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S7-PLCSIM V5.3 incl. SP1

User Manual

Edition: 01/2005

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Indicates a potentially hazardous situation that, if not avoided, could result in death or severe injury.

Caution
Used with the safety alert symbol indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.

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Note the following:

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Preface

S7-PLCSIM allows you to simulate the operation of an S7 programmable logic controller. You can test control programs from S7-PLCSIM without connecting to S7 hardware. S7-PLCSIM provides a graphical user interface for viewing and modifying control program variables, running the simulated PLC in single or continuous scan mode, and changing the operating mode of the simulated controller.

Audience

This manual is intended for engineers, programmers, and maintenance personnel who have knowledge and experience with S7 programmable logic controllers and STEP 7 programming.

Scope

This document describes the features and the operation of S7-PLCSIM V5.3 incl. SP1.

Other Manuals

You can find additional information in the online help for STEP 7 and in the following manuals:

- *Programming with STEP 7 Manual*. This manual provides basic information on designing and programming control programs. Use this manual when creating a control program with the STEP 7 automation software.

- *System Software for S7-300/400 System and Standard Functions Reference Manual*. This manual provides you with descriptions of the system functions, organization blocks, and standard functions that you use when developing a control program.

- *Working with STEP 7 Getting Started Manual*. This manual explains how to use the STEP 7 automation software. This manual provides you with an overview of the procedures used to configure a PLC and to develop control programs.

To find these and other manuals, select the **Start > Simatic > Documentation** menu command from the Start menu of the computer where STEP 7 is installed.

Additional Assistance

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Product Overview

The S7-PLCSIM software enables you to run and test your program on a simulated programmable logic controller (PLC) that exists on your computer or programming device (such as a PG 740, Power PG or Field PG). Because the simulation exists completely within the STEP 7 software, you do not need to be connected to any S7 hardware (CPU or I/O modules).

With the simulated S7 PLC, you can test and debug programs for S7-300, S7-400, and WinAC 3.x controllers. S7-PLCSIM does not support the hardware configuration for WinAC 4.x controllers; however, you can test your WinAC 4.x control program logic if you modify your hardware configuration to use an S7-300, S7-400, or WinAC 3.x controller.

S7-PLCSIM provides a simple interface for monitoring and modifying different parameters used by the program (such as for turning inputs on and off). You can also use the various applications of the STEP 7 software while you are running your program on the simulated PLC. This allows you to use such tools as the variable table (VAT) to monitor and modify variables.

S7-PLCSIM Features

S7-PLCSIM simulates an S7 controller and contains the following memory areas:

Memory Area	Description
Timers	T 0 to T 2047
Memory bits	131,072 bits (16 Kbytes) of M memory
Total addressable I/O memory	131,072 bits (16 Kbytes) of I/O memory
Process image (setable; updated every scan)	Maximum: 131,072 bits (16 Kbytes) Preset: 8192 bits (1024 bytes)
Local data (setable)	Maximum: 64 Kbytes Preset: 32 Kbytes
Logic blocks and data blocks	2048 function blocks (FBs) and functions (FCs) 4095 data blocks (DBs)
System function blocks (SFBs)	SFB0, SFB1, SFB2, SFB3, SFB4, SFB5, SFB8, SFB9, SFB12, SFB13, SFB14, SFB15, SFB16, SFB19, SFB20, SFB21, SFB22, SFB23, SFB32, SFB33, SFB34, SFB35, SFB36, SFB37, SFB41, SFB42, SFB43, SFB44, SFB46, SFB47, SFB48, SFB49, SFB52, SFB53, SFB54, SFB60, SFB61, SFB62, SFB63, SFB64, and SFB65 Note that SFB12, SFB13, SFB14, SFB15, SFB16, SFB19, SFB20, SFB21, SFB22, SFB23, SFB41, SFB42, SFB43, SFB44, SFB46, SFB47, SFB48, SFB49, SFB60, SFB61, SFB62, SFB63, SFB64, and SFB65 are NOPs (do not perform any operation). You do not need to modify a program that calls a NOP.

System functions (SFCs)	SFC0, SFC1, SFC2, SFC3, SFC4, SFC5, SFC6, SFC7, SFC8, SFC9, SFC10, SFC11, SFC12, SFC13, SFC14, SFC15, SFC17, SFC18, SFC19, SFC20, SFC21, SFC22, SFC23, SFC24, SFC25, SFC26, SFC27, SFC28, SFC29, SFC30, SFC31, SFC32, SFC33, SFC34, SFC35, SFC36, SFC37, SFC38, SFC39, SFC40, SFC41, SFC42, SFC43, SFC44, SFC46, SFC47, SFC48, SFC49, SFC50, SFC51, SFC52, SFC54, SFC55, SFC56, SFC57, SFC58, SFC59, SFC60, SFC61, SFC62, SFC64, SFC65, SFC66, SFC67, SFC68, SFC69, SFC72, SFC73, SFC74, SFC79, SFC80, SFC81, SFC82, SFC83, SFC84, SFC87, SFC90, SFC102, SFC103, SFC105, SFC106, SFC107, SFC108, SFC126, and SFC127
	For SFC26 and SFC27, S7-PLCSIM supports only an input parameter of 0.
	Note that SFC7, SFC11, SFC12, SFC25, SFC35, SFC36, SFC37, SFC38, SFC48, SFC60, SFC61, SFC62, SFC65, SFC66, SFC67, SFC68, SFC69, SFC72, SFC73, SFC74, SFC81, SFC82, SFC83, SFC84, SFC87, SFC102, SFC103, SFC105, SFC106, SFC107, SFC108, SFC126, and SFC127 are NOPs (do not perform any operation). You do not need to modify a program that calls a NOP.
Organization blocks (OBs)	OB1 (free cycle)	OB10 to OB17 (time-of-day interrupt)
	OB20 to OB23 (time-delay interrupt)	OB30 to OB38 (cyclic interrupt)
	OB40 to OB47 (hardware interrupt)	OB55 (status interrupt)
	OB56 (update interrupt)	OB57 (manufacturer specific interrupt)
	OB61 to OB64 (synchronous cycle interrupt)	OB70 (I/O redundancy error)
		OB73 (communication error)
	OB72 (CPU redundancy error)	OB81 (power supply error)
	OB80 (time error)	OB83 (insert/remove interrupt)
	OB82 (diagnostic interrupt)	OB85 (priority class error)
	OB84 (CPU hardware fault)	OB87 (communication error)
	OB86 (rack failure)	OB90 (background OB)
	OB88 (processing interrupt)	OB101 (hot restart)
	OB100 (warm restart)	OB121 (programming error)
	OB102 (cold restart)	
	OB122 (I/O access error)	
	Note that OB55, OB56, OB57, OB61, OB62, OB63, OB64, OB81, OB84, OB87, OB88, and OB90 are NOPs (do not perform any operation). You do not need to modify a program that calls a NOP.	

In addition, S7-PLCSIM provides the following features:

- A button on the SIMATIC Manager turns the simulation on or off. Clicking on the simulation button opens the S7-PLCSIM software with its simulated CPU. When S7-PLCSIM is running, any new connection goes automatically to the simulated CPU.

- The simulated PLC runs programs intended for S7-300 or S7-400 CPUs, including the CPU 317-T.

- You can create view objects that allow you to access the input and output memory areas, accumulators, and registers of the simulated PLC. You can also access memory through symbolic addressing.

- You can choose to have the timers run automatically or set and reset them manually. You can reset timers individually or all at once.

- You can change the CPU operating mode (STOP, RUN, and RUN-P) as with a real CPU. In addition, S7-PLCSIM provides a Pause feature that allows you to halt the CPU momentarily without affecting the state of the program.

- You can use interrupt OBs with the simulated PLC to test the behavior of your program.

- You can record a series of events (manipulate input and output memory areas, bit memory, timers and counters) and play back your recording in order to automate program tests.

You can use all of the STEP 7 tools to monitor and modify the activities of the simulated PLC, and to debug your program. Although the simulated PLC exists entirely in software (requiring no special hardware), STEP 7 works as if the simulated PLC were an S7 PLC, with few differences.

Getting Started

If you are new to S7-PLCSIM, the following procedures will help you get started. Simulation mode is available from the SIMATIC Manager, provided you don't have any existing connections to real PLCs. To begin using S7-PLCSIM, follow these steps:

1. Open the SIMATIC Manager.

2. Click ⬛ or select the menu command **Options > Simulate Modules**. This action starts the S7-PLCSIM application and opens a CPU view object (with the default MPI address of 2).

3. From the SIMATIC Manager, navigate to the S7_ZEBRA example project. This project is supplied with the STEP 7 software, V 5.x and higher (project file name ZEN01_09_STEP7_Zebra).

4. Within the S7_ZEBRA example project, navigate to the "Blocks" object. (See the SIMATIC Manager online Help for an overview of STEP 7 objects.)

5. From the SIMATIC Manager, click ⬛ or select the menu command **PLC > Download** to download the "Blocks" object to the simulated PLC.

6. At the prompt, "Do you want to load the system data?", choose No if you do not want to download a hardware configuration to the simulated PLC, or Yes in order to download a hardware configuration (for instance, in order to use clock memory).

7. From the S7-PLCSIM application, create additional "view objects" for monitoring information from the simulated PLC:

    *   Click ⬛ or select the menu command **Insert > Input Variable**. The view object displays **IB0** (Input Byte 0).

    *   Click ⬛ or select the menu command **Insert > Output Variable** to insert a second view object, **QB0** (Output Byte 0).

    *   Click ⬛ or select the menu command **Insert > Timer** three times to insert three Timer view objects. Type **2**, **3**, and **4** (for Timers T 2, T 3, and T 4) in their respective text boxes, pressing the Enter key after each entry.

8. Select the **PLC** menu in S7-PLCSIM and verify that there is a bullet (•) beside **Power On**.

9. Select the **Execute > Scan Mode** menu command and verify that there is a bullet (•) beside **Continuous Scan**.

10. Put the simulated CPU in RUN mode by clicking either the RUN or RUN-P check box.

11. Click bit 0 of IB0, to simulate turning on input 0.0, and watch the effect on the timers and on QB0.

12. Click ⬛ or select the menu command **File > Save PLC As...** to save the current state of the simulated PLC as a new file.

