

EcoStruxure™ Control Expert PLC Simulator

(Original Document)

12/2018

EIO0000001714.07

www.schneider-electric.com



The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

You agree not to reproduce, other than for your own personal, noncommercial use, all or part of this document on any medium whatsoever without permission of Schneider Electric, given in writing. You also agree not to establish any hypertext links to this document or its content. Schneider Electric does not grant any right or license for the personal and noncommercial use of the document or its content, except for a non-exclusive license to consult it on an "as is" basis, at your own risk. All other rights are reserved.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

© 2018 Schneider Electric. All rights reserved.

Table of Contents



	Safety Information	5
	About the Book	9
Chapter 1	Simulating a PLC	11
	Introduction	12
	PLC Simulator Cyber Security	13
	Loading a Project in the Simulator	14
	Simulator Icon in the Toolbar	17
Chapter 2	Differences Between the Simulator and a Real CPU . . .	19
	Limitations of the PLC Simulator	20
	System Bits and System Words	23
Chapter 3	Menu Commands and Dialog Boxes in the PLC Simulator	37
	Simulator Control	38
	Simulator Control for Unknown CPU	39
	Simulator Control for Modicon M580 CPU	42
	Simulator Control for Modicon M580 Safety CPU	44
	Memory Card for Modicon M580 CPU	47
	Simulator Control for Modicon Quantum CPU	51
	Simulator Control for Modicon Quantum Safety CPU	54
	Simulator Control for Modicon Premium CPU	57
	Simulator Control for Modicon M340 CPU	59
	Memory Card for Modicon M340 CPU	62
	Simulator Control for Modicon Momentum CPU	66
	Event Dialog	68
	Clear	69
	Reset	70
	Power Cycle	71
	Options	72
	Timing (simulator)	73
	Processor Load	74
	Priority of the Simulator	76
	Data in the User Task	77

Minimal Sample Time	78
Info	79
Help	80
Ending the Simulation	81
Index	83

Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

 WARNING
UNGUARDED EQUIPMENT
<ul style="list-style-type: none">• Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.• Do not reach into machinery during operation.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book



At a Glance

Document Scope

This document describes the PLC Simulator for EcoStruxure™ Control Expert.

Validity Note

This document is valid for EcoStruxure™ Control Expert 14.0 or later.

Related Documents

Title of documentation	Reference number
EcoStruxure™ Control Expert, System Bits and Words, Reference Manual	EIO0000002135 (English), EIO0000002136 (French), EIO0000002137 (German), EIO0000002138 (Italian), EIO0000002139 (Spanish), EIO0000002140 (Chinese)
EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35013361 (Italian), 35006147 (Spanish), 35013362 (Chinese)
Modicon M580, Safety System Planning Guide	QGH60283 (English), QGH60284 (French), QGH60285 (German), QGH60286 (Spanish), QGH60287 (Italian), QGH60288 (Chinese)

You can download these technical publications and other technical information from our website at www.schneider-electric.com/en/download.

Chapter 1

Simulating a PLC

Overview

This chapter describes simulating a PLC.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Introduction	12
PLC Simulator Cyber Security	13
Loading a Project in the Simulator	14
Simulator Icon in the Toolbar	17

Introduction

Installation

The simulator is automatically installed with Control Expert.

Area of Use

The simulator allows you to simulate a CPU.

The use of Breakpoints, Stepping and the GoTo function enables you to test your user program in the simulated CPU.

Structure of the Simulator

The Simulator Dialog (*see page 38*) provides the following indications:

- Type of simulated CPU.
- Current status of the simulated CPU.
- Name of the loaded project.
- IP address and DNS name of the host PC for the simulator.
- IP addresses and DNS names of connected client PCs.
- Dialog box to simulate IO events.
- **Reset** button to simulate a cold start.
- **Power Cycle** button to simulate a warm start.
- Shortcut menu (right mouse button) to control the simulator.

The Simulator symbol shown in the task bar offers the following features:

- Display of the current status of the simulated PLC (*see page 17*).
- QuickInfo (Tooltips) shows the IP address of the host PC for the simulator, the used port number and the name of the loaded project.
- Shortcut menu (right mouse button) to control the simulator.

PLC Simulator Cyber Security

At a Glance

PLC simulator fits the Cyber Security requirements.

These two rules are applied:

- The PLC simulator only starts with an application inside.
- The PLC simulator forbids to upload an application in monitoring mode.

PLC Simulator Only Starts with an Application Inside

The PLC Simulator Option Panel supplies a new check box **Use default application to start simulator (enforce security)** and a new field to give the application path.

If **Use default application to start simulator (enforce security)** box is checked, an application with password should be accessible by the path given in the field, this is the default option.

If the option is unchecked, a message is displayed to inform that the PLC Simulator use is not secured on its 502 Port.

At first start of PLC Simulator, the box is checked but the path is empty. A popup message informs that:

- A valid Control Expert application is mandatory to start PLC Simulator.
- To enforce security, it is necessary to use an Application Password.

NOTE: Password protected application is necessary to enforce security on Ethernet port of computer which is by default port 502.

When PLC Simulator is started from Control Expert (menu **PLC → Connect**) or from Windows menus with **Use default application to start simulator (enforce security)** box checked:

- If there is no application with password in the PLC simulator or application path is not valid, the **Simulator Panel Options** windows pops up and PLC simulator will not start unless a valid path is set or the option is unchecked.
- If application path is valid, the PLC simulator starts, without displaying the option panel.

PLC Simulator Forbid to Upload an Application in Monitoring Mode

In Monitoring mode the **PLC → Transfer Project from PLC** option is grayed. The related icon is grayed too.

As a result, the PLC Project from PLC simulator cannot be uploaded.



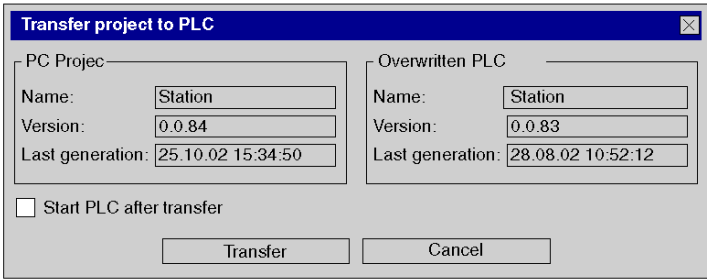
Loading a Project in the Simulator



Introduction

The process for loading a project to the simulator is identical in principle to loading a project on a real PLC.

Loading a Project

Loading a project in the simulator

Step	Action
1	<p>In Control Expert, enable the simulator mode using the menu command PLC → Simulation mode or the symbol</p>  <p>on the toolbar:</p>
2	<p>Execute the menu command Rebuild → Rebuild All Project.</p>
3	<p>Create a connection to the simulator using the menu command PLC → Connect, see also <i>Creating a Connection, page 15</i>.</p> <p>Result:</p> <ul style="list-style-type: none"> The simulator icon (<i>see page 17</i>) appears in the toolbar:  <ul style="list-style-type: none"> see also <i>Possible Error Messages, page 16</i> <p>Note: It is standard procedure for the simulator to be installed on the same PC as Control Expert (Local Host). The project can also be loaded on a simulator in another PC via a TCP/IP connection.</p>
4	<p>Execute the menu command PLC → Transfer project to PLC.</p> <p>Result: A transfer dialog box appears.</p> 

Step	Action
5	Press the Transfer button. Result: The project is loaded on the simulator and the simulator icon looks as follows in the toolbar: 
6	Select the menu command PLC → Start . Result: The project is launched on the simulator and the simulator icon looks as follows in the toolbar: 

Transferring Safety/Non-Safety Projects

It is not possible to transfer a non-safety project after you have transferred a safety project to the PLC simulator and vice versa.

In this case you first have to clear the PLC simulator. See *Clear*, page 69.

Control Expert XLS Password Protection

Safety projects built with Control Expert XLS are password protected.

If a safety project has been transferred to the simulator and you try to connect Control Expert XLS to the simulator, you are asked to enter the password.

You are asked to enter the password either if no project is opened in Control Expert XLS or if a different one is opened.

NOTE: To remove the currently loaded project from the simulator memory you can use the **Clear** menu command. See *Clear*, page 69.

For further information on password protection of safety projects please refer to the chapter *Application Protection* (see *Modicon M580, Safety System Planning Guide*).

Creating a Connection

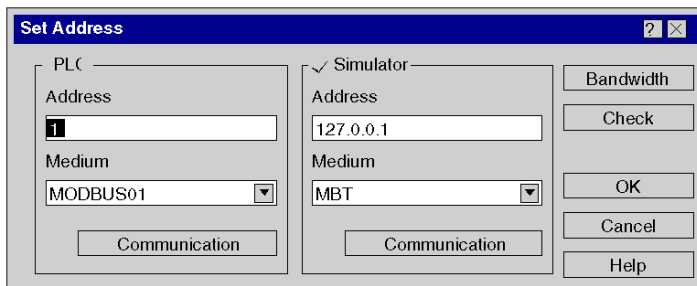
It is standard procedure for the simulator to be installed on the same PC as Control Expert (Local Host). When the menu command **PLC → Connect** is selected, a connection to the Local Host PC on the default port 502 (Schneider Port) is automatically created. The project can also be loaded on a simulator in another PC via a TCP/IP connection or on a simulator running on a different port.

In this case you must specify the TCP/IP address and port number of the target PC in the *Loading a project* procedure before carrying out step 3 (creating a connection).

Then select the Control Expert menu command **PLC → Set Address**, and in the **Simulator** text box **Address** enter the TCP/IP address and the optional port number of the target PC (i.e.: 139.158.106.127:123 where 123 is the port number). Then continue with step 3.

If you want to load the project in the Local Host PC simulator running on default port 502 (Control Expert and simulator on the same PC), you do not have to carry out this step as the Local Host PC address and port number is automatically entered.

Representation of the default dialog box:



Possible Error Messages

The following error messages can occur when launching the simulator:

Error message	Cause	Removal
A simulator is already running!	The simulator is already active. Only one simulator can be active.	Confirm the error message with OK and use the simulator that is already active.
Version information from xxx cannot be read (err=0)!	invalid file in the simulator directory	Reinstall Control Expert after uninstalling it.
The DLL xxx is incompatible (...)!	invalid file in the simulator directory	Reinstall Control Expert after uninstalling it.
At least one Simulator DLL is incompatible. Simulation not possible!	invalid file in the simulator directory	Reinstall Control Expert after uninstalling it.

Exiting the Simulator

The procedure for exiting the simulator is as follows:

Step	Action
1	Call the menu command Exit Simulation from the shortcut menu for the simulator icon in the toolbar or the simulator dialog box. Result: The simulator is closed.

Simulator Icon in the Toolbar




Introduction

After launching the simulators the simulator icon appears in the toolbar. This icon identifies the active simulator and displays the different states of the simulated PLC.


General Structure

The simulator icon is composed according to the following rules.





The background color represents the basic state.

Example	Color	Description
	green	normal operating mode
	yellow	PLC in HALT state
	red	PLC in ERROR state



A frame around the icon shows the active debug mode

Example	Color	Description
	blue	Debug mode is active, i.e. at least one breakpoint is set in the project, or there is at least one user task in debug mode.

