Unity Pro XLS Software

Operating Mode Manual
Safety PLC Specifics

07/2012

Schneider Electric

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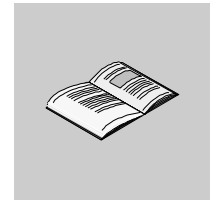
When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

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.

Table of Contents

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, 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 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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

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

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can 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.

About the Book
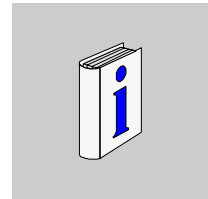
At a Glance

Document Scope

This documentation describes the operating mode specifics of Unity Pro XLS Software for programming safety projects with Quantum Safety PLCs.

For detailed information on safety please refer to the *Modicon Quantum Safety Reference Manual*.

This documentation is intended for qualified personnel familiar with functional safety and with the Unity Pro software.

Commissioning and operating the Quantum Safety PLC may only be performed by persons who are authorized to commission and operate systems in accordance with established safety standards.

Validity Note

This documentation is valid from Unity Pro 7.0.

Unity Pro XLS Software is used to program safety and also non-safety (standard) projects. For standard (non-safety) features please refer to the standard *Unity Pro Software Operating Modes Manual*.

Related Documents

Title of Documentation	Reference Number
Modicon Quantum Safety Reference Manual	33003879
Unity Pro Safety Block Library	33003873
Unity Pro Operating Modes Manual	33003101
Unity Pro Languages and Program Structure, Reference Manual	EN 35006144
Modicon Quantum Automation Series, Hardware Reference Guide	35013379
Quantum Instruction Sheets	33002365 -RL
Quantum Discrete and Analog I/O Reference Guide	33002447

IEC 61131-2 Programmable controllers Part 2: Equipment requirements and tests, Second edition 2003-02	–
IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems, edition 2.0	–
IEC 61511 Functional safety - safety instrumented systems for the process industry sector, First edition	–

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

Product Related Information

> ## ⚠ WARNING
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> Use only Schneider Electric approved software.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

> ## ⚠ WARNING
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> - Refer to IEC 61508, "Functional safety of electrical/electronic/programmable electronic safety-related systems".
> - Completely understand the applications and environment defined by Safety Integrity Level (SIL) 3 within IEC 61508 Parts 1-7, edition 2.0.
> - SIL requirements are based on the standards current at the time of certification.
> - Do Not exceed SIL3 ratings in the application of this product.
> - The terms safety application, safety project and safety PLC as used in this document are applied only within the SIL3 rating.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Unity Pro XLS Software Safety Application Specifics, Context Help

I
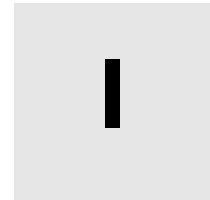
Overview

This part contains descriptions for the menus and dialog boxes of Unity Pro XLS.

What Is in This Part?

This part contains the following chapters:

General Presentation of Unity Pro XLS Software

1

Capabilities of Unity Pro XLS Software with Quantum Safety PLCs

Overview

Unity Pro XLS Software is used to program safety and also non-safety (standard) projects.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

The following documentation applies to Unity Pro XLS Software projects working with Quantum safety PLCs.

Hardware Platforms

Unity Pro XLS Software working with Quantum safety PLCs supports the following hardware platform:
● Quantum Safety

Programming Languages

Unity Pro XLS Software provides the following programming languages for creating a safety program:
● Function Block Diagram (FBD)
● Ladder Diagram (LD) language

No other programming languages are allowed.

These two programming languages can be used together in the same safety project.

Safety Block Library

The blocks that can be used to program a safety project are included in the Safety block library of Unity Pro XLS.

For a better overview the library is broken down into families.

The blocks can be used in the programming languages FBD and LD.

Elements of a Program

A safety program only allows sections *(see page 61)* in the master (MAST) task *(see page 58)*.