Using STEP 7 to Monitor Program Simulation

You can also use the STEP 7 tools to monitor the simulation of your program, as follows:

1. When you have created the view objects (step 7, above), go to the SIMATIC Manager.

2. Click ⬛ or select **View > Online** to switch to online mode.

3. Navigate to the "Blocks" object in the ZEBRA example project, and open FC1. This action invokes the "LAD/STL/FBD" application.

4. When the simulated CPU is in RUN mode and you have turned on bit 0 of IB0 (step 11, above), go to the "LAD/STL/FBD" application window and select **Debug > Monitor** to see the effect of these changes on the program.

Differences from a Real S7 PLC

The simulated PLC provides the following features, which are not available in a real PLC:

- The Pause command halts the simulated CPU and allows you to resume the execution of the program at the instruction where the program was halted.

- You can change the operating mode (RUN, RUN-P, and STOP) as you do with a real CPU. Unlike with a real CPU, however, putting the simulated CPU in STOP mode does not change the state of the outputs.

- Any change that you make with a view object immediately updates the contents of the memory location. The CPU does not wait until the beginning or end of the scan to update any changed data.

- Execution control options allow you to select how the CPU runs the program:

  o Single Scan executes the program for one scan and then waits for you to start the next scan.

  o Continuous Scan executes the program like a real PLC: it starts a new scan immediately after the previous one finishes.

- You can allow the timers to run automatically, or you can enter timer values manually. You can also reset timers globally or individually.

- You can manually trigger the interrupt OBs: OB40 to OB47 (hardware interrupt), OB70 (I/O redundancy error), OB72 (CPU redundancy error), OB73 (communication redundancy error), OB80 (time error), OB82 (diagnostic interrupt), OB83 (insert/remove module), OB85 (program sequence error), and OB86 (rack failure).

- Process image and peripheral memory: When you make a change to a process input value in a view object, S7-PLCSIM copies it immediately to peripheral memory. This way, when the peripheral input value is written to the process image register at the beginning of the next scan, the desired change is not lost. Correspondingly, when you make a change to a process output value, it is copied immediately to peripheral output memory. The following diagram illustrates the order of activities in the scan cycle:
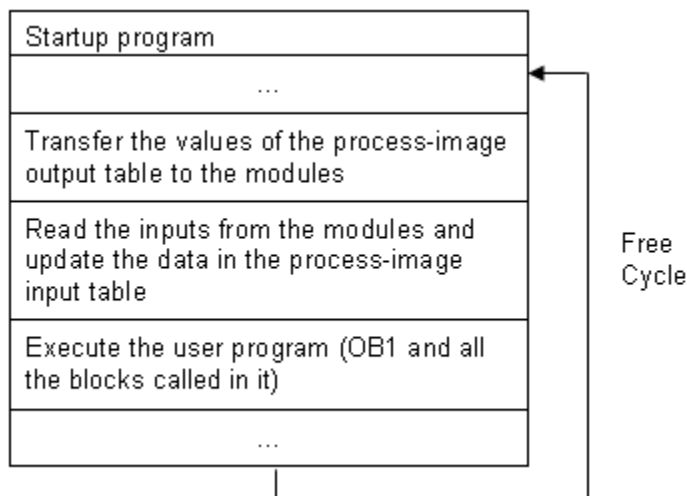
S7-PLCSIM also differs from a real PLC in the following ways:

- Diagnostic buffers: S7-PLCSIM does not support all of the error messages written to the diagnostic buffer. For instance, bad batteries in the CPU or EEPROM errors cannot be simulated. However, most I/O and program errors can be simulated.

- A transition in operating mode (such as from RUN to STOP) does not change the I/O to a "safe" state.

- Function modules (FMs) are not supported.

- Peer-to-peer communication (such as between two S7-400 CPUs in the same rack) is not supported.

- S7-PLCSIM supports four accumulators like an S7-400 CPU does. For certain special cases, a program running on S7-PLCSIM with four accumulators can have different behavior from the same program running on an S7-300 CPU, which uses only two accumulators.

- S7-PLCSIM does not support forcing variables.

Differences with I/O

Most of the CPUs in the S7-300 family autoconfigure I/O: once a module has been inserted into a physical controller, it is automatically recognized by the CPU. It is not possible to replicate the autoconfiguration feature with a simulated PLC. If you download a program to S7-PLCSIM from an S7-300 CPU that autoconfigures I/O, the system data does not include an I/O configuration. Consequently, when you use S7-PLCSIM with S7-300 programs, if you want to define which modules are supposed to be available to the CPU, you must first download a hardware configuration.

To download a hardware configuration to S7-PLCSIM, you can create a project for one of the S7-300 CPUs that does not autoconfigure I/O, such as the CPU 315-2DP, CPU 316-2DP, or CPU 318-2. Put a copy of your hardware configuration into this project and download the hardware configuration to S7-PLCSIM. Once you have done this, you can download program blocks from any of your S7 projects and the I/O will be handled correctly.

S7-PLCSIM Simulation View Window

The simulation view window of S7-PLCSIM includes the workspace, title bar, status bar, window controls, and S7-PLCSIM menus and toolbars.

The S7-PLCSIM workspace is where you display different types of view objects to monitor and modify data in the simulated PLC.

To open the simulated PLC, click on the Simulation On/Off button on the toolbar (menu command **Options > Simulate Modules**) in the SIMATIC Manager. S7-PLCSIM starts and loads a CPU view object for your simulated PLC.

You can also create a new simulated PLC, or open one that you have previously saved.

- To create a new PLC for simulation, select the menu command **File > New PLC**.

- To open a previously saved PLC, select the menu command **File > Open PLC**.

To get familiar with S7-PLCSIM, use the procedures described in Getting Started.

CPU Operating Modes

RUN-P mode

The CPU runs the program, and you can change the program and its parameters. In order to use the STEP 7 tools for modifying any of the parameters of the program while the program is running, you must put the CPU in RUN-P mode. You can use the view objects created within S7-PLCSIM to modify any data used by the program.

RUN mode

The CPU runs the program by reading the inputs, executing the program, and then updating the outputs. By default, you cannot download any program or use the STEP 7 tools to change any parameters (such as input values) when the CPU is in RUN mode. If you have configured CiR (Configuration in Run) elements in your STEP 7 project, however, you can download the CiR objects in RUN mode. With the simulated CPU in RUN mode, you can use the view objects created within S7-PLCSIM to modify any data used by the program.

STOP mode

The CPU does not run the program. Unlike STOP mode for real CPUs, the outputs are not set to predefined ("safe") values but remain at the state they were in when the CPU changed to STOP mode. You can download programs to the CPU while the CPU is in STOP mode. Changing from STOP mode to RUN mode starts execution of the program from the first instruction.

The CPU operating modes, the CPU indicators, and the Memory Clear/Reset button are all displayed on the CPU view object. You can set the CPU operating mode with the Key Switch Position command. You can pause execution of the simulated PLC program when the CPU is in RUN or RUN-P mode.

CPU Indicators

The CPU view object provides a set of indicators that correspond to the LED indicators on a real CPU:

- **SF** (system fault) alerts you that the CPU encountered a system error, causing a change in the operating mode.

- **DP** (distributed peripherals, or remote I/O) indicates the status of communication with distributed (remote) I/O.

- **DC** (power supply) indicates whether power to the CPU is on or off.

- **RUN** indicates that the CPU is in RUN mode.

- **STOP** indicates that the CPU is in STOP mode.

Memory Areas

You access data in the S7 PLC by addressing specific areas of memory. These areas perform specific functions:

- **PI** (peripheral input): provides direct access to the input modules.

- **I** (input): provides access to the process image of the peripheral inputs. These values are updated by the CPU at the beginning of every CPU scan cycle.

- **PQ** (peripheral output): provides direct access to the output modules. These values are updated by the CPU at the end of every CPU scan cycle.

- **Q** (output): provides access to the process image of the outputs.

- **M** (bit memory): provides storage for data used within the program.

- **T** (timer): provides storage for timers.

- **C** (counter): provides storage for counters.

You can also access data in the data blocks (DBs).

Simulation Tasks

Starting the Simulation

You can use one of the following methods to start S7-PLCSIM:

- From the Windows Start menu, select the menu command **Simatic > STEP 7 > S7-PLCSIM Simulating Modules**.

- From the SIMATIC Manager toolbar, click the Simulation On/Off button or select the **Options > Simulate Modules** menu command.

When the Simulation On/Off button is turned on in the Simatic Manager, any new connection goes automatically to the simulated PLC. Any program that you download goes to the simulated PLC if the MPI address of the simulated PLC matches that of the STEP 7 project containing the program. If you click the Accessible Nodes button, the Accessible Nodes window shows the node address for the simulated PLC that you have created.

When the simulation button is turned off , any new connection goes to the real PLC. If you click the Accessible Nodes button, the Accessible Nodes window shows the network of real PLCs.

After you start S7-PLCSIM, you can open a simulated PLC or monitor the simulated program. You can continue PLC simulation until you end the simulation session.

Notes

Simulation mode is not available if you have any existing connections to real PLCs.

You can have only one simulated PLC active at a time.

Using Help

You can access the S7-PLCSIM Help through the Help menu or in any of the following ways:

- To get Help about an object in the S7-PLCSIM window, click the Help button on the toolbar, and then click the object.

- To get help about any dialog or error message, click the Help button in the dialog or message box, or press F1.

The Help window provides the following buttons, menu commands and tabs:

Help Buttons

Hide Button / **Show Button:** Toggles the display of the navigation area (Table of Contents, Index, and Search tabs). To reduce the overall size of the help window, you can hide the navigation area; when you are ready to view new topics, click the Show button to restore the navigation area.

Back Button: If you have examined more than one topic, this button allows you to move back to the previous topic(s).

Print Button: Allows you to send a selected topic, or an entire book, to any printer that you have installed.

Options Button Menu Commands

Hide Tabs / Show Tabs: Toggles the display of the Table of Contents, Index, and Search tabs. To reduce the overall size of the help window, you can hide the tabs; when you are ready to search for new topics, you can show the tabs.

Back: If you have examined more than one topic, this option allows you to move back to the previous topic(s).

Forward: If you have moved back in the sequence of topics examined, this option allows you to move forward until you reach the topic that you were viewing when you started moving back.

Home: Takes you to the web page that is defined as the home page for the S7-PLCSIM online help.

Stop: Allows you to stop the browser from retrieving any more information pertaining to the current help page. This command is useful if a page contains a great deal of information (for example, large graphic files) that causes the page to take a long time to display completely.