The inner symbol shows the current PLC state, such as NOCONF, IDLE, STOPPED, RUN.



Symbol	The simulated PLC is in state...	Description
	NOCONF (no configuration)	No user project loaded or the loaded project is invalid or removed with the Clear command.
	IDLE	The project loaded on the PLC has not been started or reset with the Reset command button.
	STOPPED	No project is running.
	RUN	A project with at least one task is running.

The color of the inner symbol shows the connection state.

Example	Color	Description
	black	No TCP/IP client is connected.
	red	At least one TCP/IP client is connected.




Error States

Meaning of the symbols

Symbol	The simulated PLC is in state...	Description
	HALT	An error has occurred in the project. The simulated PLC must be re-initialized or reset using the Reset command button.
	ERROR	An fatal error has occurred in the project. This means communication is no longer possible. The simulated PLC must be reset using the Reset command button.

Internal States

The following symbols represent temporary internal states which should not be seen normally. It is not possible to recover from these states, so the PLC simulator must be closed and restarted again.

Symbol	The simulated PLC is in state...	Description
	POWER OFF	An internal error has occurred during the simulation of a PLC reset or power cycle.
	INIT	An internal error has occurred during the initialization of the PLC simulator.
	UNKNOWN	The PLC simulator has entered an unknown state.

Chapter 2

Differences Between the Simulator and a Real CPU

Overview

This chapter describes the difference between the simulator and a real PLC.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Limitations of the PLC Simulator	20
System Bits and System Words	23

Limitations of the PLC Simulator

General

General limitations

- The PLC simulator simulates a complete project with its user tasks. However, the runtime behavior of the simulator cannot be compared to that of a real PLC and cannot be used to draw conclusions about the behavior of a real PLC. This includes Multitasking behavior and time information.
- The PLC Simulator does not support any form of I/O. Although the simulation contains project components for I/Os, they are not processed by the PLC simulator. Inputs and outputs can only be accessed via the project or via the Control Expert online functions (read, write, force, animate, ...).
- With the PLC simulator I/O events can not be triggered by setting/forcing %I bits.
- For limitations concerning the memory card please refer to Memory Card for Modicon M580 CPU (*see page 47*) and Memory Card for Modicon M340 CPU (*see page 62*).
- The PLC Simulator does not support any Hot Standby feature.

PLC OS System Services

The PLC simulator supports the most PLC OS system services on a variety of platforms. These services are only implemented as dummy services.

This means that functions and function blocks can be used in the loaded project, but they do not work as expected and/or they return an error message.

This mainly affects functions and function blocks that accessed special platforms, such as I/O blocks, communication and hardware specific functions.

The following PLC OS system services are supported:

- diagnostics functions
- functions to read the date and time
- propagation delay time
- object access (except network variables)
- Premium DFBs
- SFC

The following PLC OS system services are not supported:

- closed loop control (CLC)
- Fip IO
- BusX IO
- Quantum IO
- configuration
- communication
- functions to set the date and time

Memory Structure

The different PLC families vary in memory structure.

For detailed information about memory alignment refer to chapter DDT: Mapping rules.
(see *EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*)

For detailed information about storage principles and memory structure refer to chapter *Application Memory structure* (see *EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*).

NOTE: PLC Simulator is a 16 bits application, whatever PLC in application is (Quantum, Premium, M580...). This is why you must rebuild your application when you switch from real PLC to Simulator.

WARNING

UNINTENDED EQUIPMENT OPERATION

Improper data mapping will occur where memory structures are different. When managing data exchanges between M340, M580 or Momentum projects and Premium or Quantum projects, ensure that the structure of the exchanged data has identical alignments (see *EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual*).

Otherwise, the data will not be exchanged properly.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Communication

Communication limitations

- The PLC simulator only supports TCP/IP based communication (Schneider Port 502). In other cases a Modbus error is returned.
- Modbus, Modbus Plus or Uni-TE are not supported by the PLC simulator.
- The PLC simulator does not support communication to other PCs or PLC simulators, neither remote nor local.
- The PLC simulator has no communication timeout.
- Communication network, such as Uni-Telway, Ethway, Fipway, Modbus, Modbus Plus, etc., are not supported by the PLC simulator.

The PLC simulator supports the following native Modbus commands:

Function Code (in hex)	Description
01	Read Coil Status (0x)
02	Read Input Status (1x)
03	Read Holding Registers (4x)
04	Read Input Registers (3x)
05	Force Single Coil (0x)

Function Code (in hex)	Description
06	Preset Single Register (4x)
0F	Force Multiple Coils (0x)
10	Preset Multiple Registers (4x)
16	Mask Write Registers (4x)

Mapping a %MW to a Boolean Element

Regarding the use of %MW mapped on a boolean element in structured data type, the PLC simulator and a real PLC behave different.

When a %MW is mapped on a boolean element in structured data type, only the first row is animated by the PLC simulator. On a real PLC both rows (zero and one) are animated. Row one is used to get the information about the history value.

Control Expert XLS Safety Project Limitations

The following limitations apply to the PLC simulator working with safety projects built with Control Expert XLS:

- The PLC simulator has no double code execution of the logic and comparison of the results. It only simulates the logic but not the safety behavior of the PLC.
- It is not possible to transfer a non-safety project after you have transferred a safety project to the PLC simulator and vice versa.

In this case you first have to clear the PLC simulator. See *Clear*, page 69.

Debugging Limitations

The PLC simulator could enter HALT state when executing the **Step Info** or **Step Over** debugging command in textual languages.

If the current element is a complex instruction (i.e. copying a huge array from one variable to another), the execution of this instruction takes a very long time, because it will be executed in single step mode on the PLC simulator.

Setting a breakpoint on the next instruction and executing the **Go** command avoids this problem.

System Word %SW125

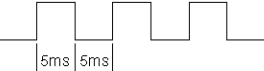
In case of division by 0 the %SW125 is set to:

- 16#DEF0 (division by 0) for legacy Quantum PLC and for the PLC simulator
- 16#DEF2: (arithmetic error) for Quantum HE (high end) PLCs

System Bits and System Words

System Bits

The following subsets of %S system bits (*see EcoStruxure™ Control Expert, System Bits and Words, Reference Manual*) are supported:

Bit Symbol	Function	Description
%S0 COLDSTART	cold start	<p>Normally at 0, this bit is set to 1 by:</p> <ul style="list-style-type: none"> ● power restoration with loss of data (battery fault) ● the user program ● the terminal, ● a change of cartridge <p>This bit is set to 1 during the first complete restored cycle of the PLC either in RUN or in STOP mode. It is reset to 0 by the system before the following cycle.</p> <p>NOTE: When %S0 is set to 1, the messages in the diagnostic buffer are deleted.</p> <p>NOTE: %S0 is not set to 1 using Reset with the PLC simulator (in contrast to a real PLC).</p> <p>%S0 is not always set in the first scan of the PLC. If a signal set for every start of the PLC is needed, %S21 should be used instead.</p>
%S1 WARMSTART	warm restart (not for safety PLCs)	<p>Normally at 0, this bit is set to 1 by :</p> <ul style="list-style-type: none"> ● power restoration with data save ● the user program ● the terminal ● action on change of cartridge <p>It is reset to 0 by the system at the end of the first complete cycle and before the outputs are updated.</p> <p>%S1 is not always set in the first scan of the PLC. If a signal set for every start of the PLC is needed, %S21 should be used instead.</p>
%S4 TB10MS	time base 10 ms (not for safety PLCs)	<p>An internal timer regulates the change in status of this bit. It is asynchronous in relation to the PLC cycle. Graph:</p> 
%S5 TB100MS	time base 100 ms (not for safety PLCs)	Similar wave structure as %S4
%S6 TB1SEC	time base 1 s (not for safety PLCs)	Similar wave structure as %S4
%S7 TB1MIN	time base 1 min (not for safety PLCs)	Similar wave structure as %S4

Bit Symbol	Function	Description
%S11 WDG	watchdog overflow	<p>Normally at 0, this bit is set to 1 by:</p> <ul style="list-style-type: none"> ● power restoration with data save ● the user program ● the terminal ● action on change of cartridge. <p>It is reset to 0 by the system at the end of the first complete cycle and before the outputs are updated.</p>
%S12 PLCRUNNING	PLC in RUN	<p>This bit is set to 1 by the system when the PLC is in RUN. It is set to 0 by the system as soon as the PLC is no longer in RUN (STOP, INIT, etc.).</p>
%S13 1RSTSCANRUN	first cycle after switching to RUN	<p>Normally set to 0, this is set to 1 by the system during the first cycle of the master task after the PLC is set to RUN.</p>
%S15 STRINGERROR	character string fault (not for safety PLCs)	<p>Normally set to 0, this bit is set to 1 when the destination zone for a character string transfer is not of sufficient size (including the number of characters and the end of string character) to receive this character string. The application stops in error state if the %S78 bit has been set to 1. This bit must be reset to 0 by the application.</p>
%S17 CARRY	rotate or shift output	<p>normally at 0 During a rotate or shift operation, this bit takes the state of the outgoing bit.</p>
%S18 OVERFLOW	overflow or arithmetic error	<p>Normally set to 0, this bit is set to 1 in the event of a capacity overflow if there is:</p> <ul style="list-style-type: none"> ● a result greater than + 32 767 or less than - 32 768, in single length ● a result greater than + 65 535, in unsigned integer ● a result greater than + 2 147 483 647 or less than - 2 147 483 648, in double length ● result greater than +4 294 967 296, in double length or unsigned integer ● real values outside limits ● division by 0 ● the root of a negative number ● forcing to a non-existent step on a drum ● stacking up of an already full register, emptying of an already empty register <p>It must be tested by the user program after each operation where there is a risk of overflow, and then reset to 0 by the user if there is indeed an overflow. When the %S18 bit switches to 1, the application stops in error state if the %S78 bit has been set to 1.</p>

Bit Symbol	Function	Description
%S19 OVERRUN	task period overrun (periodical scanning)	Normally set to 0, this bit is set to 1 by the system in the event of a time period overrun (i.e. task execution time is greater than the period defined by the user in the configuration or programmed into the %SW word associated with the task). The user must reset this bit to 0. Each task manages its own %S19 bit.
%S20 INDEXOVF	index overflow (not for safety PLCs)	Normally set to 0, this bit is set to 1 when the address of the indexed object becomes less than 0 or exceeds the number of objects declared in the configuration. In this case, it is as if the index were equal to 0. It must be tested by the user program after each operation where there is a risk of overflow, and then reset to 0 if there is indeed an overflow. When the %S20 bit switches to 1, the application stops in error state if the %S78 bit has been set to 1.
%S30 MASTACT	activation/deactivation of the master task (not for safety PLCs)	Normally set to 1. The master task is deactivated when the user sets the bit to 0. This bit is taken into consideration by the system at the end of each MAST task cycle.
%S31 FASTACT	activation/deactivation of the fast task (not for safety PLCs)	Normally set to 1 when the user creates the task. The task is deactivated when the user sets the bit to 0.
%S32 AUX0ACT to %S35 AUX3ACT	activation/deactivation of the auxiliary tasks 0-3 (not for safety PLCs)	Normally set to 1 when the user creates the task. The auxiliary task is deactivated when the user sets the bit to 0.
%S38 ACTIVEVT	enabling/inhibition of events (not for safety PLCs)	Normally set to 1. Events are inhibited when the user sets the bit to 0.
%S39 EVTTOVR	saturation in event processing (not for safety PLCs)	This bit is set to 1 by the system to indicate that one or more events cannot be processed following saturation of the queues. The user must reset this bit to 0.
%S62 MEMPROTOFF	memory protect OFF (not for safety PLCs)	This bit is the image of the key switch on legacy and high end Quantum PLCs.
%S65 CARDIS	card disable (Mirano) (not for safety PLCs)	Set to 1 by the user to disable access to the card. The system will detect a rising edge on this bit. When current access is finished (for example application save in progress), then the access LED will be off indicating that extraction is possible. The user has to reset the bit after extracting the card.
%S68 PLCBAT	state of the processor battery	This bit is used to check the operating state of the backup battery for saving data and the program in RAM: <ul style="list-style-type: none"> ● set to 0: battery present and operational ● set to 1: battery missing or non-operational