Performance Scope

The following table shows the available features of the Unity Pro XLS Software software when programming safety projects:

Programming languages	
Function Block Diagram (FBD)	+
Ladder Diagram (LD) language	+
Libraries	
Safety library	+
General information	
Create and use data structures (DDTs)	-
Create and use Derived Function Blocks (DFBs)	+
Project browser with structural and/or functional view	+
Managing access rights	+
Operator screen	+
Diagnostic viewer	+
System diagnostics	+
Project diagnostics	-
Application converter	-
Managing multi-stations	-
Supported platforms	
Quantum Safety	140 CPU 651 60S 140 CPU 671 60S
Openness	
Hyperlinks	+
Unity Pro Server for OFS, UDE Unity Pro Server for UAG	+ (with write restrictions) -
Documentation as context help and PDF	+
OS Loader tool	+
Unity Loader	-

Legend:

+ = available

- = not available

Global Project Management for Unity Pro XLS Software

<div style="text-align: right">

2

</div>

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to global project management.

What Is in This Chapter?

This chapter contains the following sections:

2.1 Security Management and Self-Test for Unity Pro XLS Software

Security Management for Unity Pro XLS Software

Overview

Features of the Access Security Management of standard Unity Pro XL Software are available.

The current rules to help protect a tool from unauthorized usage are applied. It is in the responsibility of systen designers, programmers and users to use the security management to activate the protection.

For detailed information on security management please refer to the standard *Unity Pro XL Software documentation*.

New Product in the Security Editor

In the **Security Editor**, on the user information tab, Unity Pro XLS Software will be added to the list of products.

For Unity Pro XLS Software, like the other products on the Security Editor list in the Security editor, you can apply a policy, create profiles and users.

For detailed information please refer to the standard *Unity Pro XL Software documentation*.

Access Rights

Unity Pro XLS Software provides the same access rights as Unity Pro XL Software plus some new ones for the special needs of safety environment.

The following new access rights are introduced:
- create or modify application password (please refer to *Protection of a Safety Project with Unity Pro XLS Software, page 44*)
- enter maintenance mode (please refer to *Maintenance Mode with Unity Pro XLS Software, page 29*)
- adapt auto-lock timeout (please refer to *Protection of a Safety Project with Unity Pro XLS Software, page 44*)

Log Information

Security editor log information is managed by the Microsoft Windows **Event Viewer**.

If you want to display the log information you must launch the event viewer. Here you can filter according to the server sequential events.

You can use the event viewer functions, like sort, filter etc.

For further information please refer to *Event Viewer (Microsoft Windows), page 20*.

2.2 Programming Environment Check with Unity Pro XLS Software

Overview

This section describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to programming environment checks.

For detailed information please refer to the *Quantum Safety PLC Safety Manual*, section Checking the Programming Environment *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*.

What Is in This Section?

This section contains the following topics:

Unity Pro XLS Software Self-Test

At a Glance

Unit Pro XLS provides a self-test to verify that the components currently in use are the correct versions originally installed and are not corrupted, e.g. by a hard disk failure.

When performing the self-test, Unity Pro XLS Software checks the version and CRC of:
- the safety-relevant DLLs,
- the safety FFB library database and
- the safety subset of the hardware catalog database.

For detailed information please refer to the *Quantum Safety PLC Safety Manual*, section Checking the Programming Environment *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*.

Check of DLLs

This check helps to ensure the integrity of the Unity Pro XLS Software.

