 5.8 Maximum of 5,120 motion control resources

There are motion control resources on each CPU that can be distributed to the technology objects. S7-PLCSIM supports a maximum of 5,120 motion control resources.

### Exceeding the quantity structure

When you load a project into a CPU, STEP 7 checks whether the quantity structure for a configured CPU is correct. An alert message displays if the quantity structure is exceeded.

A project that uses more than 5,120 motion control resources can be downloaded to a virtual controller. However, there is no message indicating that the quantity structure has been exceeded.

After your program accesses the technology objects, you can observe the following indications if the quantity structure has been exceeded:

- An error message at the block
- A value of zero for the object

## 5.9 High Speed Counter

S7-PLCSIM does not support simulation for the High\_Speed\_Counter technology object for S7-1500 compact CPUs.

## 5.10 Wait after going to RUN mode to access motion control technology objects

The simulated PLC processes motion control commands more slowly than a physical PLC. Because of this difference in processing time, you might encounter an "error" or "busy" state if you attempt to access motion control objects too quickly after going to RUN mode. This is because the objects might not have finished processing completely.

To avoid this situation, wait to access motion control objects after you put the PLC in RUN mode.

## 5.11 High-Speed Counter functionality for S7-1500C (compact) PLCs

S7-PLCSIM supports simulation for the S7-1500 compact controllers (S7-15xxC).

However, it is not possible to simulate the onboard high-speed counters (HSC) or pulse generators (PTO/PWM). Programs that rely on this functionality might not behave realistically during simulation.

## 5.12 TO\_PositioningAxis

With the TO\_PositioningAxis technology object, the simulated drive provides feedback regarding position functions to S7-PLCSIM.

### Axis position feedback

The setpoint (position) is integrated with a certain time delay (PT1 element). The result of this calculation is fed back to the TO\_PositioningAxis object as the actual position of the axis.

### Homing axis

If you have selected the homing mode "Use zero mark via PROFIdrive telegram" in STEP 7, S7-PLCSIM responds immediately to every active (Mode 2, 3, 8) or passive (Mode 4, 5) homing command (MC\_Home) with the actual position being set as the home position.

### Simulation restrictions

- S7-PLCSIM does not simulate an analog positioning axis.
- With Dynamic Servo Control (DSC) telegram 5, you might need to adjust the STEP 7 settings under "Control loop: Precontrol and velocity gain (Kv factor)" and/or under "Positioning monitoring > Following error" to obtain meaningful simulation behavior. Adjust these settings incrementally until your simulation responds as expected.

## 5.13 TO\_ExternalEncoder

With the TO\_ExternalEncoder technology object, the simulated external encoder provides static/fixed position feedback, which is set by homing commands, to S7-PLCSIM.

### Homing

Active homing is not possible with the TO\_ExternalEncoder object.

If you have selected the passive homing mode "Use zero mark via PROFIdrive telegram" in STEP 7, S7-PLCSIM responds immediately to every passive (Mode 4, 5) homing command (MC\_Home) with the actual position being set as the home position.

## Error conditions and limitations

### 6.1 S7-1200 Fail-Safe simulation

To use S7-PLCSIM to simulate an S7-1200 Fail-Safe CPU, you must use a safety system version that is compatible with the CPU firmware version:

S7-1200 Fail-safe CPU firmware version	System Safety version
V4.2 or below	V2.1 or below
V4.3 or above	Any version

To modify the system safety version, follow these steps in STEP 7:

1. Open the Safety Administration dialog for the CPU.
2. Click "Settings" and select an appropriate system safety version from the drop-down list.

### 6.2 Value status defaults

The default value status differs between Fail-safe I/O devices and non-Fail-safe (standard) I/O devices as follows:

- Fail-safe I/O device value status defaults to "1", ON, or TRUE
- Standard I/O device value status defaults to "0", OFF, or FALSE

You can modify the reported value status by using SIM tables and sequences.

### 6.3 Processor requirements for S7-PLCSIM

Because you run S7-PLCSIM and TIA Portal together, your programming device requires a more powerful processor than if you were running either application alone. For acceptable performance, your programming device needs a quad core processor that is equal to, or better than, an Intel® Core™ i5-6440EQ processor, up to 3.40 GHz.

### 6.4 High feature module support

For physical CPUs, high feature (HF) modules can provide advanced functions for additional requirements.

S7-PLCSIM does not support simulation of any of these advanced functions. For example, high feature power modules do not provide additional retentive memory for simulations.