Refresh: Refreshes the display of the current help page.

Internet Options: Allows you to define options for Internet browsing.

Print: Allows you to send a selected topic, or an entire book, to any printer that you have installed.

Search Highlight Off / Search Highlight On: Toggles the display of highlighting for topics that contain a term that you have specified in the Search field. The highlighting enables you to see exactly where in a given topic the term appears.

Help Browser Tabs

Contents Tab: Choose this tab to view the table of contents for the help system. Double-click any book icon to expand it and view the topics that it contains.

Index Tab: Choose this tab to view an alphabetical list of index keywords for the help system.

Search Tab: Choose this tab and type in a term that you wish to find. Double-click a topic from the list to view the topic. By default, the term is highlighted every place that it appears in the topic to make it easy to locate the term. To toggle highlighting off or on before displaying a topic, use the Options button.

Opening a Simulated PLC

When you start S7-PLCSIM, the simulator opens with a new, untitled, simulated PLC. If this is your first time using S7-PLCSIM, you see only a CPU view object; otherwise, S7-PLCSIM displays the view objects from your previous work session.

At this point, you have two choices:

- You can begin work in S7-PLCSIM using the new simulated PLC.

- You can open a simulated PLC that you have previously saved: use either the **File > Recent Simulation** command or the **File > Open PLC** command to select the appropriate .PLC file. The work that you did with this PLC (such as downloading a program or hardware configuration, or assigning values through a view object) is saved in the archived simulation, so when you open the simulation, you do not have to repeat those steps. You can begin work where you left off the last time.

After you decide whether to work with a new or an archived PLC simulation, you can add or change the view objects displayed in S7-PLCSIM. If a layout is displayed when you open S7-PLCSIM, you can close it. You can use the toolbar or the View and Insert menus to add new view objects. You can use the menu command **File > Open Layout** to select a different layout if you have archived more than one layout. Changes to your layout do not cause changes to your program information; they only affect the way that the information is displayed.

Note

When you open a new or archived PLC simulation, any view objects that were displayed in S7-PLCSIM are automatically closed. If you intend to open an archived layout as well as a new or archived PLC simulation, open the simulated PLC before opening the layout.

What Is the Difference between a .PLC File and a .LAY File?

A .PLC file is used to save information about work that you do with a CPU view object (that is, a simulated PLC). It also records changes you make to data: if you assign a value to a memory area using any view object, that change is saved in the .PLC file.

A .LAY file is used to save the physical layout of your workspace in S7-PLCSIM. If you arrange your view objects in a certain order and want to preserve that order for future work sessions, save the layout before you close S7-PLCSIM. The next time you open S7-PLCSIM, the view objects will be displayed in that order. (However, if you open a new or archived PLC simulation during that work session, S7-PLCSIM automatically closes your layout. If you want to use the same layout with the simulated PLC that you have opened, just re-open the .LAY file.)

Opening a Layout

To open a previously saved layout of S7-PLCSIM view objects, select the menu command **File > Open Layout**.

A layout is simply an arrangement of view objects. In other words, the .LAY file archives only the position and selected data format of the view objects in your simulation; the data values that are displayed in the view objects are not saved as part of the layout.

When you work in S7-PLCSIM, you can open both a .PLC file and a .LAY file (if you have previously saved your simulated PLC and the layout of your view objects). These are not mutually exclusive actions; you do not have to choose only one. However, it is more efficient to open the simulated PLC (.PLC file) before the layout (.LAY file), because any time you open a new or archived PLC simulation, S7-PLCSIM automatically closes the open layout. You can also save a layout, save a simulated PLC, and close a simulated PLC.

Selecting Scan Mode Options

S7-PLCSIM offers you options for running the simulated program:

- **Single Scan**: The CPU executes one scan and then waits for you to initiate another scan. Each scan consists of the CPU reading the peripheral inputs (PI), executing the program, and then writing the results to the peripheral outputs (PQ). The CPU then waits for you to run the next scan (using the **Execute > Next Scan** menu command or).

- **Continuous Scan**: The CPU executes one complete scan and then starts another scan. Each scan consists of the CPU reading the peripheral inputs (PI), executing the program, and then writing the results to the peripheral outputs (PQ).

To choose Single Scan mode, click or select the menu command **Execute > Scan Mode > Single Scan**. Accessing a program one scan at a time allows you to see the changes in each scan. While a real CPU can execute faster than the editor can display data, the S7-PLCSIM Single Scan option allows you to "freeze" the state of the program from scan to scan.

To choose Continuous Scan mode, click or select the menu command **Execute > Scan Mode > Continuous Scan**. (The default setting is Continuous Scan.)

Changing CPU Operating Modes

You can change the operating modes for the CPU. The simulated PLC responds to changes in the operating mode just like a real PLC. The checkboxes on the view object of the simulated PLC show the current operating mode. To change the operating mode, click the desired checkbox or use the menu command **Execute > Key Switch Position > [mode]**.

The CPU operating modes on the simulated CPU function like the key switch on a real CPU: if you use the STEP 7 tools to change the operating mode, or if the CPU automatically changes mode (for example, encounters an error condition that causes the CPU to change from RUN to STOP), the checkboxes on the simulated CPU view object do not change. The LED indicator changes, but not the key switch. This alerts you that the CPU operating mode changed, possibly because of some error in the program.

Monitoring the Simulated Program

You can display different types of view objects that allow you to monitor and modify the program running in the simulated PLC.

The following seven view objects are activated from the **Insert** menu:

- Input Variable: allows you to access the data stored in the process input (I) memory area. The default address is byte 0 (IB0).

- Output Variable: allows you to access the data stored in the process output (Q) memory area. The default address is byte 0 (QB0).

- Bit Memory: allows you to access the data stored in the bit memory (M) area. The default address is byte 0 (MB0).

- Timer: allows you to access the timers used by the program. The default timer is T 0.

- Counter: allows you to access the counters used by the program. The default counter is C 0.

- Generic: allows you to access any of the memory areas in the simulated CPU, including the data blocks (DBs) for the program.

- **Vertical Bits**: allows you to see the symbolic or absolute address of each bit and to monitor and modify data. The vertical bits variable view object can be used to show a bit representation of peripheral input and output variables, process image input and output variables, bit memory, and data blocks.

You can also use symbolic addressing to address any of these view objects.

The following three view objects are activated from the **View** menu:

- Accumulators: allows you to display the data in the different accumulators within the simulated CPU, as well as the status word and address registers. This view object displays four accumulator fields to accommodate the four accumulators of the S7-400 CPU. Programs for an S7-300 CPU use only two accumulators.

- Block Registers: allows you to display the contents of the data block address registers within the simulated CPU. It also displays the number of the logic block that is currently being executed and the number of the previous logic block, along with the number of the instruction (step address counter, or SAC) being executed.

- Stacks: allows you to display the data stored in the nesting stack and the master control relay (MCR) stack within the simulated PLC.

You can also simultaneously monitor the program in the STEP 7 "LAD/STL/FBD" application:

1. In the SIMATIC Manager, click or select **View > Online** to switch to online mode.

2. Navigate to the "Blocks" object in the S7_ZEBRA example project, and open FC1.

3. The "LAD/STL/FBD" application displays the program that is being executed by the simulated PLC. Use the menu commands to view the status of the instructions.

Using the Slider Control

The slider control allows you to simulate values that change gradually or have a specific range, such as analog values. You can use the slider control for the following view objects:

- Input Variable

- Output Variable

- Bit Memory

You can access the memory area with either a memory address or a symbolic address. To specify a slider control for one of the variable view objects, you select a slider format representation from the Select Numeric Format drop-down list. You also select whether to represent the values as decimal (positive integers), integer (positive and negative integers), or real numbers. The selection options are determined by the size of the memory location being accessed:

- Byte (B): decimal

- Word (W): decimal and integer

- Double word (D): decimal, integer, and real

You can use either the mouse or the arrow keys to change the position of the slider control indicator. Changing the position of the indicator changes the value of the variable stored in the memory location. You can also enter a specific value in the "Value" field.

You can also configure a minimum and maximum value for the slider control. Selecting a range of values does not affect the values that can be stored in the variable: the minimum and maximum values affect only the values that can be entered or displayed by the slider control. Selecting a range of values provides the following benefits:

- You can simulate a specific range of values, for example, the range of values that would be generated by a specific analog module.

- By limiting the range of values between the minimum and maximum, you can provide better resolution for entering data with the slider. You can always enter an exact value in the Value field of the view object.

To select a minimum value for the slider, select Min from the Display Value, Min, or Max drop-down list of the view object. Then, enter the numeric value for the minimum in the Min field.

To select a maximum value for the slider, select Max from the Display Value, Min, or Max drop-down list of the view object. Then, enter the numeric value for the maximum in the Max field.

Using S7-PLCSIM to Debug Your Program

S7-PLCSIM provides the following features to help you debug your program:

- The Pause command halts the simulated CPU immediately and allows you to resume the execution of the program at the instruction where the program was halted.

- Any change that you make with a view object immediately updates the contents of the memory location. The CPU does not wait until the beginning or end of the scan to update any changed data.

- Execution control options allow you to select how the CPU runs the program:

  o Single Scan executes the program for one scan and then waits for you to start the next scan.

  o Continuous Scan executes the program like a real PLC; it starts a new scan immediately after the previous one finishes.

Using Interrupt OBs in Your Program

You can use S7-PLCSIM to test how your program handles different interrupt OBs. S7-PLCSIM supports the following error and interrupt OBs:

- OB40 to OB47 (hardware interrupt)

- OB70 (I/O redundancy error) {417-H systems only}

- OB72 (CPU redundancy error) {417-H systems only}

- OB73 (communication redundancy error) {417-H systems only}

- OB80 (time error)

- OB82 (diagnostic interrupt)

- OB83 (insert/remove module)

- OB85 (priority class error)

- OB86 (rack failure)

Use the menu command **Execute > Trigger Error OB** to select a specific OB, and enter the header information in the dialog box. When you click the "OK" or "Apply" button, the simulated PLC generates the appropriate event and runs the program in the associated OB. The OBs that are available to be triggered from the Trigger Error OB menu depend on the I/O configuration for the simulated PLC.