Safety Library Check
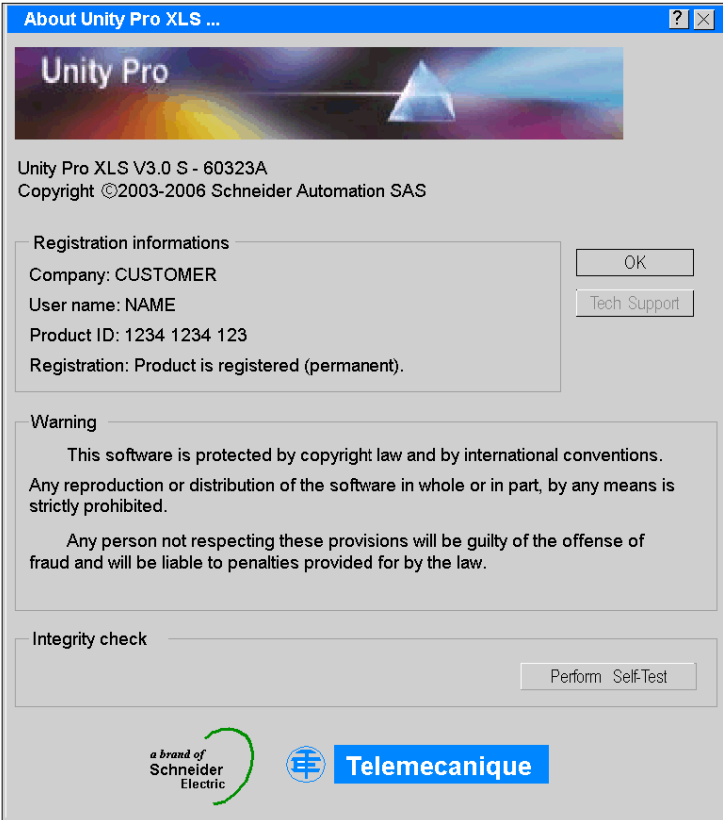
For verifying the physical integrity of the safety library, a CRC check is performed on the *libset.db* and the object-code files of the safety library.
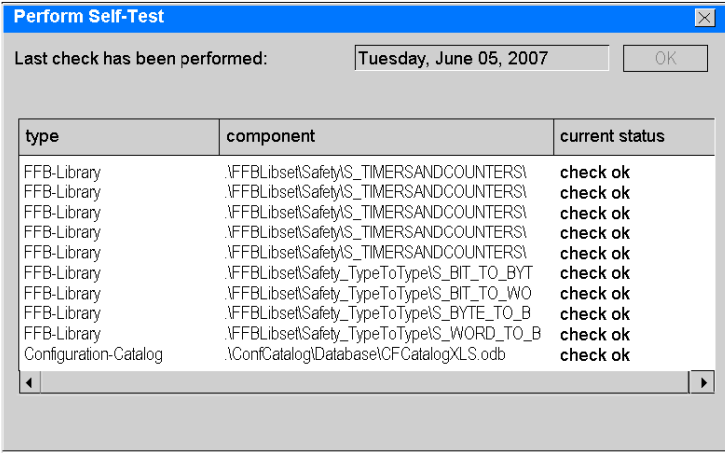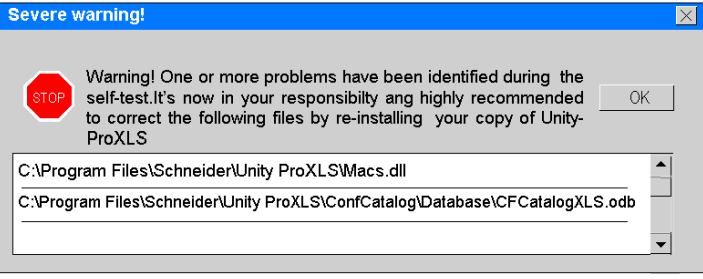
Hardware Catalog Check

This check helps to ensure the integrity of the safety subset of the hardware catalog including safety hardware (physical integrity).

Performing the Self-Test

To perform the self-test proceed as follows:

Step	Action
1	Open the **About** dialog box via **Help** →**About Unity Pro XLS Software**. **Result:**