## 6.5 HMI type-safe array element display

HMI tags for type-safe array elements might display as "####". This display can be avoided in one of the following ways:

- Do not use arrays in HMI tags. Use single elements only.
- Adjust the maximum acquisition time of the HMI tag to a higher value (such as 10 seconds) to allow the tag to display correctly.

## 6.6 Saving S7-1500 retentive data block (DB) values

Retentive data block values for an S7-1500 PLC might not be saved unless you power off the PLC before you save the workspace.

S7-1200 projects do not experience this behavior.

## 6.7 Yellow coloring for fail-safe I/O

S7-PLCSIM does not display I/O addresses for fail-safe devices with yellow coloring or indicate F-CPU's with yellow coloring.

## 6.8 Scan cycle overflow

The S7-PLCSIM cyclic event queue can overflow when your simulation contains cyclic interrupts. Due to the speed of S7-PLCSIM in relation to the speed of actual hardware, your simulation might not be able to process cyclic OBs within the cycle time you specified.

If the main scan cycle overflows, follow these steps:

1. Select the properties for the simulated PLC instance.
2. From the "Cycle time" options, take one of the following actions:
  - Select "Disable scan cycle monitoring".
  - Select "Specify maximum cycle time" and then increase the value in the "Max Cycle Time" box.

If a cyclic interrupt OB overflows, increase the cyclic time for the OB in STEP 7 and download the PLC from STEP 7.

## 6.9 Incompatible diagnostic status for simulated S7-1500 PLCs with firmware version 1.8

When you simulate an S7-1500 PLC with firmware version 1.8, S7-PLCSIM might display the diagnostic status "Incompatible". You can ignore this status message because your simulation will function normally.



## 6.10 Simulating HMI connections

When you simulate HMI connections, the simulated HMI firmware version must be 14.0.0.0 or higher.

## 6.11 HMI Accessible tags

STEP 7 sets tags to "Accessible from HMI" by default. In the following example, a user has removed HMI accessibility for the tags "Static\_3" and "Static\_4":

Data_block_1					
	Name	Data type	Start value	Retain	Accessible from HMI/OPC UA
1	▼ Static			<input type="checkbox"/>	<input type="checkbox"/>
2	Static_1	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	Static_2	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	Static_3	Bool	false	<input type="checkbox"/>	<input type="checkbox"/>
5	Static_4	Bool	false	<input type="checkbox"/>	<input type="checkbox"/>
6	Static_5	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7	Static_6	Bool	false	<input type="checkbox"/>	<input checked="" type="checkbox"/>

After you download from STEP 7 to S7-PLCSIM, the tags "Static\_3" and "Static\_4" are not available in S7-PLCSIM. To work with these tags in S7-PLCSIM, you must select HMI accessibility for the tags in STEP 7 and download the changes to S7-PLCSIM.

## 6.12 Compile error after attempting to download to S7-PLCSIM

When you attempt to download a STEP 7 program to S7-PLCSIM, you might receive an error that the user program was not compiled and that you should compile the program again.

You might encounter this scenario under one of these conditions:

- When you simulate a program that was uploaded from a physical PLC
- When you simulate a program that was copied and pasted into your project

This error is related to automatically generated program blocks such as MC-Servo and MC-Interpolator OBs in motion control programs.

To resolve the error, delete the automatically generated blocks and then compile the program again by using the command "Compile > Software (rebuild all blocks)". This command will correctly recreate and compile the blocks for use in S7-PLCSIM. However, before deleting the blocks, check the settings in your OBs.

Be aware that this error is not limited to motion control. Any program that contains automatically generated blocks might experience the issue. After you remove the automatically generated blocks, your program should compile and download to S7-PLCSIM without further error.

## 6.13 Simulating communication with an HMI and multiple PLCs

If you want to simulate multiple PLCs with an HMI, you might encounter unexpected connection behavior due to the way S7-PLCSIM simulates communication.

You can prevent the problem by starting all PLC simulations before launching your HMI.

---

### Note

If you have started your HMI before starting all PLC simulations and then notice unexpected behavior, close and restart the HMI while the PLC simulations remain active.

---

## 6.14 Simulating fail-safe programs

Because of differences in cycle times between the simulated PLC and a physical PLC, your fail-safe program might go to STOP unexpectedly.

To correct the situation, increase the F parameter value in STEP 7 by following these steps:

1. From the Device configuration for the F-CPU, go to "Fail-safe > F parameters" and set the "Default F monitoring time for central F I/O" to its maximum allowable time (65535 ms).
2. Download from STEP 7 and then run your simulation again.