Bit Symbol	Function	Description
%S76 DIAGBUFFCONF	configured diagnostics buffer	This bit is set to 1 by the system when the diagnostics option has been configured. Then, a diagnostics buffer for storage of errors found by diagnostics DFBs is reserved. This bit is read-only.
%S77 DIAGBUFFFULL	full diagnostics buffer	This bit is set to 1 by the system when the buffer that receives errors from the diagnostics function blocks is full. This bit is read-only.
%S78 HALTIFERROR	stop in the event of error	Normally at 0, this bit can be set to 1 by the user, to program a PLC stop on application fault: %S15, %S18, %20.
%S80 RSTMSGCNT	reset message counters	Normally set to 0, this bit can be set to 1 by the user to reset the message counters %SW80 to %SW86.
%S94 SAVECURVAL	saving adjustment values (not for safety PLCs)	Normally at 0, this bit can be set to 1 by the user to replace the initial values of the declared variables with a 'Save' attribute (e.g.: DFB variables) with the current values. For Modicon M340, on a %S94 rising edge, the internal RAM and the memory card content are different (%S96 = 0 and the CARDERR LED is on). On cold start, the current values are replaced by the most recent initial values only if a save to memory card function (Backup Save or %S66 rising edge) was done. The system resets the bit %S94 to 0 when the replacement has been made. Note: this bit must be used with care: do not set this bit permanently to 1 and use the master task only.
%S95 RESTINITVAL	restore initial values (not for safety PLCs)	Normally on 0, this bit can be set on 1 by the user to restore the adjustment values of user function blocks.
%S96 BACKUPPROGOK	backup program OK (not for safety PLCs)	TSX Micro: <ul style="list-style-type: none"> on 0: application program saves are invalid on 1: application program saves are valid This bit can be read at any time (either by the program or while adjusting), in particular after a cold start or a warm restart. It is significant with regard to a PL7-effected backup application within the internal flash EPROM. M340: <ul style="list-style-type: none"> Set to 0 by the system when the card is missing or not usable (bad format, unrecognized type) or card content inconsistent with internal application RAM. Set to 1 when the card is correct and application is consistent with CPU internal application RAM.
%S97 SAVEMWOK	save %MW OK (not for safety PLCs)	on 0: %MW saves are invalid on 1: %MW saves are valid This bit can be read at any time (either by the program or while adjusting), in particular after a cold start or a warm restart.

NOTE: Quantum Safety PLCs specific system bits usage is described in the *Unity_Pro_XLS Software Operating Modes Specifics* guide.

System Words

The following subsets of %SW system word (*see EcoStruxure™ Control Expert, System Bits and Words, Reference Manual*) are supported:

Word Symbol	Function	Description
%SW0 MASTPERIOD	master task scanning period	This word is used to modify the period of the master task via the user program or via the terminal. The period is expressed in ms (1...255 ms) %SW0=0 in cyclic operation. On a cold restart: it takes the value defined by the configuration.
%SW1 FASTPERIOD	fast task scanning period (not for safety PLCs)	This word is used to modify the period of the fast task via the user program or via the terminal. The period is expressed in milliseconds (1...255 ms). On a cold restart, it takes the value defined by the configuration.
%SW2 AUX0PERIOD to %SW5 AUX3PERIOD	auxiliary task scanning period (not for safety PLCs)	This word is used to modify the period of the tasks defined in the configuration, via the user program or via the terminal. The period is expressed in tens of ms (10ms to 2.55s).
%SW10 TSKINIT	first cycle after cold start (not for safety PLCs)	If the value of the current task bit is set to 0, this means that the task is performing its first cycle after a cold start: <ul style="list-style-type: none"> ● %SW10.0: assigned to the MAST task ● %SW10.1: assigned to the FAST task ● %SW10.2 to 5: assigned to the AUX 0...3 tasks
%SW11 WDGVALUE	watchdog duration	Reads the duration of the watchdog. The duration is expressed in milliseconds (10...1500 ms). This word cannot be modified. NOTE: The duration range in Quantum Safety PLCs is: 20...990 ms.
%SW12 APMODE	mode of application processor (for safety PLCs only)	This word indicates the operating mode of the application processor. Possible values are: <ul style="list-style-type: none"> ● 16#A501: application processor is in Maintenance Mode ● 16#5AFE: application processor is in Safety Mode Any other value is interpreted as a detected error. This system word is not available for the standard Quantum CPU.
%SW13 INTELMODE	mode of Intel processor (for safety PLCs only)	This word indicates the operating mode of the Intel Pentium processor. Possible values are: <ul style="list-style-type: none"> ● 16#501A: application processor is in Maintenance Mode ● 16#5AFE: application processor is in Safety Mode Any other value is interpreted as a detected error. This system word is not available for the standard Quantum CPU.

Word Symbol	Function	Description
%SW15 OSCOMMPATCH	PLC processor patch version	This word contains the commercial version of the PLC processor patch. It is coded onto the least significant byte of the word. coding: 0 = no patch, 1 = A, 2 = B... Example: 16#0003 corresponds to patch C.
%SW17 FLOATSTAT	error status on floating operation (%SW17 System word is also managed by Quantum Safety PLCs)	When an error in a floating arithmetic operation is detected, bit %S18 is set to 1 and %SW17 error status is updated according to the following coding: <ul style="list-style-type: none"> ● %SW17.0 = Invalid operation / result is not a number ● %SW17.1 = Denormalized operand / result is acceptable (flag not managed by Modicon M340 or Quantum Safety PLCs) ● %SW17.2 = Division by 0 / result is infinity ● %SW17.3 = Overflow / result is infinity ● %SW17.4 = Underflow / result is 0 ● %SW17.5 to 15 = not used This word is reset to 0 by the system on cold start, and also by the program for re-usage purposes.
%SW18 %SW19 100MSCOUNTER	absolute time counter	%SW18 is the low and %SW19 the high word for calculating durations. Both are incremented every 1/10th of a second by the system (even when the PLC is in STOP, they are no longer incremented if it is powered down). They can be read and written by the user program or by the terminal.
%SW20 %SW21 MSCOUNTER	absolute time counter	The low word %SW20 and the high word %SW21 are incremented every 1/1000th of a second by the system (even when the PLC is in STOP, they are no longer incremented if it is powered down). They can be read by the user program or by the terminal. %SW20 and %SW21 are reset on a cold start, but not on a warm start.
%SW26	number of requests processed	This system word allows to verify on server side the number of requests processed by PLC per second. NOTE: This system word is available only for Modicon M340 CPU.
%SW30 MASTCURRTIME	master task execution time	This word indicates the execution time of the last master task cycle (in ms). Note: In general %SW30 works, but keep in mind that a PC is much faster as a PLC. For a short application a scan time less than 1ms is possible, in such a case %SW30 remains at 0. %SW30 will not be updated when an exception (division by 0, overflow, etc.) occurs during execution of the user logic or after any user debug activity. If an application throws an exception in each cycle, %SW30 will remain at 0 and %SW31, %SW32 will remain at 32768 and 32767 from the beginning.

Word Symbol	Function	Description
%SW31 MASTMAXTIME	maximum master task execution time	This word indicates the longest master task execution time since the last cold start (in ms).
%SW32 MASTMINTIME	minimum master task execution time	This word indicates the shortest master task execution time since the last cold start (in ms).
%SW33 FASTCURRTIME	fast task execution time (not for safety PLCs)	This word indicates the execution time of the last fast task cycle (in ms).
%SW34 FASTMAXTIME	maximum fast task execution time (not for safety PLCs)	This word indicates the longest fast task execution time since the last cold start (in ms).
%SW35 FASTMINTIME	minimum fast task execution time (not for safety PLCs)	This word indicates the shortest fast task execution time since the last cold start (in ms).
%SW36 AUX0CURRTIME %SW39 AUX1CURRTIME %SW42 AUX2CURRTIME %SW45 AUX3CURRTIME	auxiliary task execution time (different function in Safety PLCs)	Those words indicate the execution time of the last cycle of the AUX 0...3 tasks (in ms). NOTE: %SW36 and %SW39 words have a different function in Quantum Safety PLCs and the other words are not available on Quantum safety PLCs.
%SW37 AUX0MAXTIME %SW40 AUX1MAXTIME %SW43 AUX2MAXTIME %SW46 AUX3MAXTIME	maximum auxiliary task execution time (different function in Safety PLCs)	Those words indicate the longest task execution time of AUX 0...3 tasks since the last cold start (in ms). NOTE: %SW37 word has a different function in Quantum Safety PLCs and the other words are not available on Quantum safety PLCs.
%SW38 AUX0MINTIME %SW41 AUX1MINTIME %SW44 AUX2MINTIME %SW47 AUX3MINTIME	minimum auxiliary task execution time (different function in Safety PLCs)	Those words indicate the shortest task execution time of AUX 0...3 tasks since the last cold start (in ms). NOTE: %SW38 word has a different function in Quantum Safety PLCs and the other words are not available on Quantum safety PLCs.
%SW48 IOEVTNB	number of events (not for safety PLCs)	This word indicates the number of IO events and telegram processed since the last cold start. This word can be written by the program or the terminal NOTE: TELEGRAM is available only for PREMIUM (not on Quantum neither M340).