Step	Action
2	Click the **Perform Self-Test** button. **Result:** The Unity Pro XLS Software **Self-Test** dialog box opens and the self-test is carried out without any additional interaction. The dialog box shows the results of the test. **Perform Self-Test** Last check has been performed: Tuesday, June 05, 2007 OK | type	component	current status
------	-----------	----------------
FFB-Library	.\FFBLibset\Safety\S_TIMERSANDCOUNTERS\	check ok
FFB-Library	.\FFBLibset\Safety\S_TIMERSANDCOUNTERS\	check ok
FFB-Library	.\FFBLibset\Safety\S_TIMERSANDCOUNTERS\	check ok
FFB-Library	.\FFBLibset\Safety\S_TIMERSANDCOUNTERS\	check ok
FFB-Library	.\FFBLibset\Safety\S_TIMERSANDCOUNTERS\	check ok
FFB-Library	.\FFBLibset\Safety_TypeToType\S_BIT_TO_BYT	check ok
FFB-Library	.\FFBLibset\Safety_TypeToType\S_BIT_TO_WO	check ok
FFB-Library	.\FFBLibset\Safety_TypeToType\S_BYTE_TO_B	check ok
FFB-Library	.\FFBLibset\Safety_TypeToType\S_WORD_TO_B	check ok
Configuration-Catalog	.\ConfCatalog\Database\CFCatalogXLS.odb	check ok	
3	Click the **OK** button. **Result:** If any of the checks failed the **Severe warning !** dialog box opens. **Severe warning!** STOP Warning! One or more problems have been identified during the self-test.It's now in your responsibilty ang highly recommended to correct the following files by re-installing your copy of Unity-ProXLS OK C:\Program Files\Schneider\Unity ProXLS\Macs.dll C:\Program Files\Schneider\Unity ProXLS\ConfCatalog\Database\CFCatalogXLS.odb
4	Click the **OK** button to confirm the warning. **Note:** Be aware that it is now in **your** responsibility to solve the identified problems.

Event Viewer (Microsoft Windows)

Overview

Events logged by Unity Pro XLS Software can be displayed in the **Event Viewer** of Microsoft Windows.

Unity Pro XLS Software enters some additional messages to the event viewer not known by a non-safety Unity Pro (e.g. when switching the PLC to maintenance mode).

The event viewer is not mandatory for safety applications.

It is an additional feature but it is not required by IEC 61508 to use it.

Launching the Event Viewer
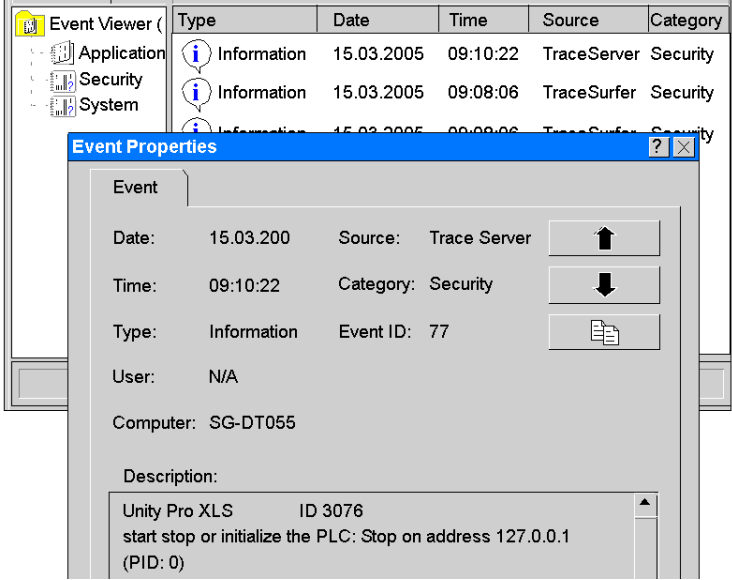
To launch the event viewer proceed as follows:

Step	Action
1	Launch the **Event Viewer** via **Start** →**Settings** →**Control Panel** → **Administrative Tools**.
2	Select **Application** in the structural view on the left side.

Setting the Filter

To set the filter proceed as follows:

Step	Action
1	Open the filter dialog via **View** →**Filter**.
2	For **Source** set **TraceServer**.

Step	Action
3	For **Category** set **Security**. **Result:** Only messages of Unity Pro XLS Software are displayed.

2.3 Project Management for Unity Pro XLS Software

Overview

This section describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to safety project management.

For standard (non-safety) features concerning project management please refer to the standard *Unity Pro XL Software documentation*.

What Is in This Section?