Input/Output Considerations

In order to simulate interrupt OBs, you must download a hardware configuration that contains your I/O. For some cases your I/O is automatically included in the system data that STEP 7 downloads to S7-PLCSIM; in other cases, you must modify the configuration to one that does.

S7-300 CPUs

S7-300 CPUs such as the CPU 315-2DP, CPU 316-2DP, and CPU 318-2 download an I/O configuration; other CPUs autoconfigure the I/O to match the physical I/O installed in the rack. Projects already configured for one of the CPUs named above do not require modifications to the hardware configuration.

For other CPUs, you must copy your hardware configuration and put the data into a project for a CPU that does not autoconfigure I/O, namely a CPU 315-2DP, CPU 316-2DP, or CPU 318-2 project. When you download the I/O information from the project, you can simulate interrupt OBs in S7-PLCSIM (and S7-PLCSIM is also able to detect any I/O referencing errors that your program may contain).

Resetting the CPU Memory

To reset the memory of the simulated CPU, select the menu command **PLC > Clear/Reset**, or click the MRES button on the CPU view object. This action resets the memory areas, deletes the program blocks, and deletes the hardware configuration of the simulated PLC.

When you perform a memory clear/reset, the CPU automatically goes to STOP mode and all existing connections to the module are disconnected.

Resetting Timers

The Reset Timers dialog allows you to reset any or all of the timers used in your program to their default values. You can select "All Timers" to reset all of the timers in the program or you can select specific timers to reset.

To reset all of the timers in your program, use the Reset Timers ![T=0] toolbar button.

To reset an individual timer, use the Reset Timers ![T=0] button on the timer view object for the specific timer.

Cycling Power for a Simulated CPU

Select the **PLC > Power On** and **Power Off** menu commands to simulate turning power on and off to the CPU.

Using Symbolic Addressing

To use symbolic addressing in your simulated program:

1. Select the menu command **Tools > Options > Attach Symbols**. This menu command invokes a dialog.
2. Browse to the STEP 7 symbol table to be referenced.
3. Click the OK button.
4. Create view objects for variables that you want to address symbolically.
5. To turn on symbols for all view objects, select the menu command **Tools > Options > Show Symbols**. To hide the symbols, select the command again.

For the Vertical Bits view object, bit values are displayed vertically, and the symbolic or absolute address is displayed beside each bit. For all other view objects, symbol tooltips are available for the address fields. Point to a field with the mouse to see its symbolic address and comment (separated by a colon) in a tooltip box.

Configuring an MPI Address

Use the MPI Address dialog box (menu command **PLC > MPI Address**) to configure the simulated PLC for a specific network node address. The new address is stored with the configuration of the simulated PLC when you use the Save PLC or Save PLC As menu command.

Ensure that the node address for the offline program matches the node address for the program in the simulated PLC.

When the Simulation On/Off ![icon] button on the SIMATIC Manager toolbar is turned on, clicking the Accessible Nodes button shows you that the simulated PLC that is currently open.

Note
You cannot change the node address for the simulated PLC while you are using STEP 7 applications to monitor the program. Close these applications before changing the node address.

Using Record/Playback

The Record/Playback dialog box allows you to record or play back a series of data changes.

To access this window, do one of the following:

- Choose the **Tools > Record/Playback** menu command.

- Click the Record/Playback button.

The key sequence Alt + F5 toggles the display of the Record/Playback toolbar button.

This topic discusses the following subjects:

- How to Record or Play Back an Event File

- Troubleshooting Tips

How to Record or Play Back an Event File

 Click the New Event File button to create a new event file.

 Click the Open Event File button to locate and open an existing event file.

 Click the Save Event File button to save the events that you have just recorded.

 Click the Play button to play back an existing recording of events.

 Click the Record button to begin recording a series of events. Use the view objects in your simulation to turn bits on and off or assign data values as desired. The recorder captures every change you make to memory areas.

 Click the Pause button to temporarily suspend recording or playback. The pause function is convenient because it allows you to pause the recording of events and resume later. If you need to perform some other activity (for instance, add new view objects or answer the telephone) before you are finished generating events, you can click Pause and thus avoid a long delay in your recording. Pause allows you to minimize the time lag between events as you record, in contrast to the Delta button, which affects the overall rate at which the recording is played back.

 Click the Stop button to stop recording, or playing back, events.

 The Delta button allows you to select a rate of speed before you play back a recording. Your selection affects the overall playback duration. However, if some events were recorded closer together, or further apart than others, the relative time intervals are preserved even as the overall playback time is reduced or increased by your Delta selection.

There are two ways for you to confirm that you are successfully recording or playing back events:

- Check the status bar of the Record/Playback dialog box to see whether it is in Recording, Playing, or Idle mode.

- Watch the title bar of the Record/Playback dialog box. It should display a numeric value that increments each time you record or play back an event.

If you are satisfied with your recording, remember to save it by using the Save Event File button before you close S7-PLCSIM.

Troubleshooting Tips

Problem	Solution
I tried to record events, but when I played them back, nothing happened.	Change the mode of S7-PLCSIM from STOP to RUN. You can record events in STOP mode provided that you had previously been recording in RUN mode. All events recorded in STOP mode have a Delta value of zero. Therefore, when you play back the recording, all of the events that you recorded during a single scan are displayed in such rapid succession that they appear to occur simultaneously.
The Play ▶ button is de-activated and I cannot play back a recording.	You must have an open event file before you can play back the recording of the events. Use the Open Event File button to select and open an event file.
I recorded a series of events and then closed S7-PLCSIM. The next time I opened S7-PLCSIM, I could not find the events.	If you close S7-PLCSIM without saving the recorded events in an event file, your work is lost. Use the Save Event File 💾 button to save your work before you close S7-PLCSIM.
I recorded a series of events, but when I tried to play them back, nothing happened.	Check the status bar of the Record/Playback dialog box to see what mode it is in. If it says Playing, watch the title bar to see when a numeric value appears. When events are played back, a counter in the title bar keeps track of how many have been played back. Note that if you start a recording but do not promptly begin to trigger events, the recorder captures the time lag. When you play back the recording, the first event will take an equally long time to occur. You can examine the event file to verify that in fact, your events have been properly recorded. You can adjust the playback speed of the recording by using the Delta ⬛ button.
I cannot remember which event file contains the sequence of events that I want to play back.	You can use long, descriptive file names to help differentiate your event files. If necessary, you can use a text editor to examine your files and locate the one with the correct sequence. The default storage location for event files is C:\Siemens\PLCSIM\S7wsi\S7EVENTS. However, if you upgraded from version 3.0 or 4.0 of S7-PLCSIM, the default storage location is C:\Siemens\STEP7\S7wsi\S7EVENTS.

I changed a single bit, but when I played back my recording, the entire byte changed.	If an Input Variable, Output Variable, Bit Memory, Generic Variable, or Vertical Bits View Object shows only one bit (e.g., Q0.0, Bits), a bit change is recorded correctly as only a change in that particular bit. However, if the view object displays all eight bits (e.g., QB0, Bits), a change to a single bit is recorded as a change in byte value instead of a change in that bit only. Consequently, it becomes possible that during playback of the recording, other bits within the byte could be represented as changing (for instance, process flags or Boolean inputs), when in fact they would not be affected during operation of a real PLC.
I am trying to record events in Single Scan mode but the recorder does not function as I would expect.	When recording events with the CPU view object in Single Scan mode, note the following: • You cannot start a recording in Single Scan mode unless you click the Next Scan button to increment the scan count. The first event in your recording must have a Delta value of 1 or higher. The Delta value is based on the number of scan cycles that have occurred since the previous event (which in this case was when you clicked the Record button). However, if you are beginning the recording in Single Scan mode, no scan cycles have elapsed. You must increment the scan. • When you record events in Single Scan mode, they have a Delta value of zero (because they are all occurring within the same scan). Therefore, when you play back the recording, all the events that you recorded during a single scan are displayed in such rapid sequence that they appear to occur simultaneously. To provide a discernable time lag between events, you would have to click the Next Scan button or switch between Continuous Scan mode and Single Scan mode for each event.
My event file contains German mnemonics even though that is not my selection in STEP 7.	Events are recorded with German mnemonics in S7-PLCSIM regardless of your STEP 7 selection. You can disregard this phenomenon.

Monitoring the Scan Cycle

The menu command **Execute > Scan Cycle Monitoring** opens a dialog box that allows you to enable or disable scan cycle monitoring (watchdog timer) and set the maximum scan cycle monitoring time for the simulation. The maximum scan cycle time is the maximum time the process is allowed to take for one full scan cycle of the S7 user program in the OB1 and update of the relevant I/O. If this time is exceeded, the simulated PLC goes into STOP mode.

Because program execution may be significantly slower in S7-PLCSIM than with an actual CPU (especially when other applications are running at higher priority), you can experience annoying timeouts. This dialog makes it possible for you to disable or extend the scan cycle monitoring without modifying the program for the target PLC.

Note that this dialog does not reflect the monitoring time set in the hardware configuration, and any changes affect the simulation only.

If "Enable Scan Cycle Monitoring" is selected, you can set the monitoring time to any value between 1 second (1000 ms) and 1 minute (60000 ms), inclusive. The default scan cycle monitoring time is 20000 ms.

Saving a Layout

To save the current layout of S7-PLCSIM view objects, select the menu command **File > Save Layout**. A layout is simply an arrangement of view objects. In other words, the .LAY file archives only the position and selected data format of the view objects in your simulation; the data values that are displayed in the view objects are not saved as part of the layout.

You can save both the layout (.LAY file) and the PLC simulation (.PLC file) when you work. They are not mutually exclusive. For information about what is archived if you save a PLC simulation (.PLC file), see Saving a Simulated PLC.

Saving a Simulated PLC

You can store the current state of the simulated PLC in one of the following ways:

- Use the menu command **File > Save PLC** to archive the configuration of the PLC to the current file name.

- Use the menu command **File > Save PLC As** to archive the configuration of the PLC to a new file.

The following elements are saved when you save the PLC:

- Program

- Hardware configuration

- The checkbox selection (key switch position) for the operating mode indicated on the CPU view object: namely, RUN-P, RUN, or STOP

- Execution control option (continuous scan, single scan)

- The status of the I/O

- Timer values (T memory)

- Symbolic addresses

- Power on/off setting

When you open a simulated PLC, whether it is a new PLC simulation or an archived PLC simulation, the simulated PLC is in STOP mode.