Word Symbol	Function	Description
%SW49 DAYOFWEEK %SW50 SEC %SW51 HOURMIN %SW52 MONTHDAY %SW53 YEAR	real-time clock function	<p>System words containing date and current time (in BCD):</p> <ul style="list-style-type: none"> ● %SW49: <ul style="list-style-type: none"> ○ 1 = Monday, ○ 2 = Tuesday, ○ 3 = Wednesday, ○ 4 = Thursday, ○ 5 = Friday, ○ 6 = Saturday, ○ 7 = Sunday, ● %SW50: Seconds (16#SS00), ● %SW51: Hours and Minutes (16#HHMM), ● %SW52: Month and Day (16#MMDD), ● %SW53: Year (16#YYYY). <p>These words are managed by the system when the bit %S50 is set to 0.</p> <p>These words can be written by the user program or by the terminal when the bit %S50 is set to 1.</p> <p>For M580:</p> <ul style="list-style-type: none"> ● The current time is in UTC (Coordinated Universal Time). If a local time is needed, use the <code>RRTC_DT</code> function.
%SW54 STOPSEC %SW55 STOPHM %SW56 STOPMD %SW57 STOPYEAR %SW58 STOPDAY	real-time clock function on last stop	<p>System words containing date and time of the last power failure or PLC stop (in Binary Coded Decimal):</p> <ul style="list-style-type: none"> ● %SW54: Seconds (00SS), ● %SW55: Hours and Minutes (HHMM), ● %SW56: Month and Day (MMDD), ● %SW57: Year (YYYY), ● %SW58: <p>The most significant byte contains the day of the week (1 for Monday through to 7 for Sunday), and the least significant byte contains the code for the last stop:</p> <ul style="list-style-type: none"> ○ 1 = change from RUN to STOP by the terminal or the dedicated input, ○ 2 = stop by watchdog (PLC task or SFC overrun), ○ 4 = power outage or memory card lock operation, ○ 5 = stop on hardware fault, ○ 6 = stop on software fault. Details on the type of software fault are stored in %SW125.
%SW70 WEEKOFYEAR	real-time clock function	<p>System word containing the number of the week in the year: 1 to 52.</p>

Word Symbol	Function	Description
%SW71 KEY_SWITCH	position of the switches on the Quantum front panel	This word provides the image of the positions of the switches on the front panel of the Quantum processor. This word is updated automatically by the system: <ul style="list-style-type: none"> ● %SW71.0 = 1 switch in the "Memory protected" position, ● %SW71.1 = 1 switch in the "STOP" position, ● %SW71.2 = 1 switch in the "START" position, ● %SW71.8 = 1 switch in the "MEM" position, ● %SW71.9 = 1 switch in the "ASCII" position, ● %SW71.10 = 1 switch in the "RTU" position, ● %SW71.3 to 7 and 11 to 15 are not used.
%SW75 TIMEREVTNB	Timer-type event counter	This word contains the number of timer-type events in the queue. (1): Not available on the following processors: TSX 57 1•/2•/3•/4•/5•. This word is not available on Quantum Safety PLCs.
%SW75 TIMEREVTNB	timer-type event counter (not for safety PLCs)	This word contains the number of timer-type events in the queue.
%SW76 DLASTREG	diagnostics function: recording	Result of the last registration: <ul style="list-style-type: none"> ● = 0 if the recording was successful, ● = 1 if the diagnostics buffer has not been configured, ● = 2 if the diagnostics buffer is full.
%SW77 DLASTDEREG	diagnostics function: non-recording	Result of the last deregistration: <ul style="list-style-type: none"> ● = 0 if the non-recording was successful, ● = 1 if the diagnostics buffer has not been configured, ● = 21 if the error identifier is invalid, ● = 22 if the error has not been recorded.
%SW78 DNBERRBUF	diagnostics function: number of errors	Number of errors currently in the diagnostics buffer.
%SW87 MSTSERVCNT	communication flow management	Number of requests processed by synchronous server per master (MAST) task cycle. The requests processed may come from communication ports (having access to the server Modbus/UNI-TE, each of them having its own limitation). This means also that requests from other clients, then communication EFs like IO Scanner, connected HMI and so on should be counted.
%SW90 MAXREQNB	maximum number of requests processed per master task cycle	This word is used to set a maximum number of requests which can be processed by the PLC per master task cycle. When the CPU is the server: This number of requests must be between 2 (minimum) and N+4 (maximum). N: number differs depending on the model. When the CPU is the client: N: number differs depending on the model. The value 0 will not work. If a value that is outside of the range is entered, it is the value N that is taken into account.

Word Symbol	Function	Description
%SW93	memory card file system erasing command and status	<p>Can be read and written by the user program or the terminal. This word is used by the customer to erase the memory card. Erasing is possible only in Stop mode:</p> <ul style="list-style-type: none"> ● %SW93.0 = 1 a rising edge starts the erasing operation. <p>%SW93.1 gives the file system status after an erasing request:</p> <ul style="list-style-type: none"> ● %SW93.1 = 0 invalid files system (bad format, erasing in progress), ● %SW93.1 = 1 valid files system.
%SW96 CMDDIAGSAVEREST	command and diagnostic of save and restore	<p>This word is used to copy or delete the current value of %MW to or from internal flash memory and to give the action's status. It can be read by the user program or by the terminal:</p> <ul style="list-style-type: none"> ● %SW96.0: Request to copy current value of %MW to internal Flash memory. Set to 1 by the user to request a save, and set to 0 by the system when a save is in progress. <p>NOTE: You must stop the processor before copying via %SW96.0.</p> <ul style="list-style-type: none"> ● %SW96.1 is set to 1 by the system when a save is finished, and set to 0 by the system when a save is in progress. ● %SW96.2 = 1 indicates an error on a save or restore operation (see %SW96.8 to 15 for error code definitions). ● %SW96.3 = 1 indicates that a restore operation is in progress. ● %SW96.4 may be set to 1 by the user to delete %MW area in internal Flash memory. ● %SW96.7 = 1 indicates that internal memory has valid %MW backup. ● %SW96.8 to 15 are error codes: When %SW96.2 is set to 1: <ul style="list-style-type: none"> ○ %SW96.9 = 1 indicates that the saved %MW number is less than the configured number, ○ %SW96.8 = 1 and %SW96.9 = 1 mean that the saved %MW number is greater than the configured number, ○ %SW96.8 = 1, %SW96.9 = 1 and %SW96.10 = 1 indicate a write error in internal flash memory.

Word Symbol	Function	Description
%SW97 CARDSTS	card status	Can be read by the user program or by the terminal. Indicates the status of the card. %SW97: 0000 = no error. 0001 = application backup or file write sent to a write-protected card. 0002 = card not recognized, or application backup damaged. 0003 = backup of the application requested, but no card available. 0004 = card access error, for example after a card has been removed improperly. 0005 = no file system present in the card, or file system not compatible. Use %SW93.0 to format the card.
%SW108 FORCEDIOIM	number of forced I/O module bits	This system word counts the number of forced I/O module bits. This word is incremented for every forcing, and decremented for every unforcing.
%SW109 FORCEDANA	number of forced analog channels	This system word counts the number of forced analog channels. This word is incremented for every forcing, and decremented for every unforcing.
%SW124 CPUERR	type of processor or system error	This system word is updated when the PLC is put in the error state. The possible values are: <ul style="list-style-type: none"> ● 0x0065: execution of HALT impossible, ● 0x0080: system watchdog. When the PLC is put in safety error state the content of %SW125 is updated and can be read after the next restart of the PLC (see below).

Word Symbol	Function	Description
%SW125 BLKERRTYPE	last fault detected	<p>The code of the last fault detected is given in this word: The following error codes cause the PLC to stop if %S78 is set to 1. %S15, %S18 and %S20 are always activated independently of %S78:</p> <ul style="list-style-type: none"> ● 16#0002: verification of PCMCIA signature fails, ● 16#2258: execution of HALT instruction, ● 16#2302: call to non supported system function in a user function block, ● 16#9690: error of application CRC detected in background, ● 16#DE87: calculation error on floating-point numbers (%S18, these errors are listed in the word %SW17), ● 16#DEB0: Watchdog overflow (%S11), ● 16#DEF0: division by 0 (%S18) ● 16#DEF1: character string transfer error (%S15), ● 16#DEF2: arithmetic error (%S18), ● 16#DEF3: index overflow (%S20). <p>Note: The codes 16#8xxx and 16#7xxx do not stop the application and indicate an error on function blocks.</p> <p>In case of a safety error, the PLC will stop. After power off and restart of the PLC, %SW125 will contain the code of the cause of the error:</p> <ul style="list-style-type: none"> ● 0x5AF1: Sequence check error (unpredictable execution in CPU) ● 0x5AF2: Error in memory (address fault) ● 0x5AF3: Comparison error (execution results of Intel and application processor differ) ● 0x5AF4: Real-time clock failure ● 0x5AF5: Error initializing double code execution ● 0x5AF6: Watchdog activation error ● 0x5AF7: Error during memory check (takes more than 8 hours) ● 0x5AF8: Error in memory check (RAM failure) <p>Note: %SW125 is only reset after <code>init</code> or complete download or restart (it always contains the last fault detected).</p>

Word Symbol	Function	Description
%SW126 ERRADDR0 %SW127 ERRADDR1	blocking error instruction address	Address of the instruction that generated the application blocking error. For 16 bit processors: <ul style="list-style-type: none"> ● %SW126 contains the offset for this address, ● %SW127 contains the segment number for this address. For 32 bit processors: <ul style="list-style-type: none"> ● %SW126 contains the least significant word for this address, ● %SW127 contains the most significant word for this address. In case of a safety error, the content of %SW126 and %SW127 is for Schneider Electric use only.

NOTE: Quantum Safety PLCs specific system words usage is described in the *Unity_Pro_XLS Software Operating Modes Specifics* guide.

Chapter 3

Menu Commands and Dialog Boxes in the PLC Simulator

Overview

This chapter describes the menu commands and dialog boxes in the PLC simulator.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Simulator Control	38
Simulator Control for Unknown CPU	39
Simulator Control for Modicon M580 CPU	42
Simulator Control for Modicon M580 Safety CPU	44
Memory Card for Modicon M580 CPU	47
Simulator Control for Modicon Quantum CPU	51
Simulator Control for Modicon Quantum Safety CPU	54
Simulator Control for Modicon Premium CPU	57
Simulator Control for Modicon M340 CPU	59
Memory Card for Modicon M340 CPU	62
Simulator Control for Modicon Momentum CPU	66
Event Dialog	68
Clear	69
Reset	70
Power Cycle	71
Options	72
Timing (simulator)	73
Processor Load	74
Priority of the Simulator	76
Data in the User Task	77
Minimal Sample Time	78
Info	79
Help	80
Ending the Simulation	81

Simulator Control

Description

You can open and close the simulator dialog using:

- The menu command **Simulator Control** in the context menu of the simulator symbol in the task bar or the simulator symbol.
- A double-click with the left mouse button on the simulator symbol in the task bar.

One of the following dialog boxes is opened or closed depending on the project loaded:

- Unknown CPU (*see page 39*)
- Modicon M580 CPU (*see page 42*)
- Modicon Quantum CPU (*see page 51*)
- Modicon Quantum Safety CPU (*see page 54*)
- Modicon Premium CPU (*see page 57*)
- Modicon M340 CPU (*see page 59*)
- Modicon Momentum CPU (*see page 66*)

Simulator Control for Unknown CPU

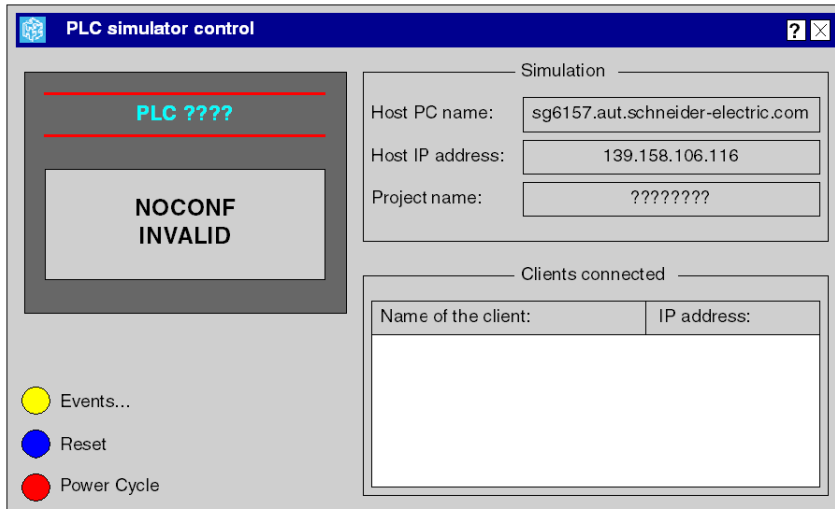
Introduction

This dialog box is shown if the simulator does not know which CPU type should be simulated.