## 6.15 Use STEP 7 safety system library V1.3 or later for Fail-Safe I/O

To successfully simulate and debug a project that contains Fail-Safe I/O, your STEP 7 project must use safety system library V1.3 or later. If your project uses an older version of this system library, your Fail-Safe I/O simulation will not function correctly.

## 6.16 Working with global libraries

If your STEP 7 project uses a library, you must compile both hardware and software before performing a download to S7-PLCSIM. If you perform only a partial compile, your download will fail.

## 6.17 Incorrect RET\_VAL parameter values for S7-1500 EN\_AIRT and DIS\_AIRT instructions that are called from multiple OBs

The extended interrupt instructions EN\_AIRT and DIS\_AIRT function correctly for S7-1500 projects if they are called from the same OB.

These instructions do not function correctly if they are called from more than one OB. If they are called from more than one OB, the RET\_VAL parameter value might not be correct.

## 6.18 HMI password protection levels and simulation

You cannot configure a PLC protection password in your HMI and then download to S7-PLCSIM.

If you attempt to run a simulation with protection levels set, the HMI receives an error and is unable to connect to S7-PLCSIM. S7-PLCSIM does not check protection levels, and therefore indicates that no password is set.

If you have already set protection levels for your PLC, you must remove them before running a simulation. After you are finished with your simulation, you can restore your protection levels.

## 6.19 STEP 7 online & diagnostics functions

Some online & diagnostics functions do not serve a useful purpose for simulation. Using them might cause unexpected behavior in S7-PLCSIM. These include:

- Assign IP address
- Format memory card
- Assign name
- Update firmware

## 6.20 Simulation during standby mode

Simulation might stop when your computer or programming device enters "standby" or "sleep" mode. If this happens, communication between STEP 7 and S7-PLCSIM is suspended.

When your programming device becomes active again, it might be necessary to reestablish communication, or in some cases, to restart S7-PLCSIM.

To prevent this situation, disable standby mode for your programming device.

## 6.21 Working with automatically synchronized network drives

If you store a STEP 7 project that is automatically synchronized on a network drive or in a cloud directory (with Dropbox, Syncplicity or Google Drive, for example), this can lead to data loss if the synchronization takes place only partially or asynchronously. Therefore, storing and editing projects directly on synchronized network drives or cloud directories is not recommended.

If you must use synchronization, make sure that it is implemented in such a way that the current (local) project data replaces the project data on the network drive or in the cloud directory.

Always close your projects before synchronization, and then make sure that all project directory files are synchronized together and completely.

## 6.22 Decimal place character

Do not enter commas, for example, "1,23", to indicate decimal places.

Use the international format with a period as the decimal place, for example, "1.23".

## 6.23 Modbus V5.2 not supported

S7-PLCSIM does not support Modbus V5.2, but does support other versions of Modbus.

## 6.24 Error returned by High\_Speed\_Counter instruction

If you use S7-PLCSIM to simulate a high-speed counter in a TM Count module, the High\_Speed\_Counter instruction returns the error 16#80C7.

The High\_Speed\_Counter instruction expects that the module has set a status ready (STS\_READY) bit. Because S7-PLCSIM does not simulate module behavior, the instruction returns an error.

The STS\_READY bit is in the input area of the module at offset 13.4. If the input area of your TM Count module begins at %I32, for example, then the STS\_READY bit is at %I45.4.

You can set the STS\_READY bit to avoid the error condition that the High\_Speed\_Counter instruction returns.

### Setting STS\_READY from a SIM table

Consider an example using an S7-1500 with a TM Count 1x24V module where the TM Count 1x24V begins at %I.0. Note that you can find this address in the device configuration for your technology module.

To set the STS\_READY bit for the module to TRUE, enter the corresponding I address for offset 13.4 in your SIM table. Set the modify value to TRUE.

## 6.25 T\_CONFIG instruction

The T\_CONFIG instruction performs no action in S7-PLCSIM.

## **6.26 Simulating the Drive controller**

S7-PLCSIM simulates only the standard CPU functionality of the SIMATIC Drive Controller.

S7-PLCSIM does not simulate the following:

- Technology functions of the onboard I/O
- SINAMICS Integrated
- PROFINET IO
- PROFIBUS DP

You can only simulate the integrated inputs/outputs of the X122, X132, and X142 interfaces as binary inputs/outputs.

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