If you archived a simulated PLC in RUN or RUN-P mode, when you open the archive, the checkbox of the CPU view object indicates your selection, but the CPU indicators show that the actual mode of the simulated PLC is STOP mode. To restore the simulated PLC to RUN or RUN-P mode, you must use the checkboxes in the CPU view object or the **Execute > Key Switch Position** command to cycle the simulated PLC to STOP mode and then back to RUN or RUN-P mode.

If you have attached symbols, when you save the simulated PLC, the symbolic addresses are saved. However, by default when you open the archived PLC simulation, symbolic addresses are not displayed. To display symbolic addresses, use the **Tools > Options > Show Symbols** command.

To save the configuration of the view objects, use the **File > Save Layout** menu command. Saving a simulated PLC does not close the simulated PLC.

Closing a Simulated PLC

Use the menu command **File > Close PLC** to end the simulation of the program. This command closes the CPU view object and all opened views.

Closing a simulated program can result in errors in applications which are currently connected to the simulator. Closing the simulated PLC does not end the simulation session. You can either exit S7-PLCSIM, or open another simulated PLC.

Ending the Simulation Session

After saving any simulated PLC or layout configuration, follow these steps to exit the S7-PLCSIM application:

1. Close any STEP 7 applications involved in the monitoring of the simulation.

2. Select the menu command **File > Exit**.

Exiting S7-PLCSIM, like closing a simulated PLC, can result in errors in applications which are currently connected to the simulator.

Simulating a CPU 317-T

S7-PLCSIM can simulate control programs developed for a CPU 317-T with limitations.

The simulation does not access any motion control devices. Calls to motion control function blocks simply return to the calling block with some limited error checking. Error checking includes:

- Existence of instance DB

- Existence of technology DB

- Range checking of parameters with defined ranges

S7-PLCSIM does set output parameters for a few of the MC commands as defined below, providing the input parameters are valid:

MC Command	Parameter	Value(s) set
MC_Power	Statusword.DriveEnabled Statusword.Standstill	True for enabled, false for disabled True
MC_Stop	Statusword.Stopping Statusword.Standstill	True True
MC_MoveAbsolute (MC_MvAbs)	Position	Input parameter position
MC_ExternalEncoder (MC_ExEnc)	Position	Input parameter position

View Objects

S7-PLCSIM provides several view objects that allow you to monitor and modify various components of the simulated PLC. These view objects are listed below:

- CPU View Object
- ACCUs & Status Word View Object
- Block Regs View Object
- Stacks View Object
- Input Variable View Object
- Output Variable View Object
- Bit Memory View Object
- Timers View Object
- Counters View Object
- Generic Variable View Object
- Vertical Bits Variable View Object

You can use symbolic addressing with view objects. If you do, tooltips are available for all view object fields that have symbols assigned to them. You can point to a view object field with the mouse to see its symbolic address and comment (separated by a colon) in a tooltip box.

Note

If you use an address in a view object that corresponds to F-System peripheral I/O, S7-PLCSIM displays a yellow background for that view object.

CPU View Object

This view object is present by default when you open a new simulation. It allows you to view the status and change the operating mode of the simulated CPU.

The operating modes on the CPU view object function like the key switch on a real CPU: if you use the STEP 7 tools to change the operating mode, or if the CPU automatically changes mode (for example, encounters an error condition that causes the CPU to change from RUN to STOP), the RUN/STOP indicators change, but not the key switch. This alerts you that the CPU changed operating mode, possibly because of some error in the program.

The MRES button allows you to reset the memory and to delete the blocks and the hardware configuration of the simulated PLC.

ACCUs & Status Word View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **View > Accumulators**

- Click the CPU Accumulators button:

This view object allows you to monitor the information that the CPU uses to execute the program:

- **Accumulators**: allows you to monitor the contents of the CPU accumulators. The view object displays four accumulator fields to accommodate the S7-400 CPU; programs for the S7-300 CPU use only two accumulators.

- **Status word**: allows you to monitor the bits of the status word.

- **Address registers**: allows you to monitor the contents of the two address registers (AR1 and AR2). These address registers are used for the indirect addressing of data.

Block Regs View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **View > Block Registers**

- Click the Block Registers button:

This view object allows you to monitor the contents of the data block address registers (DB1 and DB2). This view object also displays the number of the current logic block and the previous logic block, along with the number of the instruction (step address counter, or SAC) for each block.

Stacks View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **View > Stacks**

- Click the Nesting Stacks button:

This view object allows you to monitor information stored in the following stacks of the CPU:

- The nesting stack stores up to seven entries. For each entry, the nesting stack stores the states of the RLO and OR bits of the status word. An entry in the nesting stack is made for each instruction that starts a new logic string. These instructions are: And (A), And Not (AN), Or (O), Or Not (ON), Exclusive Or (X), and Exclusive Or Not (XN).

- The MCR stack stores up to eight levels of nesting for a master control relay (MCR). Each level shows the status of the RLO bit for an MCR instruction, which begins an MCR area.

Input Variable View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Input Variable**

- Click on the Insert Input Variable button:

This view object allows you to monitor and modify the following data:

- **Peripheral (external) input variables**: you can access the peripheral input (PI) memory areas of the CPU. S7-PLCSIM displays a yellow background for the view object if the variable address corresponds to F-System peripheral I/O.

- **Process-image input variables**: you can access the input (I) memory areas of the CPU. By default, the CPU overwrites the I memory with the PI memory at the beginning of every scan. If you change an I memory value, the simulator immediately copies the changed value to the peripheral area. This way, the desired change is not lost when the peripheral value overwrites the process input value on the next scan.

The CPU reacts immediately to any changes made with this view object. (Any modifications made with a STEP 7 variable table take effect at the proper time in the CPU scan: inputs are read at the beginning of the scan, and outputs are written at the end.)

You can choose the numeric data format for the input variable and you can also use symbolic addressing if you have attached symbols. You can also view input variables with a Vertical Bits View Object.

Output Variable View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Output Variable**

- Click the Insert Output Variable button:

This view object allows you to monitor and modify the following data:

- **Peripheral (external) output variables**: you can access the peripheral output (PQ) memory areas of the CPU. S7-PLCSIM displays a yellow background for the view object if the variable address corresponds to F-System peripheral I/O.

- **Process-image output variables**: you can access the output (Q) memory areas of the CPU. During the scan cycle, the program calculates output values and places them in the process-image output table. At the end of the scan cycle, the operating system reads the calculated output values from this table and sends them to the process outputs. The process-image output table maps the first 512 bytes (CPU-dependent) of the peripheral output memory.

The CPU reacts immediately to any changes made with this view object. (Any modifications made with a STEP 7 variable table take effect at the proper time in the CPU scan: inputs are read at the beginning of the scan, and outputs are written at the end.)

You can choose the numeric data format for the output variable and you can also use symbolic addressing if you have attached symbols. You can also view input variables with a Vertical Bits View Object.

Bit Memory View Object

To access this view object, do one of the following:

- Choose the menu command **Insert > Bit Memory**

- Click on the Insert Bit Memory button:

This view object allows you to monitor and modify bit memory: you can access the variables stored in the bit memory (M) area of the CPU.

The bit memory (M) area provides storage for interim results calculated in the program. You designate what data format to use to access the data.

You can choose the numeric data format for the bit memory and you can also use symbolic addressing if you have attached symbols. You can also view bit memory with a Vertical Bits View Object.

Timer View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Timer**

- Click the Insert Timer button:

This view object allows you to monitor and modify any timer used by your program. The timer view object displays the name of the timer, the actual timer value, and the time base.

Note

If you change the time base, the actual timer value changes, while the displayed value remains the same. This is because the actual timer value is the product of the displayed value and the time base. For example, if the value of timer T 0 is 600 and the time base is 10ms, this represents a timer of 6 seconds. If you change the time base to 100ms, then the actual timer value becomes 60 seconds. (600 * 100ms = 60 seconds)

To reset all of the timers in your program, use the Reset Timers toolbar button.

To reset an individual timer, use the Reset Timers button on the view object for that timer.

You can use symbolic addressing for the timer if you have attached symbols. You can also configure the timers to be under either automatic or manual control from commands on the Execute menu.

Counter View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Counter**

- Click the Insert Counter button: (or in German mnemonics)

This view object allows you to monitor and modify the counters used by your program. It opens with a default memory location of C 0.

You can choose the numeric data format for the counter and you can also use symbolic addressing if you have attached symbols.

Generic Variable View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Generic**

- Click the Insert Generic Variable button:

This view object allows you to monitor and modify the following data:

- Peripheral (external) input and output variables: you can access the peripheral input (PI) and peripheral output (PQ) memory areas of the CPU. S7-PLCSIM displays a yellow background for the view object if the variable address corresponds to F-System peripheral I/O.

- Process-image input and output variables: you can access the input (I) and output (Q) memory areas of the CPU. By default, the CPU overwrites the I memory with the PI memory at the beginning of every scan. If you change an I memory value, the simulator immediately copies the changed value to the peripheral area. This way, the desired change is not lost when the peripheral value overwrites the process input value on the next scan.

- Bit memory: you can access the variables stored in the bit memory (M) area of the CPU.

- Timers and counters: you can access the timers and counters used by the program.

- Data blocks: you can access the data stored in the data blocks of the program, for example, DB1.DBX 0.0 or DB1.DBW 0.

The CPU reacts immediately to any changes made with this view object. Any modifications made with a STEP 7 variable table take effect at the proper time in the CPU scan; inputs are read at the beginning of the scan, and outputs are written at the end.

You can choose the numeric data format for the generic variable and you can also use symbolic addressing if you have attached symbols.

Vertical Bits Variable View Object

To add this view object to a simulation, do one of the following:

- Choose the menu command **Insert > Vertical Bits**

- Click the Insert Vertical Bits button:

You can use the Vertical Bits view object with bit or byte addresses. The Vertical Bits view object allows you to see the symbolic or absolute address of each bit and to monitor and modify the following data:

- Peripheral (external) input and output variables: you can access the peripheral input (PI) and peripheral output (PQ) memory areas of the CPU. S7-PLCSIM displays a yellow background for the view object if the variable address corresponds to F-System peripheral I/O.

- Process-image input and output variables: you can access the input (I) and output (Q) memory areas of the CPU. By default, the CPU overwrites the I memory with the PI memory at the beginning of every scan. If you change an I memory value, the simulator immediately copies the changed value to the peripheral area. This way, the desired change is not lost when the peripheral value overwrites the process input value on the next scan.