This is the case for example in the following situations:

- Directly after the simulator is started and before a project is loaded.
- If the simulated CPU is in NOCONF state (in other words a valid project is not loaded in the simulator).

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the CPU and the project in a two line display.

The first line shows the current state of the CPU and can contain the following texts:

Text in the first line	The simulated CPU is in state...	Meaning
NOCONF	NOCONF (no configuration)	No user project loaded or the loaded project is invalid.
IDLE	IDLE	The project loaded on the CPU has not been started or reset with the Reset button.
STOP	STOPPED	No project is running. However, the loaded project was in RUN state at least once.
RUN	RUN	A project with at least one task is running.

Text in the first line	The simulated CPU is in state...	Meaning
HALT	HALT	An error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
ERROR	ERROR	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

The second line shows the current state of the project and can contain the following texts:

Text in the Second Line	Meaning
INVALID	No user project loaded or the loaded project is invalid.
CHECKED	The project was checked formally and found to be valid. However, the CPU has not been configured using this project.
CONF	The project was checked formally and found to be valid. The CPU has been configured using this project.

Events

With this button, you can open and close the event dialog box (*see page 68*).

The button is shown if I/O events are defined in the project currently loaded (if the project uses event tasks).

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU (the connection between Control Expert and the simulator is broken, project variables are reset).

This button corresponds to the reset button on a real CPU.

Power Cycle

With this button, you simulate a warm start of the CPU. It means that the connection between Control Expert and the simulator is broken, the current project variables remain and the simulator goes into the state RUN (autostart active) or STOP (autostart deactivated).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

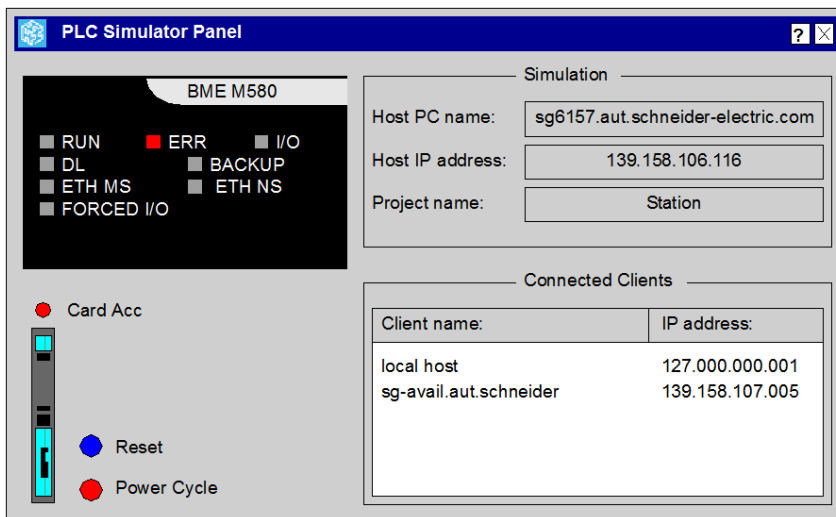
The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Simulator Control for Modicon M580 CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon M580 family.

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the CPU in a multi-line display using combinations of the **RUN** and **ERR** LEDs:

RUN LED	ERR LED	The simulated CPU is in state...	Meaning
–	–	NOCONF	The LED display is replaced with NOCONF - INVALID display. No user project loaded or the loaded project is invalid.
flashing	off	STOP	The project loaded on the PLC has not been started or has been reset with the Reset button.
on	off	RUN	A project with at least one task is running.
flashing	flashing	HALT	A detected error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
off	on	–	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

The **BACKUP LED** is **on** if a problem occurs during simulated card access or if the simulated memory card is removed.

The **I/O**, **DL**, **ETH MS**, **ETH NS**, and **FORCED I/O** LEDs are not supported by the simulator.

Card Acc

The **Card Acc** LED is **on** when the card is accessible.

Memory Card

Simulated features of a memory card for the Modicon M580 CPU (*see page 47*):

- Files on the memory card generated by the data storage function blocks.
- Remove/insert memory card.
- Memory card full.
- Write protection.

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU where the connection between Control Expert and the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Power Cycle

With this button, you execute a power cycle (power off/ power on) for the simulated CPU. This corresponds to a warm start of the CPU (the connection between Control Expert and the simulator is broken and the current project variables remain).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

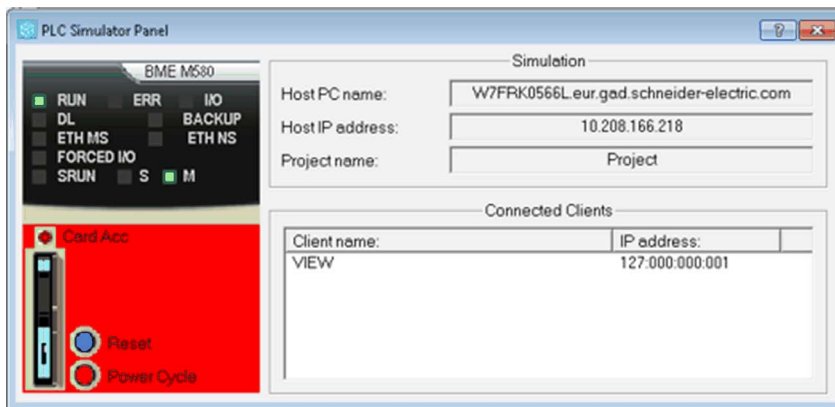
The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Simulator Control for Modicon M580 Safety CPU

Introduction

The dialog box is shown if the simulator is simulating a Modicon M580 Safety CPU.

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the CPU in a multi-line display using combinations of the **RUN** and **ERR** LEDs:

LEDs					The simulated CPU is in state...	Meaning
RUN	ERR	SRUN	S	M		
—	—	—	—	—	NOCONF	The LED display is replaced with NOCONF - INVALID display. No user project loaded or the loaded project is invalid.
flashing	off	on: SAFE task running off: SAFE task stopped.	on: Safety mode off	off flashing: Maintenance mode	STOP	The project loaded on the PLC has not been started or has been reset with the Reset button.

LEDs					The simulated CPU is in state...	Meaning
RUN	ERR	SRUN	S	M		
on	off	on: SAFE task running off: SAFE task stopped.	on: Safety mode	off	RUN	A project with at least one task is running.
			off	flashing: Maintenance mode		
flashing	flashing	on: SAFE task running off: SAFE task stopped.	on: Safety mode	off	HALT	A detected error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
			off	flashing: Maintenance mode		
off	on	off	off	off	SAFE	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

The **BACKUP** LED is **on** if a problem occurs during simulated card access or if the simulated memory card is removed.

The **I/O**, **DL**, **ETH MS**, **ETH NS**, and **FORCED I/O** LEDs are not supported by the simulator.

Card Acc

The **Card Acc** LED is **on** when the card is accessible.

Memory Card

Simulated features of a memory card for the Modicon M580 CPU (*see page 47*):

- Files on the memory card generated by the data storage function blocks.
- Remove/insert memory card.
- Memory card full.
- Write protection.

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU where the connection between Control Expert and the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Power Cycle

With this button, you execute a power cycle (power off/ power on) for the simulated CPU. This corresponds to a warm start of the CPU (the connection between Control Expert and the simulator is broken and the current project variables remain).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Connected Clients

The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Memory Card for Modicon M580 CPU

Overview

The Modicon M580 PLC simulator panel displays a memory card in the bottom left corner of the virtual front plate, for both M580 PLCs and M580 Safety PLCs. See, for example, Simulator control for Modicon M580 CPU (*see page 42*).

The memory card is inserted by default after the startup of the PLC Simulator.

No Backup/Restore

On a real Modicon M580 CPU, the memory card is separated in 2 parts:

- A part for the OS, where the application is stored persistent (backup/restore mechanism).
- A part for the application, where the application can store data by using data storage function blocks.

NOTE: The simulator does not simulate the backup/restore part of the memory card.

Not Simulated Features of a Memory Card

The following features of a real memory card are not supported:

- Backup/restore to/from memory card.
- Operating modes for memory cards.
- %S66 (APPLIBCK).

Simulated Features of a Memory Card

The following features of a memory card can be simulated for the Modicon M580 CPU:

- Files on the memory card generated by the data storage function blocks.
- Remove/insert memory card.
- Memory card full.
- Write protection.

File Management Function Blocks

The simulator supports the file management function blocks and simulates the generation of the files on the PC.

A directory on the PC simulates the file management part of the memory card. In this directory, the files created by the user application are stored.

The directory used for memory card simulation is either the default one (*C:\Documents and Settings\USERNAME\Local Settings\Temp\DataStorage*) or the directory used during the last simulation. The last used directory is stored persistent in the registry.

The files written by the application can be accessed by normal tools like an editor or Office tools.

The simulator never deletes the application written files. If an application needs to have a blank empty memory card, the system word %SW93 (Memory Card File System Format) has to be used in STOP state of the CPU.

NOTE: There is no tracking of the size and number of files written into the memory card.

Limitations for File Management Function Blocks

- Error codes generated by these functions/function blocks may be different between PLC simulator and a real CPU.
- With the PLC simulator, it is not possible to delete a file that is opened (neither with the `DELETE_FILE` function, nor by FTP command).
It is mandatory to close the file before deleting it, in order to delete the file descriptor.
Trying to delete a file that is opened generates a general error code (-1).
- The `SET_FILE_ATTRIBUTES` function is not supported by the PLC simulator.
Trying to call this function generates a general error (-1).

For detailed information about the file management functions/function blocks please refer to the *System Block Library* documentation.

Remove Memory Card

By default the memory card is inserted at simulator start.

The procedure for removing the memory card is as follows:

Step	Action
1	Set the system bit %S65 (CARDIS). Result: After a potential card access has finished the Card Acc LED goes out.
2	Open the context menu by clicking the memory card with the right mouse button.
3	Select Remove Memory Card... Result: The virtual front plate shows an empty memory card slot and the CARDERR LED is on.

NOTE: Removing the memory card has no influence on the used directory and the files, but the access to the files is disabled inside the simulator.