This section contains the following topics:

Topic	Page
Creating a Safety Project with Unity Pro XLS Software	23
Opening a Safety Project with Unity Pro XLS Software	25
Safety Mode with Unity Pro XLS Software	27
Maintenance Mode with Unity Pro XLS Software	29
Switching Between Safety and Maintenance Mode	30
Monitoring Mode	33
Connecting To A Safety PLC	34
Connecting to the PLC Simulator	36
Transferring a Safety Project to a Safety PLC	37
Transferring a Safety Project from a Safety PLC	38
Starting and Stopping a Safety Project	39

Creating a Safety Project with Unity Pro XLS Software

Overview

Unity Pro XLS Software manages safety projects.

By selecting a safety PLC a project will become a safety project.
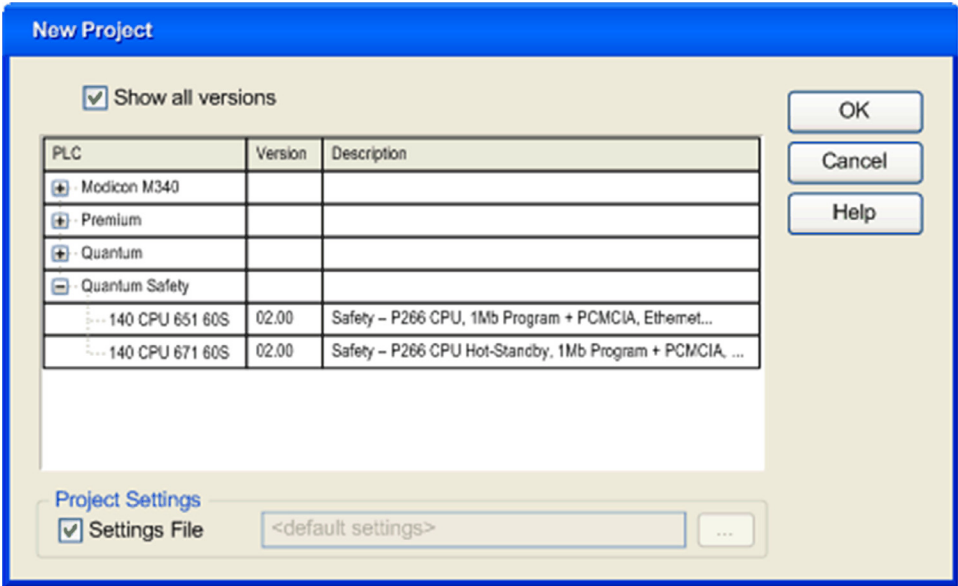
A safety project is automatically password protected. By default an empty password is set and is a valid one.

NOTE: Schneider Electric strongly recommends you to change the default password immediately after having selected a Quantum safety PLC in order to help protect your project against unauthorized access from the beginning. If you forget to change the default password, the empty password is kept if you save and close your project.

For further information please refer to *Protection of a Safety Project with Unity Pro XLS Software, page 44*.

Creating a Project

To create a new safety project, carry out the following actions:

Step	Action
1	Click the **New** command in the **File** menu. **Result**: The **New Project** dialog box is displayed. ![New Project dialog box showing PLC selection list with Modicon M340, Premium, Quantum, and Quantum Safety options expanded. Quantum Safety shows 140 CPU 651 60S version 02.00 "Safety – P266 CPU, 1Mb Program + PCMCIA, Ethernet..." and 140 CPU 671 60S version 02.00 "Safety – P266 CPU Hot-Standby, 1Mb Program + PCMCIA, ...". Includes Show all versions checkbox, OK, Cancel, Help buttons, and Project Settings with Settings File checkbox set to default settings.]

Step	Action
2	To see all PLC versions, click on the box Show all versions.
3	Select a Quantum safety CPU. **Result:** Your project automatically becomes a safety project and Unity Pro XLS Software sets an empty password by default to help protect it. **NOTE:** An empty password doesn't protect a project.
4	Select the processor you wish to use from those proposed.
5	To create a project with specific values of project settings, check the box **Settings File** and use the browser button to localize the .XSO file (Project Settings file). It is also possible to create a new one. If the **Settings File** box is not checked , default values of project settings are used.
6	Confirm with **OK**.

Opening a Safety Project with Unity Pro XLS Software

Overview

If you select a project file (*.STU) in the **Open** dialog box the **Project information** field shows the **Type** of the PLC.