- Bit memory: you can access the variables stored in the bit memory (M) area of the CPU.

- Data blocks: you can access the data stored in the data blocks of the program.

The CPU reacts immediately to any changes made with this view object. Any modifications made with a STEP 7 variable table take effect at the proper time in the CPU scan; inputs are read at the beginning of the scan, and outputs are written at the end. You can use symbolic addressing if you have attached symbols for variables represented with a Vertical View Object.

Error and Interrupt OBs

S7-PLCSIM supports the following interrupt and error OBs:

- OB40 to OB47 (hardware interrupt)
- OB70 (I/O redundancy error) {417-H systems only}
- OB72 (CPU redundancy error) {417-H systems only}
- OB73 (communication redundancy error) {417-H systems only}
- OB80 (time error)
- OB82 (diagnostic interrupt)
- OB83 (insert/remove module)
- OB85 (priority class error)
- OB86 (rack failure)

To simulate the triggering of any of these OBs, select the S7-PLCSIM menu command **Execute > Trigger Error OB** and the OB or OB group that you want to trigger.

> **Notice**
> If values in the simulated PLC change after an error or interrupt OB has been triggered and is executing, S7-PLCSIM does not update the OB with the changed data. To cause the OB to use the changed data, you must close the OB dialog and reopen it.

Hardware Interrupt (OB40-OB47)

This dialog allows you to test the program that you downloaded in OB40 to OB47.

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Description
Module address	OB4x_MDL_ADDR	WORD	Logical base address of the module that triggers the interrupt.
Module status	OB4x_POINT_ADDR	DWORD (Hex)	For digital modules: bit field with the status of the inputs on the module. (Bit 0 corresponds to the first input.)
			For analog modules, CPs or FMs: interrupt status of the module (irrelevant to user).
Interrupt OB (read-only)	OB4x_OB_NUMBR	BYTE	OB number (40 to 47).

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

I/O Redundancy Error (OB70)

This dialog allows you to test the loss of redundancy of PROFIBUS-DP and can only be used with H CPUs.

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter (Input/Output)	Variable	Data Type	Description
Error Event Class	OB70_EV_CLASS	BYTE	Event class and IDs: * B#16#72: event entering state * B#16#73: event leaving state
Error Code	OB70_FLT_ID	BYTE	Error code (possible values): * B#16#A2 * B#16#A3

You must also enter values for DP Master Base Address, DP Master System ID, DP Slave Base Address, and DP Station Number. Each field needs to match the value that was assigned in the STEP 7 hardware configuration of the project that you are simulating.

The DP Slave Base Address, DP Station Number, and the Input/Output selection are only available for Error Code 0xA3.

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

CPU Redundancy Error (OB72)

This dialog allows you to test a CPU redundancy failure and exists only with H CPUs. The operating system of the H CPU calls OB72 when one of the following events occurs:

- Loss of CPU redundancy

- Reserve-master switchover

- Synchronization error

- Error in a SYNC module

- Updating aborted

- Comparison error (for example, RAM, PIQ)

OB72 is executed by all CPUs that are in the RUN or STARTUP mode following a suitable event.

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	ID
Error Event Class	OB72_EV_CLASS	B#16#73
		B#16#75
		B#16#78
		B#16#79
Error Code	OB72_FLT_ID	see fault ID table

OB72 Fault IDs (Error Codes)

The error code in OB72_FLT_ID indicates which event occurred that caused the OB72 call:

OB72_FLT_ID	Start Event of OB72
B#16#01	Loss of redundancy (1 of 2) due to a CPU failure
B#16#02	Loss of redundancy (1 of 2) due to STOP on the reserve triggered by user
B#16#03	H system (1 of 2) changed to redundant mode
B#16#20	Error in RAM comparison
B#16#21	Error comparing process image output value
B#16#22	Error comparing memory bits, timers, or counters
B#16#23	Different operating system data recognized
B#16#31	Standby-master switchover due to master failure

B#16#33	Standby-master switchover due to operator intervention
B#16#34	Standby-master switchover due to sync module connection problem
B#16#35	Standby-master switchover triggered by 90 "H_CTRL"
B#16#40	Synchronization error in user program due to elapsed wait time
B#16#41	Synchronization error in user program due to waiting at different synchronization points
B#16#42	Synchronization error in operating system due to waiting at different synchronization points
B#16#43	Synchronization error in operating system due to elapsed wait time
B#16#44	Synchronization error in operating system due to wrong data
B#16#50	No SYNC module
B#16#51	Modification at SYNC module without Power On
B#16#52	SYNC module removed/inserted
B#16#53	Modification at SYNC module without reset
B#16#54	SYNC module: rack number assigned twice
B#16#55	SYNC module error/eliminated
B#16#56	Illegal rack number set on the SYNC module
B#16#C1	Updating aborted
B#16#C2	Abort of update attempt because a monitoring time was exceeded during the nth attempt (1 <= n <= maximum possible number of update attempts after an abort due to the monitoring time being exceeded)

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Communication Redundancy Error (OB73)

This dialog allows you to test when the first loss of redundancy occurs in a fault-tolerant S7 connection and exists only with H CPUs.

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Description
Error Event Class	OB73_EV_CLASS	BYTE	Possible value of B#16#73 (loss of redundancy in communication) or B#16#72 (problem eliminated)
Error Code	OB73_FLT_ID	BYTE	Possible value of B#16#E0

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Time Error (OB80)

This dialog allows you to test the program that you downloaded in OB80 (Time Error). The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Description
Cycle time exceeded	OB80_FLT_ID	BYTE	Error code: B#16#01
Requested OB is still being processed	OB80_FLT_ID	BYTE	Error code: B#16#02
OB call buffer overflow for the current priority class	OB80_FLT_ID	BYTE	Error code: B#16#07
Expired time of day interrupt:			
* due to a time jump	OB80_FLT_ID	BYTE	Error code: B#16#05
* on return to run after hold	OB80_FLT_ID	BYTE	Error code: B#16#06

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Diagnostic Interrupt (OB82)

This dialog allows you to test the program that you downloaded in OB82 (Diagnostic Interrupt).

Default Tests: (Optional) In this drop-down box, choose from the list to set the fault conditions for the desired test automatically.

For all fault conditions the event class (OB82_EV_CLASS) is set to B#16#39 (incoming event) and OB82_FLT_ID uses the error code B#16#42. If no fault condition is selected (Module OK), the event class is set to B#16#38 (outgoing event).

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Module Address Parameter

The module address is the logical base address of the module that triggers the interrupt. It is the first input, if any; otherwise, it is the first output address. (Example: PIB 0)

Parameter	Variable	Data Type
Module address	OB82_MDL_ADDR	INT

Fault Conditions

Check the following checkboxes to enable the following fault conditions:

Parameter Checkbox	Variable	Data Type
Module defect (*read-only*)	OB82_MDL_DEFECT	BOOL
Internal fault	OB82_INT_FAULT	BOOL
External fault	OB80_EXT_FAULT	BOOL
Channel fault	OB82_PNT_INFO	BOOL
External voltage failed	OB82_EXT_VOLTAGE	BOOL
Front panel connector unplugged	OB82_FLD_CONNCTR	BOOL
Module not configured	OB82_NO_CONFIG	BOOL
Incorrect parameters on module	OB82_CONFIG_ERR	BOOL
Channel information exists	OB82_MDL_TYPE	BYTE (Bit 4)
User information exists	OB82_MDL_TYPE	BYTE (Bit 5)
Diagnostic interrupt from substitute	OB82_MDL_TYPE	BYTE (Bit 6)
Submodule missing or has an error	OB82_SUB_MDL_FAULT	BOOL
Communication problem	OB82_COMM_FAULT	BOOL

Operating mode is STOP	OB82_MDL_STOP	BOOL
Watchdog timer responded	OB82_WTCH_DOG_FLT	BOOL
Internal power supply failed	OB82_INT_PS_FLT	BOOL
Battery exhausted	OB82_PRIM_BATT_FLT	BOOL
Entire backup failed	OB82_BCKUP_BATT_FLT	BOOL
Expansion rack failure	OB82_RACK_FLT	BOOL
Processor failure	OB82_PROC_FLT	BOOL
EPROM fault	OB82_EPROM_FLT	BOOL
RAM fault	OB82_RAM_FLT	BOOL
ADC/DAC error	OB82_ADU_FLT	BOOL
Fuse tripped	OB82_FUSE_FLT	BOOL
Hardware interrupt lost	OB82_HW_INTR_FLT	BOOL

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Insert/Remove Module Interrupt (OB83)

This dialog allows you to test the program that you downloaded in OB83 (Insert/Remove Module Interrupt).

For all fault conditions, the event class (OB83_EV_CLASS) is set to B#16#39 (incoming event). If no fault condition is selected (Module OK), the event class is set to B#16#38 (outgoing event).

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	DataType	Value / Description
Module removed or not responding	OB83_FLT_ID	BYTE	B#16#61
Module inserted: module type OK	OB83_FLT_ID	BYTE	B#16#61
Module inserted: incorrect module type	OB83_FLT_ID	BYTE	B#16#63
Module inserted: type ID cannot be read	OB83_FLT_ID	BYTE	B#16#64
Module inserted: error in module parameter assignment	OB83_FLT_ID	BYTE	B#16#65
Module address	OB83_MDL_ADDR	WORD	Logical base address of the module affected; if a mixed module, it is the smallest logical address used in the module. If the I and O addresses in the mixed block are equal, the logical base address is the one that receives the event identifier.
			Example: PQW 0

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Priority Class Error (OB85)

This dialog allows you to test the program that you downloaded in OB85 (Priority Class Error). OB85 is automatically triggered if an error occurs while the operating system is accessing a block (error code B#16#A3).

Note that events B#16#A1, B#16#A2, B#16#B1, and B#16#B2 must be generated by other means, for example, by deleting one of the required blocks from your program.

The parameters that you select with this dialog are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Value
Integrated function:	OB85_Z1	WORD	
No error resolution			W#16#0100
Block not loaded			W#16#0101
Area length error			W#16#0102
Write protect error			W#16#0103
IEC timer:	OB85_Z1	WORD	
No error resolution			W#16#0200
Block not loaded			W#16#0201
Area length error			W#16#0202
Write protect error			W#16#0203

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Rack Failure (OB86)

This dialog allows you to test the program that you downloaded in OB86 (Rack Failure).