Insert Memory Card

The procedure for inserting the memory card is as follows:

Step	Action
1	Open the context menu by clicking the memory card with the right mouse button.
2	Select Insert Memory Card... Result: A Windows standard file selection dialog opens. The selection is pre-initialized with the last used memory card directory. Note: The file selection box also has a Write protected check box to insert a write protected virtual memory card.
3	Proceed with one of the 2 following possibilities: <ul style="list-style-type: none"> ● Use the preinitialized directory. Result: The last removed memory card is inserted. ● Select another directory. Result: Another memory card (for example different in content or empty) is inserted. Result: The CARDERR LED turns off.
4	Reset the system bit %S65 (CARDIS). Result: The virtual front plate shows a memory card and the Card Acc LED goes on.

Since a directory and its content represent the memory card, exchanging the content of the directory can simulate the exchange of a memory card. This can be done by normal Windows means (cut/copy/paste of files or renaming/moving folders).

Memory Card Full

By default the memory card is not full at simulator start.

Since there is no size tracking, at any time it is possible to simulate that the memory card is full.

This is done by opening the context menu (right-click the memory card) and selecting the menu command **Memory Card Full**.

After this menu command is selected:

- New data writing is not possible.
- Read accesses are possible.
- Overwrite actions are possible.

This state is indicated by the check mark in the context menu command.

Write Protection

By default the memory card is not write protected at simulator start.

At any time, it is possible to simulate that the memory card is write protected.

This is done by opening the context menu (right-click the memory card) and selecting the menu command **Write Protection**.

After this menu command is selected:

- Data writing is not possible.
- Read accesses are possible.

This state is indicated by the check mark in the context menu command.

Control Expert adds some restrictions linked with the memory card (for example program modification is forbidden if the card is write protected). The simulator supports these restrictions too.

To simulate the write protection feature the following system bits and words are supported by the simulator:

- %S65 (CARDIS)
- %S96 (BACKUPPROGOK)
- %SW97 (CARDSTS)

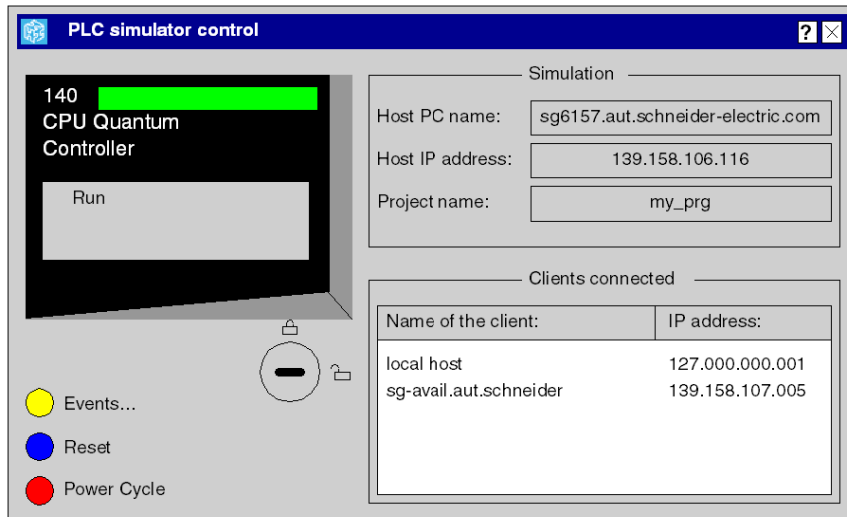
NOTE: It is not possible to access the files via an FTP client through the simulator since the files are directly accessible by Windows features.

Simulator Control for Modicon Quantum CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon Quantum family.

Representation of the dialog box:



CPU Front Plate



The virtual CPU front plate shows the current state of the CPU in a one line display:

Text in the display	The simulated CPU is in state...	Meaning
Init	INIT (Initialization)	This display is shown for a very short time while the simulator is starting. It is quickly replaced by one of the following displays.
UnCfg	NOCONF (no configuration)	No user project loaded or the loaded project is invalid.
Idle	IDLE	The project loaded on the CPU has not been started or reset with the Reset button.
Stop	STOPPED	No project is running. However, the loaded project was in RUN state at least once.
Run	RUN	A project with at least one task is running.

Text in the display	The simulated CPU is in state...	Meaning
Halt	HALT	An error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
Err	ERROR	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

Key Switch

By clicking the switch symbol, various switch positions can be simulated:

Switch position	Switch position on real CPU	Meaning
	Start	CPU unlocked: <ul style="list-style-type: none"> ● Project can be loaded. ● CPU can be started or stopped.
	Mem Prt	CPU locked: <ul style="list-style-type: none"> ● Project cannot be loaded. ● As opposed to the key switch on a real CPU, the CPU can be started or stopped in this position.
-	Stop	This switch position of a real CPU is not supported by the simulator.

Events

With this button, you can open and close the event dialog box (*see page 68*).

The button is shown if I/O events are defined in the project currently loaded (if the project uses event tasks).

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU (the connection between Control Expert and the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Reset corresponds to the reset button on a real CPU.

Power Cycle

With this button, you execute a power cycle (power off / power on) for the simulated CPU. This corresponds to a warm start of the CPU (the connection between Control Expert and the simulator is broken and the current project variables remain).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

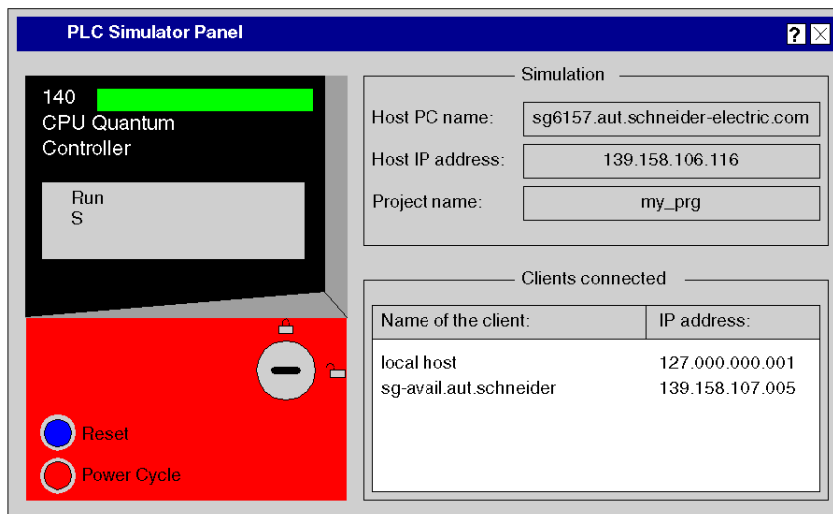
The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Simulator Control for Modicon Quantum Safety CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon Quantum safety family.

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the safety CPU in a display:

Text in the display	The simulated CPU is in state...	Meaning
Init	INIT (Initialization)	This display is shown for a very short time while the simulator is starting. It is quickly replaced by one of the following displays.
UnCfg	NOCONF (no configuration)	No user project loaded or the loaded project is invalid.
Idle	IDLE	The project loaded on the CPU has not been started or reset with the Reset command button.
Stop	STOPPED	No project is running. However, the loaded project was in RUN state at least once.
Run	RUN	A project with at least one task is running.
Halt	HALT	An error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset command button.

Text in the display	The simulated CPU is in state...	Meaning
Err	ERROR	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset command button.
S	Safety Mode	The project is running in safety mode. For further information on the different modes please refer to the <i>Unity Pro XLS Software Specifics</i> manual.
M	Maintenance Mode	The project is running in maintenance mode. For further information on the different modes please refer to the <i>Unity Pro XLS Software Specifics</i> manual.

Safety/Maintenance Mode (Safety Projects)

For switching between safety and maintenance mode please pay attention to the following special features:



- Switching from safety to maintenance mode in Control Expert XLS Software is only possible, if the simulator key switch is unlocked (see table below).
- Switching from maintenance to safety mode can be done by setting the key switch position of the simulator to locked.
- If the simulator is in maintenance mode and Control Expert XLS Software is disconnected from the simulator, it is automatically set to safety mode.

NOTE: The CPU simulator has no double code execution of the logic and comparison of the results. Therefore the execution behaves the same in safety and maintenance mode.

For further information on the different modes please refer to the *Unity Pro XLS Software Specifics* manual.

Key Switch

By clicking the switch symbol, various switch positions can be simulated:

Switch position	Switch position on real CPU	Meaning
	Start	CPU unlocked: <ul style="list-style-type: none"> • Project can be loaded. • CPU can be started or stopped.
	Mem Prt	CPU locked: <ul style="list-style-type: none"> • Project can not be loaded. • As opposed to the key switch on a real CPU, the CPU can be started or stopped in this position.
-	Stop	This switch position of a real CPU is not supported by the simulator.

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU (the connection between the Control Expert and the simulator is broken, project variables are reset).

This command button corresponds to the reset button on a real CPU.

Power Cycle

With this button, you simulate a cold start of the CPU as a safety CPU does not support warm start. The connection between Control Expert and the simulator is broken, the simulator goes into the state RUN (autostart active) or STOP (autostart deactivated).

This command button corresponds to the power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

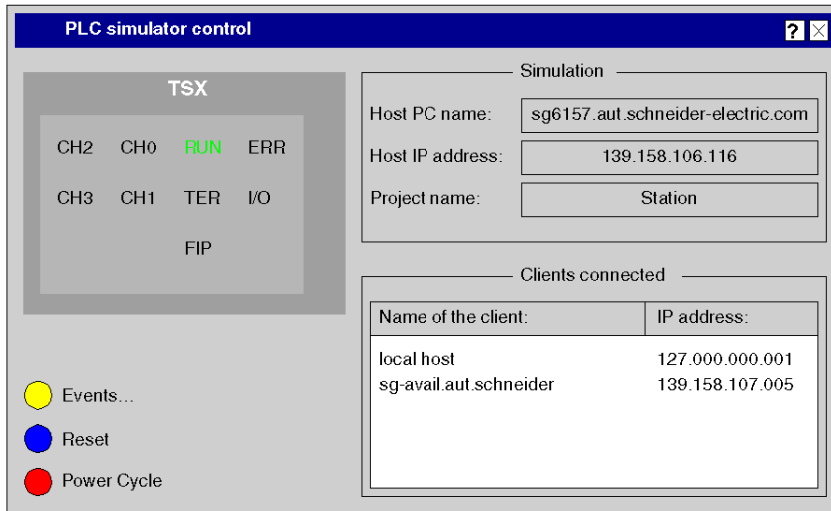
The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Simulator Control for Modicon Premium CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon Premium family.

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the CPU in a multi-line display using combinations of the **RUN** and **ERR** LEDs:

RUN LED	ERR LED	The simulated CPU is in state...	Meaning
off	flashing	NOCONF (no configuration)	No user project loaded or the loaded project is invalid.
flashing	off	IDLE	The project loaded on the CPU has not been started or reset with the Reset button.
flashing	off	STOPPED	No project is running. However, the loaded project was in RUN state at least once.
on	off	RUN	A project with at least one task is running.
off	flashing	HALT	An error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
off	on	ERROR	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

When data is being exchanged between Control Expert and the simulator, the **TER LED** is flashing.

The **CH0**, **CH1**, **CH2**, **CH3**, **I/O**, and **FIP** LEDs are no supported by the simulator.

Events

With this button, you can open and close the event dialog box (*see page 68*).

The button is shown if I/O events are defined in the project currently loaded (if the project uses event tasks).

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU where the connection between Control Expert and the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Reset corresponds to the reset button on a real CPU.

Power Cycle

With this button, you execute a power cycle (power off/ power on) for the simulated CPU. This corresponds to a warm start of the CPU (the connection between Control Expert and the simulator is broken and the current project variables remain).

A power cycle corresponds to a power off and power on (or pressing the reset button) of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

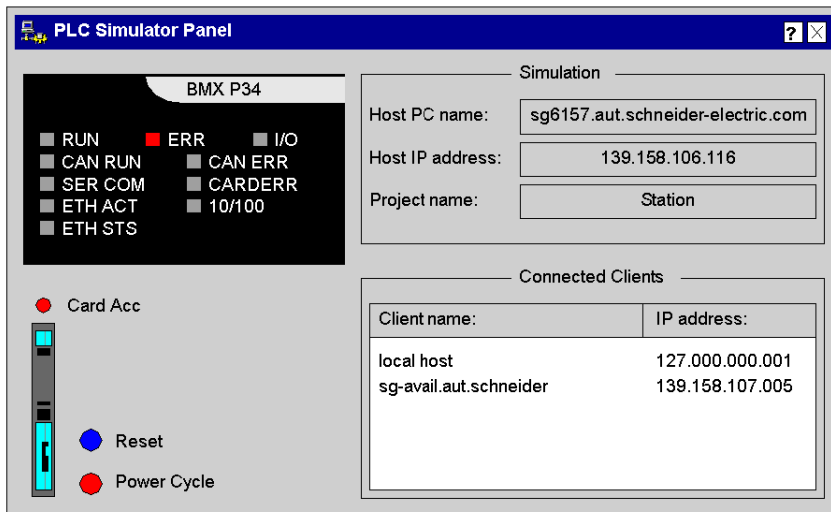
The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Simulator Control for Modicon M340 CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon M340 family.

Representation of the dialog box:



CPU Front Plate

The virtual CPU front plate shows the current state of the CPU in a multi-line display using combinations of the **RUN** and **ERR** LEDs:

RUN LED	ERR LED	The simulated CPU is in state...	Meaning
off	flashing	NOCONF (no configuration)	No user project loaded or the loaded project is invalid.
flashing	off	IDLE	The project loaded on the CPU has not been started or reset with the Reset button.
flashing	off	STOPPED	No project is running. However, the loaded project was in RUN state at least once.
on	off	RUN	A project with at least one task is running.

RUN LED	ERR LED	The simulated CPU is in state...	Meaning
off	flashing	HALT	An error has occurred in the project. The simulated CPU must be reinitialized or reset using the Reset button.
off	on	ERROR	An unrecoverable detected error has occurred in the project. This means communication is no longer possible. The simulated CPU must be reset using the Reset button.

When data is being exchanged between Control Expert (or other clients) and the simulator, the **SER COM** LED is flashing.

The **CARDERR** LED is ON if a problem occurs during card access or if the memory card is removed.

The **I/O**, **CAN RUN**, **CAN ERR**, **ETH ACT**, **ETH STS**, and **10/100** LEDs are not supported by the simulator.

Card Acc

The **Card Acc** LED is on when the card is accessible.

Memory Card

The following features of a memory card can be simulated for the Modicon M340 CPU (*see page 62*):

- Files on the memory card generated by the data storage function blocks.
- Remove/insert memory card.
- Memory card full.
- Write protection.

Reset

With this button, you can reset the simulated CPU. This corresponds to a cold start of the CPU where the connection between Control Expert and the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Power Cycle

With this button, you execute a power cycle (power off/ power on) for the simulated CPU. This corresponds to a warm start of the CPU (the connection between Control Expert and the simulator is broken and the current project variables remain).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Memory Card for Modicon M340 CPU

Overview

The Modicon M340 PLC simulator panel displays a memory card in the bottom left corner of the virtual front plate. See *Simulator Control for Modicon M340 CPU*, page 59.

The memory card is inserted by default after the startup of the PLC Simulator.

No Backup/Restore

On a real Modicon M340 CPU, the memory card is separated in 2 parts:

- A part for the OS, where the application is stored persistent (backup/restore mechanism).
- A part for the application, where the application can store data by using data storage function blocks.

NOTE: The simulator does not simulate the backup/restore part of the memory card.

Not Simulated Features of a Memory Card

The following features of a real memory card are not supported:

- Backup/restore to/from memory card.
- Operating modes for memory cards.
- %S66 (APPLIBCK).

Simulated Features of a Memory Card

The following features of a memory card can be simulated for the Modicon M340 CPU:

- Files on the memory card generated by the data storage function blocks.
- Remove/insert memory card.
- Memory card full.
- Write protection.

File Management Function Blocks

The simulator supports the file management function blocks and simulates the generation of the files on the PC.

A directory on the PC simulates the file management part of the memory card. In this directory, the files created by the user application are stored.

The directory used for memory card simulation is either the default one (*C:\Documents and Settings\USERNAME\Local Settings\Temp\DataStorage*) or the directory used during the last simulation. The last used directory is stored persistent in the registry.

The files written by the application can be accessed by normal tools like an editor or Office tools.

The simulator never deletes the application written files. If an application needs to have a blank empty memory card, the system word %SW93 (Memory Card File System Erasing) has to be used in STOP state of the CPU.

NOTE: There is no tracking of the size and number of files written into the memory card.

Limitations for File Management Function Blocks

- Error codes generated by these functions/function blocks may be different between PLC simulator and a real CPU.
- With the PLC simulator, it is not possible to delete a file that is opened (neither with the `DELETE_FILE` function, nor by FTP command).
It is mandatory to close the file before deleting it, in order to delete the file descriptor.
Trying to delete a file that is opened generates a general error code (-1).
- The `SET_FILE_ATTRIBUTES` function is not supported by the PLC simulator.
Trying to call this function generates a general error (-1).

For detailed information about the file management functions/function blocks please refer to the *System Block Library* documentation.

Remove Memory Card

By default the memory card is inserted at simulator start.

The procedure for removing the memory card is as follows:

Step	Action
1	Set the system bit %S65 (CARDIS). Result: After a potential card access has finished the Card Acc LED goes out.
2	Open the context menu by clicking the memory card with the right mouse button.
3	Select Remove Memory Card... Result: The virtual front plate shows an empty memory card slot and the CARDERR LED is on.

NOTE: Removing the memory card has no influence on the used directory and the files, but the access to the files is disabled inside the simulator.

Insert Memory Card

The procedure for inserting the memory card is as follows:

Step	Action
1	Open the context menu by clicking the memory card with the right mouse button.
2	Select Insert Memory Card... Result: A Windows standard file selection dialog opens. The selection is pre-initialized with the last used memory card directory. Note: The file selection box also has a Write protected check box to insert a write protected virtual memory card.

Step	Action
3	Proceed with one of the 2 following possibilities: <ul style="list-style-type: none"> ● Use the preinitialized directory. Result: The last removed memory card is inserted. ● Select another directory. Result: Another memory card (for example different in content or empty) is inserted. Result: The CARDERR LED turns off.
4	Reset the system bit %S65 (CARDIS). Result: The virtual front plate shows a memory card and the Card Acc LED goes on.

Since a directory and its content represent the memory card, exchanging the content of the directory can simulate the exchange of a memory card. This can be done by normal Windows means (cut/copy/paste of files or renaming/moving folders).

Memory Card Full

By default the memory card is not full at simulator start.

Since there is no size tracking, at any time it is possible to simulate that the memory card is full.

This is done by opening the context menu (right-click the memory card) and selecting the menu command **Memory Card Full**.

After this menu command is selected:

- New data writing is not possible.
- Read accesses are possible.
- Overwrite actions are possible.

This state is indicated by the check mark in the context menu command.

Write Protection

By default the memory card is not write protected at simulator start.

At any time, it is possible to simulate that the memory card is write protected.

This is done by opening the context menu (right-click the memory card) and selecting the menu command **Write Protection**.

After this menu command is selected:

- Data writing is not possible.
- Read accesses are possible.

This state is indicated by the check mark in the context menu command.

Control Expert adds some restrictions linked with the memory card (for example program modification is forbidden if the card is write protected). The simulator supports these restrictions too.

To simulate the write protection feature the following system bits and words are supported by the simulator:

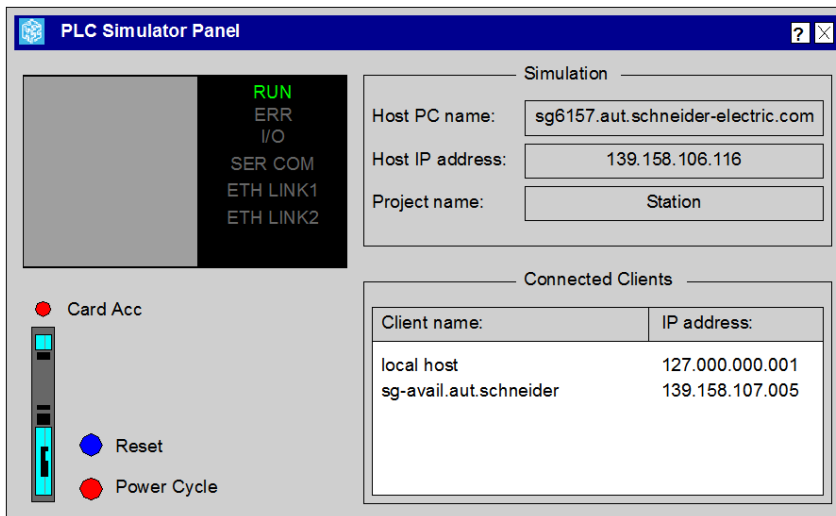
- %S65 (CARDIS)
- %S96 (BACKUPPROGOK)
- %SW97 (CARDSTS)

NOTE: It is not possible to access the files via an FTP client through the simulator since the files are directly accessible by Windows features.

Simulator Control for Modicon Momentum CPU

Introduction

The dialog box is shown if the simulator is simulating a CPU from the Modicon Momentum family.
Representation of the dialog box:



CPU Front Plate

The **RUN** display is always on, green when a project is loaded in the simulator.

The **SER COM** display is flashing yellow when data is exchanged between Control Expert (or other clients) and the simulator.

The other grayed displays of the front plate are not supported by the simulator.

Card Acc and Memory Card

The **Card Acc** and memory card are represented but they do not concern Modicon Momentum CPUs.

Reset

The **Reset** button is represented but it does not concern Modicon Momentum CPUs.

Power Cycle

With this button, you simulate a warm start of the CPU. It means that the connection between Control Expert and the simulator is broken, the current project variables remain and the simulator goes into the state RUN (autostart active) or STOP (autostart deactivated).

A power cycle corresponds to a power off and power on of a real power supply.

Simulation

Dialog box fields:

Host PC name: DNS name of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Host IP address: TCP/IP address of the host PC for the simulator. If the PC has multiple network cards, only the first is shown.

Project name: Name of the project loaded in the simulator.

Clients Connected

The list shows current clients connected with the PC (PCs which are connected via TCP/IP with the host PC of the simulator (*see page 15*)). The DNS name and TCP/IP address are shown for each client.