For all fault conditions the event class (OB86_EV_CLASS) is set to B#16#39 (incoming event). If no fault condition is selected (Rack Return, Rack Return with Discrepancy, DP Station Return and DP Station OK), the event class is set to B#16#38 (outgoing event).

The two tabs of the dialog provide the following options:

Expansion Rack FailureTab

The parameters that you select in this tab are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Value
IM address	OB86_MDL_ADDR	WORD	Address of the interface module to which expansion racks are connected.
Failure	OB86_FLT_ID	BYTE	B#16#C1
Return	OB86_FLT_ID	BYTE	B#16#C1
Return with discrepancy	OB86_FLT_ID	BYTE	B#16#C2
Expansion Rack operational again but error in module parameter assignment	OB86_FLT_ID	BYTE	B#16#C6
Rack Status	OB86_RACKS_FLTD	ARRAY OF BOOL	Shows the status of up to twenty-one expansion racks connected to the interface module (IM). In the array, you must select the rack with the fault conditions. Green = Good Red = Fault Gray = Not configured

DP Failure Tab

This tab allows you to test for DP system failure and view the status of the DP under various error conditions. The parameters that you select in this tab are passed to the following variables when the OB is called:

Parameter	Variable	Data Type	Value
Subnet	OB86_MDL_ADDR	WORD	Logical base address of the DP master system.
Failure of DP master system	OB86_FLT_ID	BYTE	B#16#C3

Station failure	OB86_FLT_ID	BYTE	B#16#C4
Station fault	OB86_FLT_ID	BYTE	B#16#C5
Station return	OB86_FLT_ID	BYTE	B#16#C4
Station OK	OB86_FLT_ID	BYTE	B#16#C5
Station operational again but error	OB86_FLT_ID	BYTE	B#16#C7
Station return with discrepancy	OB86_FLT_ID	BYTE	B#16#C8
DP Status	OB86_RACKS_FLTD	ARRAY OF BOOL	Shows the status of up to 126 DP stations. In the array, you must select the rack with the fault conditions. Green = Good Red = Fault Gray = Not configured

For further information, refer to the STEP 7 Help on Organization Blocks help system or to the *SIMATIC System Software for S7-300/400 System and Standard Function*s manual.

Reference Information

S7-PLCSIM Toolbars

S7-PLCSIM includes the toolbars pictured below. You can use the **View > Toolbars...** command to hide or display any of the toolbars.

From the online help, click any button from any of the following toolbar pictures for detailed information, or reference the appropriate menu topic:

Standard

The standard toolbar contains selected commands from the File Menu, Edit Menu, View Menu, and Window Menu as well as "What's This" help.

The commands available from this toolbar are: **File > New PLC**, **File > Open PLC**, **File > Save PLC**, **Edit > Cut**, **Edit > Copy**, **Edit > Paste**, **Window > Cascade**, **Window > Tile Ordered**, **View > Always On Top**, and What's This Help.

Insert

The insert toolbar contains selected commands from the Insert Menu or the View Menu.
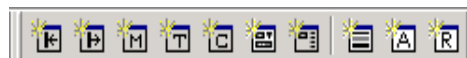
The commands available from this toolbar are: **Insert > Input Variable**, **Insert > Output Variable**, **Insert > Bit Memory**, **Insert > Timer**, **Insert > Counter**, **Insert > Generic**, **Insert > Vertical Bits**, **View > Accumulators**, **and View > Block Registers**.

CPU Mode

The CPU Mode toolbar contains selected commands from the Execute Menu.

Record/Playback Files

The Record/Playback Files toolbar button is also accessible from the Tools Menu.

The commands available from this toolbar are: **Execute > Scan Mode > Single Scan**, **Execute > Scan Mode > Continuous Scan**, **Pause, Execute > Next Scan**, and **Execute > Reset Timers**.

Toolbar Shortcut Key Combinations

You can toggle the display of any of these toolbars by concurrently pressing the Alt key and a function key. The following shortcut key combinations are available:

ALT + F1 Toggles the display of the Standard toolbar.

ALT + F2 Toggles the display of the Insert toolbar.

ALT + F3 Toggles the display of the CPU Mode toolbar.

ALT + F4 Closes S7-PLCSIM.

ALT + F5 Toggles the display of the Record/Playback toolbar.

S7-PLCSIM Menus

S7-PLCSIM includes the following menus for performing operations with the simulated PLC:

- File
- Edit
- View
- Insert
- PLC
- Execute
- Tools
- Window
- Help

File Menu

The S7-PLCSIM File menu contains the following commands:

New PLC Command

Click or select the menu command **File > New PLC** to create a new simulated PLC.

Open PLC Command

To find and open an existing (saved) simulation of a PLC, click or select the menu command **File > Open PLC**.

Close PLC Command

Select the menu command **File > Close PLC** to close the currently open simulated PLC. This command closes the CPU view object and all other currently open view objects.

Closing a simulated PLC can result in errors in applications which are currently connected to the simulator.

Save PLC Command

Click or select the menu command **File > Save PLC** to save the current state of the simulated PLC.

Save PLC As Command

Select the menu command **File > Save PLC As** to save the current state of the simulated PLC as a new file.

Open Layout Command

To open a previously saved layout of S7-PLCSIM view objects, select the menu command **File > Open Layout**.

Close Layout Command

To close the current layout of S7-PLCSIM view objects, select the menu command **File > Close Layout**.

Save Layout Command

To save the current layout of S7-PLCSIM view objects, select the menu command **File > Save Layout**.

Save Layout As Command

To save the current layout of S7-PLCSIM view objects as a new file, select the menu command **File > Save Layout As**.

Recent Simulation Command

Use the menu command **File > Recent Simulation** to open a list of your four most recently used programs. Select file 1, 2, 3, or 4 from the list of recent simulations.

Recent Layout Command

Use the menu command **File > Recent Layout** to select from a list of your four most recently used layouts. Select file 1, 2, 3, or 4 from the list of recent layouts.

Exit Command

Select the menu command **File > Exit** to close the simulated PLC and to exit the S7-PLCSIM application.

Exiting S7-PLCSIM can result in errors in applications which are currently connected to the simulator.

Edit Menu

The S7-PLCSIM Edit menu contains the following commands:

Undo Command

Select the menu command **Edit > Undo** to reverse the last action you performed. **Undo** only applies to editable text/numeric fields and to the commands of the Edit and Window menus.

The **Undo** command is also available from the right-click menu of any editable text field.

✂ Cut Command

Select the **Edit > Cut** command or click ✂ to remove selected text and put it on the clipboard.

📋 Copy Command

Select the **Edit > Copy** command or click 📋 to copy selected text and put it on the clipboard.

📋 Paste Command

Select the **Edit > Paste** command or click 📋 to insert the contents of the clipboard (whatever was last cut or copied) at the location of the cursor.

View Menu

The S7-PLCSIM View menu contains the following commands:

Accumulators Command

Select the menu command **View > Accumulators** or click to create an ACCUs & Status Word view object. This view object allows you to monitor accumulators, status word bits and address registers.

Block Registers Command

Select the menu command **View > Block Registers** or click or to create a Block Regs view object that allows you to monitor the contents of the data block address registers (DB1 and DB2). This view object also displays the number of the current logic block and the previous logic block, along with the number of the instruction (step address counter, or SAC) for each block.

Stacks Command

Select the menu command **View > Stacks** or click or to create a Stacks view object that allows you to monitor the nesting stack and the master control relay (MCR) stack.

Toolbars Command

Select the menu command **View > Toolbars** to choose which S7-PLCSIM toolbars you want to display. From the Toolbars dialog box, check or uncheck the selections corresponding to the following toolbars:

- Standard
- Insert
- CPU Mode
- Record/Playback Files

Status Bar Command

Select the menu command **View > Status Bar** to toggle on/off the display of the S7-PLCSIM status bar. The status bar, as shown below, appears at the bottom of the S7-PLCSIM window and contains information and messages that help you use S7-PLCSIM.

Press F1 to get Help.	MPI = 2

Always On Top Command

Select the menu command **View > Always On Top** or click to keep S7-PLCSIM in front of any other concurrently running applications. Repeat the action to return S7-PLCSIM to its normal state.

Insert Menu

The S7-PLCSIM Insert menu contains the following commands:

Input Variable Command

Click on ![icon] or select the menu command **Insert > Input Variable** to create a view object that allows you to monitor and modify variables in the process input (I) memory area. This view object opens with a default memory location of IB0.

Output Variable Command

Click on ![icon] or select the menu command **Insert > Output Variable** to create a view object that allows you to monitor and modify variables in the process output (Q) memory area. This view object opens with a default memory location of QB0

Bit Memory Command

Click on ![icon] or select the menu command **Insert > Bit Memory** to create a view object that allows you to monitor and modify variables that are stored in the bit memory (M) area of the CPU. This view object opens with a default memory location of MB0.

Timer Command

Click on ![icon] or select the menu command **Insert > Timer** to create a view object that allows you to monitor and modify the timers that are used by the program. This view object opens with a default memory location of T 0.

Counter Command

Click on ![icon] ![icon] in German mnemonics) or select the menu command **Insert > Counter** to create a view object that allows you to monitor and modify the counters that are used by the program. This view object opens with a default memory location of C 0.

Generic Command

Click on ![icon] or select the menu command **Insert > Generic** to create a view object that allows you to monitor and modify any of the variables used by the program, such as the input (I) or output (Q) memory areas. You can also access the data stored in the data blocks (DBs).

Vertical Bits Command

Click on ![icon] or select the menu command **Insert > Vertical Bits** to create a view object displays the symbolic or absolute address next to each bit and allows you to monitor and modify any of the variables used by the program, such as the input (I) or output (Q) memory areas. You can also access the data stored in the data blocks (DBs).

PLC Menu

The S7-PLCSIM PLC menu contains the following commands:

Power On Command

Select the menu command **PLC > Power On** to simulate turning on the power to the PLC.

Power Off Command

Select the menu command **PLC > Power Off** to simulate turning off the power to the PLC.

Clear/Reset Command

Select the menu command **PLC > Clear/Reset**, or click the "MRES" button on the CPU view object to reset the memory, delete the program blocks, and delete the hardware configuration of the simulated PLC.

When you perform a memory clear/reset, the CPU automatically goes to STOP mode and all existing connections to the module are disconnected.