Event Dialog

Introduction

You can open and close the event dialog with

- the menu command **Event dialog** in the context menu of the simulator symbol in the task bar or the simulator symbol
- the command button **Events** in the simulator dialog (only open)

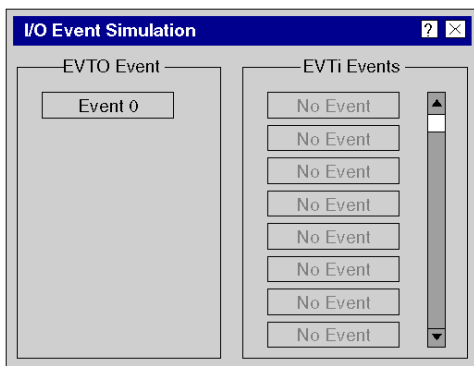
This dialog is not available for safety PLCs.

Selection Condition

The menu command and the command button are enabled if IO events are defined in the project currently loaded, i.e. if the project uses event tasks.

Representation

Event dialog:



EVT0 Event

Possible events for the EVT0 task are shown here. This user task has the highest priority in the system and can only contain one IO event.

If this task is part of the project, the event command button is enabled.

EVTi IO Event

Possible events for the EVTi IO task are shown here. The maximum number of tasks depends on the PLC simulated.

The event command buttons are enabled according to the number of events defined in the project.

Clear

Introduction

With **Clear**, you can remove the currently loaded project from the simulator memory and put the simulated PLC (and the simulator) into NOCONF status.

This corresponds to a cold start of the PLC without valid project loaded (the connection between Control Expert and the simulator is broken).

You can execute **Clear** with the menu command **Clear** in the context menu of the simulator symbol in the task bar.

Reset

Introduction

With **Reset**, you can reset the simulated PLC (and the simulator). This corresponds to a cold start of the PLC (the connection between Control Expert, the simulator is broken, project variables are reset and the simulator goes in RUN (if auto start is activated) or in STOP (if auto start is deactivated)).

Reset corresponds to the reset button on a real CPU.

You can execute reset with

- the menu command **Reset** in the context menu of the simulator symbol in the task bar or the simulator symbol
- the command button **Reset** in the simulator dialog.

NOTE: %S0 is not set to 1 using **Reset** with the PLC simulator (in contrast to a real PLC).

Power Cycle

Introduction

With **Power Cycle**, you execute a power cycle (power off/ power on) for the simulated PLC (and the simulator). This corresponds to a warm start of the PLC (the connection between Control Expert and simulator is broken and the current project variables remain).

A power cycle corresponds to the reset button of a Premium power supply or the unplugging and plugging in of a power supply.

You can execute a power cycle with

- the menu command **Power Cycle** in the context menu of the simulator symbol in the task bar or the simulator symbol
- the command button **Power Cycle** in the simulator dialog

NOTE: In case of a safety PLC, power cycle simulates a cold start. Project variables are reset.

Options

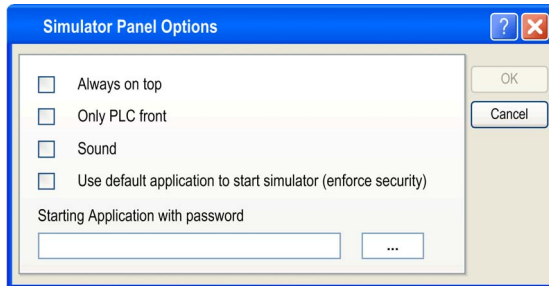
Description

In this dialog box, you can define special settings for the simulator.

You can open the dialog with the menu command **Options** in the context menu of the simulator symbol in the task bar or the simulator symbol.

Representation

Options



Always on Top

If you activate this check box, the simulator control window is always on top of other dialog boxes and windows.

Only PLC Front

If you activate this check box, the simulator control window is minimized and only the virtual front plate of the PLC is shown.

Sound

If you activate this check box, the simulator plays a sound in the following situations:

- Starting and exiting the simulator.
- Error in project.

Use default application to start simulator (enforce security)

If you activate this check box, the simulator needs an application with password to start (*see page 13*).

Starting Application with password

Path and name of the application with password used to start the simulator.

Timing (simulator)

Description

With this menu command, you can open and close the timing dialog box. This dialog box shows simulator statistics for CPU use, process priority and user scan time. Additionally, you can change the priority and the sleep time in this dialog box, to optimize simulator timing and adjust the PC load.

Representation of the dialog box

The dialog box 'Simulator timing' is divided into four main sections:

- Processor load:** Contains input fields for Process (0%), Overhead (0%), Mast (0%), Fast (0 s), Aux0 (0 s), Auy1 (0 s), Auy2 (0 s), Auy3 (0 s), Evt0 (0 s), Evt10 (0 s), and Evt1T (0 s). A 'Display' section has radio buttons for 'Absolute' (selected) and 'Relative', and a 'Reset' button.
- Data in the user task:** Contains two graphs. The first is 'Cycle time for: MAST' with a y-axis from 0.0 to 100% and an x-axis from 0.0 to 5.0 ms. The second is 'Sleep time for: MAST' with a similar y-axis and x-axis. Below the graphs are input fields for '0' and 'Reset'.
- Priority of the simulator:** Contains radio buttons for 'Real-time (with care)', 'High', 'Normal' (selected), and 'Low'. An 'Actual value:' field shows 'NORMAL' in red, and an 'Apply' button is present.
- Minimum sample time [ms]:** Contains an 'Actual value:' field showing '50' in red and a 'Setpoint:' field with '50'. An 'Apply' button is present.

The dialog box consists of 4 main areas:

- *Processor Load, page 74*
- *Priority of the Simulator, page 76*
- *Data in the User Task, page 77*
- *Minimal Sample Time, page 78*

Processor Load

Introduction

The processor load (on the PC) caused by the entire simulation and the individual user tasks is shown here.

Process

This bar graph shows the actual processor load caused by the simulator process in percent.

Unlike the display in the Windows task manager which only indicates the current value, this bar graph indicates the average value over the time shown at the end of the bar graph.

The time entry at the end of the bar graph is the time that has passed since the simulator was started or since the last time **reset** was pressed.

Overhead

This bar graph shows the average processor load caused by the simulator process overhead in percent.

The overhead is calculated as follows:

`load caused by the entire process - load caused by the user tasks`

This can be an absolute or relative value for the processor load caused by the simulator. This setting can be made in the **Display** area.

The time entry at the end of the bar graph is the time that has passed since the simulator was started or since the last time **Reset** was pressed.

Mast ... Evt1T

The bar graph shows the average processor load caused by the individual user tasks in percent.

These can be absolute or relative values for the processor load caused by the simulator. The representation method can be set in the **Display** area.

The option button at the beginning of the bar graph can be used to select a user task. The details for this user task will be displayed in the **Data in the user task** area.

The time entry at the end of the bar graph is the time that has passed since the individual tasks were started or since the last time **Reset** was pressed.

NOTE: In case of a safety PLC, only the Mast task is enabled

Display: Absolute

If you activate this option button, the actual value is shown in the bar graph. This is shown as a percentage of the entire processor load for the PC.

Display: Relative

If you activate this option button, the relative processor load is shown in the bar graph. This is shown as a percentage of the processor load caused by the simulator.

Reset

If you press this command button, time measurements in this area are reset.

This is required to achieve a consistent representation of the times which have passed because the individual times are not started simultaneously when opening the simulator.

Priority of the Simulator

Introduction

In this area, you can define the priority of the simulator process.

It may be necessary to assign a high priority to the simulator because the cycle times of the individual user tasks can deviate greatly if there is a heavy load on the PC. These deviations are directly caused by the Windows operating system and can reach 100 ms with **Normal** priority. In most cases, the watchdog timer is also affected. In this case, setting the simulator priority higher can prevent the watchdog from being triggered.

Real-time

In this priority, user task cycle times only deviate by a few milliseconds.

NOTE: This priority should be used with care because the simulator has the highest possible priority in this case and interrupts the Windows system. If you use this priority with a very small sleep time and a cyclic user task, the PC may cease proper operation.

High

In this priority, user task cycle times normally do not deviate by more than 10 ms.

Normal

In this priority, user task cycle times can deviate up to several 100 ms.

Low

This priority quickly causes the watchdog to be triggered and should only be used on a PC with nearly no load.

Apply

If you press this command button, settings in this area are applied and used immediately.

Data in the User Task

Introduction

2 histograms are shown in this area

- the cycle time histogram for the selected user task
- the sleep time histogram for the selected user task

Structure of the Histograms

The histograms automatically adjust their ranges to the current values.

The percent scale (y-axis) is adjusted to the maximum percent value.

If a new value is not in the range for the time scale (x-axis), the range is increased by a factor of 2 until the new value is in the range. In this case, the previous values are recalculated for the new range.

If a value occurs so seldom that it does not create a peak in the histogram, then a one pixel peak is created so that the value can be seen.

Cycle time

This histogram shows the relative frequency of cycle time values in the user task currently selected. See also *Minimal Sample Time, page 78*

The counter to the left under the histogram counts the number of cycles in RUN mode represented in this histogram.

Sleep time

This histogram shows the relative frequency of sleep time values in the user task currently selected. See also *Minimal Sample Time, page 78*

For cycle tasks, normally a single value is shown with 100 %. This is the minimum sleep time for user tasks. If you change the value for the minimum sample time, a second peak is created for the new value.

User tasks cycles are included in this histogram (regardless of the PLC mode).

Cycle Counter

The counter to the left under the histogram counts the number of cycles in RUN mode represented in the cycle time histogram.

This counter has no meaning for the sleep time histogram because cycles are included there (regardless of the PLC mode).

Reset

If you press this command button, the histograms for the user task currently selected is reset and a new statistic is started.

Minimal Sample Time

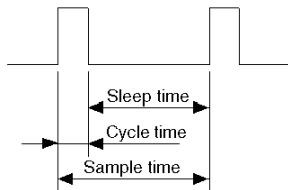
Description

The simulator is not the only thing running on the PC, therefore the other programs must be given a chance to be executed. Therefore the user task is assigned a fixed sample time.

The sample time is calculated according to the following formula:

Sample Time = Cycle Time + Sleep Time.

Time of the user task



Legend

Time	Meaning
Sample time	Time which is made available for running the user task.
Cycle time	Time which is actually required for running the user task.
Sleep time	Time in which the other programs on the PC can be executed.

Minimum sample time (ms)

A minimum sample time of 10 to 100 ms can be set. The smaller the sample time you select, the smaller the sleep time (sleep time = sample time - cycle time) and therefore the more loaded the PC is.

NOTICE

LOSS OF PC OPERATION

Do not use a small sample time when selected in combination with a high simulator priority and cyclic user tasks.

Failure to follow these instructions can result in equipment damage.

Apply

If you press this command button, the minimum sample time is applied to the selected user task and used immediately.

Info

Description

With this menu command, you can open and close the info dialog box. This dialog box shows the current version of the simulator and its components.

Help

Description

With this menu command, you can open the online help for the simulator.

Ending the Simulation

Description

With this menu command, you can exit the simulator.



D

dialog boxes, *37*

M

menu commands, *37*

S

simulating a PLC, *11*

simulation, *11*