MPI Address Command

Select the menu command **PLC > MPI Address...** to modify the network node address for the simulated PLC. The new address is stored with the configuration of the simulated PLC when you use the Save PLC or Save PLC As menu commands.

Execute Menu

The S7-PLCSIM Execute menu contains the following commands:

Key Switch Position Command

Select the menu command **Execute > Key Switch Position** and choose **RUN-P**, **RUN**, or **STOP** to put the simulated PLC in the desired operating mode. You can also change the mode by clicking the check-boxes in the CPU view object.

Startup Switch Position Command

Select the menu command **Execute > Startup Switch Position** and pick a restart option to determine what the simulated CPU will do when it is switched from STOP to RUN mode:

- Warm Start: the operating system calls OB100

- Hot Start: the operating system calls OB101

- Cold Start: the operating system calls OB102

Scan Mode Command

You can choose from two modes of execution for your simulated program: Single Scan and Continuous Scan.

Single Scan Command

Select the menu command **Execute > Scan Mode > Single Scan** or click to set up the CPU for executing the program one scan at a time. The CPU executes the complete program for one scan, then waits for you to request the next scan.

Continuous Scan Command

Select the menu command **Execute > Scan Mode > Continuous Scan** or click to set up the CPU for executing the program in a continuous cycle (in the same way that OB1 is executed by the CPU). The CPU executes the program when the operating mode is set to RUN, and stops when the operating mode is set to STOP.

The scan starts by reading the peripheral inputs (PI) and updating the process-image input (I) memory. The CPU then executes the instructions of the program and updates the memory areas. The scan ends by writing the process-image output (Q) memory to the peripheral-output (PQ) memory.

Next Scan Command

Click on or select the menu command **Execute > Next Scan** to request that the simulated CPU execute the next scan (if the simulation is set for Single Scan).

Pause Command

Click on or select the menu command **Execute > Pause** to momentarily halt the execution of the program in the simulated PLC without changing any of the data (such as the state of the outputs). To resume the execution of the program, turn off the Pause function. The program then starts at the instruction where execution had been halted.

If a STEP 7 application is connected to the simulated PLC, using Pause may cause the application to time out and disconnect. If this happens, turn off the Pause function and reconnect the STEP 7 application.

Automatic Timers Command

The timers in the simulated PLC can be set to either automatic or manual.

Select the menu command **Execute > Automatic Timers** to set up the CPU for executing the timers automatically in the program.

Manual Timers Command

Select the menu command **Execute > Manual Timers** to set up the CPU to allow you to enter a specific value or to reset the timers in the program. To return to running the timers automatically, select the menu command **Execute > Automatic Timers**.

T=0 Reset Timers Command

The menu command **Execute > Reset Timers** opens a dialog box allowing you to set the time value for each timer to its default value. You can reset all of the timers used by the program, or you can reset timers individually.

To reset all of the timers in your program, use the Reset Timers T=0 toolbar button.

To reset an individual timer, use the Reset Timer T=0 button on the view object for that timer.

Trigger Error OB Command

The menu command **Execute > Trigger Error OB** allows you to test how your program handles different interrupt OBs.

Scan Cycle Monitoring Command

The menu command **Execute > Scan Cycle Monitoring** opens a dialog box allowing you to enable or disable scan cycle monitoring (watchdog timer) and set the maximum scan cycle monitoring time (in milliseconds) for the simulation. The maximum scan cycle time is the maximum time the process is allowed to take for one full scan cycle of the S7 user program in OB1 and for the update of the relevant I/O. If this time is exceeded, the simulated PLC goes into STOP mode.

Tools Menu

The S7-PLCSIM Tools menu contains the following commands:

Record/Playback Command

Click on or select the menu command **Tools > Record/Playback** to record or play back a sequence of events. The key sequence Alt + F5 toggles the display of the Record/Playback toolbar button.

Options Command

The menu command **Tools > Options** contains the following options:

- Attach Symbols...
- Show Symbols
- Reference Data
- Symbol Table

Attach Symbols

Select the menu command **Tools > Options > Attach Symbols** to use symbolic addressing in your simulated program. This menu command invokes a dialog box where you can choose the STEP 7 symbol table to be referenced.

Once you have attached a symbol table, you can use the Show Symbols, Reference Data, and Symbol Data options.

Show Symbols

Select the menu command **Tools > Options > Show Symbols** to display the symbolic addresses used in your program. To hide the symbols, select the command again.

This menu command is only available when a STEP 7 symbol table has been attached to the simulated program using the Attach Symbols option.

Reference Data

Select the menu command **Tools > Options > Reference Data** to open the Displaying S7 Reference Data application of STEP 7. You can use this application to debug your simulated program.

This menu command is only available when a STEP 7 symbol table has been attached to the simulated program using the Attach Symbols option.

Symbol Table

Select the menu command **Tools > Options > Symbol Table** to open the STEP 7 Symbol Editor and view the currently attached symbol table.

This menu command is only available when a STEP 7 symbol table has been attached to the simulated program using the Attach Symbols option.

Window Menu

The S7-PLCSIM Window menu contains the following commands:

Cascade Command

To arrange windows so that they overlap (starting in the upper-left corner of the S7-PLCSIM window), click or select the menu command **Window > Cascade**.

Tile Ordered Command

To arrange the S7-PLCSIM view objects side by side, with the CPU view object in the top left, click or select the menu command **Window > Tile Ordered**.

Arrange Icons Command

The menu command **Window > Arrange Icons** arranges all minimized view objects (view object icons) along the bottom edge of the S7-PLCSIM window.

1, 2, 3... 9 Command

You can activate an open view object by selecting it from an alphabetical list in the **Window** menu. Select the number that corresponds to the desired view object. The currently active view object is indicated by a check mark.

If you have more than 9 view objects open, you can select **More Windows...** to see a dialog box with a complete list.

Help Menu

The S7-PLCSIM Help menu contains the following commands:

Contents Command

The menu command **Help > Contents...** opens the Contents screen of the S7-PLCSIM Help. From the table of contents, you can expand any book and click any topic to view help on S7-PLCSIM.

Introduction Command

The menu command **Help > Introduction** opens a Help topic that gives a general overview of S7-PLCSIM and the tasks you can perform with it.

Getting Started Command

The menu command **Help > Getting Started** opens a Help topic that helps you get started when you begin working with S7-PLCSIM for the first time.

Using Help Command

The menu command **Help > Using Help** provides information on using the online Help system.

About Command

The menu command **Help > About** gives you information on the version of the software and on the copyright.
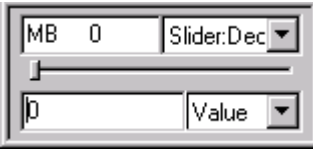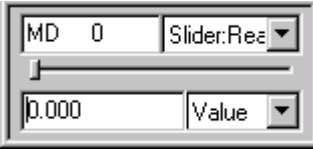
"What's This?" Help Button

To get information about S7-PLCSIM toolbars and features, follow these steps:

1. Click . The mouse pointer changes to a question-mark pointer .

2. Click the part of the screen about which you want more information. S7-PLCSIM displays the help topic on that item.

S7-PLCSIM Numeric Data Formats

Refer to the table below for the numeric data formats supported by S7-PLCSIM.

Numeric Data Format	Size	Example
Bits	Bit, Byte	☐ = off ☑ = on
Binary	Byte, Word	1001_0011
Decimal	Byte, Word, Double Word	232
Hex (Hexadecimal)	Byte, Word, Double Word	9A
S7 Format	Byte, Word, Double Word	dw#16#9a2ff23
Integer	Word, Double Word	632, −2370
BCD (Binary-coded Decimal)	Word, Double Word	400
Real	Double Word	1.234567e+023
Char (Character)	Byte, Word, Double Word	'C', 'AB'
String	254 Alphanumeric Characters	This is a string
DT (DATE_AND_TIME)	8 Bytes	1993-12-25-08:01:01 **Note:** The DT numeric data format does not support milliseconds.
S5TIME	Word	3m5s00ms
Date	Word	1998-06-18
Time	Double Word	9h26m53s703ms
TOD	Double Word	9:26:53.702
Slider: Dec	Byte, Word, Double Word	
Slider: Int	Word, Double Word	
Slider: Real	Double Word	

Troubleshooting Tips

The following table describes some problems that you can encounter when using S7-PLCSIM, and lists possible causes of the problem and recommended corrective actions.

Problem	Possible Causes or Corrections
Your program does not download to the simulated CPU.	Verify that the CPU is in either STOP mode or RUN-P mode. You cannot download your program if the simulated CPU is in RUN mode, unless you have configured CiR (Configuration in RUN) elements in STEP 7. CiR objects are the only objects that can be downloaded to S7-PLCSIM in RUN mode.
	If your program contains a System Data Block (SDB), verify that the CPU is in STOP mode. As with a real CPU, you can download SDBs only when the CPU is in STOP mode. **Note:** If the CPU view object is in RUN-P mode, STEP 7 prompts you to change to STOP so that the hardware configuration can be downloaded.
	Verify that the CPU and the program use the same node address. The node address defined for the program must match the node address of the CPU.
When you attempt to close the simulated CPU, a message alerts you that there is a connection open.	If you attempt to close the simulated CPU while one of the STEP 7 tools (such as S7 Status) is monitoring the program, STEP 7 alerts you to disconnect the STEP 7 tool from the simulated CPU. Always disconnect any STEP 7 tool by turning off the monitoring of the program status or by closing the tool before closing the simulated CPU.
The S7-PLCSIM application does not respond and appears to be "locked up."	Check the execution mode. S7-PLCSIM can appear to be locked up when paused or in Single Scan mode.
You enter a peripheral variable and get an "Invalid Address" error, even though the address value is valid. **- or -** You get a peripheral access error in your program, even though your S7-300 project contains the correct configuration.	Only the CPU 315-2DP, CPU 316-2DP, and CPU 318-2 CPUs download an I/O configuration. If you download a program from another S7-300 CPU, the system data does not include the I/O configuration. This causes errors when you attempt to access peripheral I/O in S7-PLCSIM. To correct this, create an CPU 315-2DP, CPU 316-2DP, or CPU 318-2 station and put a copy of your hardware configuration into it. Download the hardware configuration from the CPU 315-2DP, CPU 316-2DP, or CPU 318-2 to S7-PLCSIM.

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