The S at the end of the type name indicates a safety PLC (e.g. 140 CPU 671 60S).

To open a safety project requires Unity Pro XLS. If you try to open a safety project with another Unity Pro version, a warning message is shown and opening will be unsuccessful.

A safety project is automatically password protected. By default an empty password is set and is a valid one. If the empty password is set you can just click **OK**. Otherwise you must enter the correct password and confirm with **OK**.

For further information please refer to *Protection of a Safety Project with Unity Pro XLS Software, page 44*.

Opening a Project

To open an existing project, carry out the following actions:

Step	Action
1	Choose the **Open** command from the **File** menu.
2	Select the file related to the project (file *.STU).
3	Confirm with **Open**. **Result:** The **Application Password** dialog box is displayed.
4	Type your password and confirm with **OK** or, if you did not assign a password yet, just click **OK**. **Result:** Unity Pro XLS Software opens your project.

Opening a project also restores the Unity Pro context, which was saved when the project was closed. This involves

- the list of open tools,
- for each tool: its window's size, position, contents and animation status,
- taskbar and tool configuration.

The context file is a companion file to the *<Project_name>.STU* file. It is saved in the same directory with the name *<Project_name>.CTX*.

NOTE: When a project file is selected, the software provides a certain amount of information: the project name, associated comment, version and date the project was generated, PLC targeted by the project, and date of last modification to the source code.

NOTE: The STU file is a work file and it cannot be used to switch from one version to another of Unity Pro software. In this case, you should use the export function in the project and create an XEF file or use the archive format (STA file).

Safety Mode with Unity Pro XLS Software

Overview

Quantum safety PLCs can run projects in two different modes:
- safety mode
- maintenance mode

The functions available in Unity Pro XLS Software depend on the current mode of the PLC to which Unity Pro XLS Software is connected.

Safety mode means that the Unity Pro XLS Software is connected to a safety PLC, which is running a project in safety mode.

Maintenance mode means that Unity Pro XLS Software is connected to a safety PLC, which is running a project in maintenance mode.

For detailed information please refer to the *Quantum Safety PLC Safety Manual*, section Operating Procedures *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*.

Restrictions in Safety Mode

In Unity Pro XLS Software the safety mode is entered when connecting to a safety PLC running in safety mode or when the mode of a connected PLC is switched from maintenance mode to safety mode.

In safety mode the following functions of Unity Pro XLS Software are not available:
- download changes
- forcing of variables (even for animation tables and operator screens)
- modification of variables (even for animation tables and operator screens)
- debugging mode
- setting a breakpoint
- setting a watch point
- upload
- transferring data from file to PLC
- transferring data from PLC to file
- replacing InitValue with current value
- link animation

It is possible to use animation in safety mode (without link animation) and it is possible to stop and start the PLC.

No Modifications in Safety Mode

A project cannot be modified in safety mode.

The following message is displayed if you try to modify a project in safety mode:
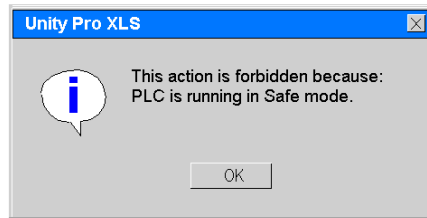
Modifications in animation tables are possible if generation of upload information is not enabled for animation tables (see *General Settings for Safety Projects, page 64*). Otherwise it is necessary to switch to maintenance mode if an animation table should be modified or created.

Maintenance Mode with Unity Pro XLS Software

Overview

Safety PLCs can run projects in two different modes:
- safety mode
- maintenance mode

The functions available in Unity Pro XLS Software depend on the current mode of the PLC to which Unity Pro XLS Software is connected.

Safety mode means that the Unity Pro XLS Software is connected to a safety PLC, which is running a project in safety mode.

Maintenance mode means that Unity Pro XLS Software is connected to a safety PLC, which is running a project in maintenance mode.

For detailed information please refer to the *Quantum Safety PLC Safety Manual*, section Operating Procedures *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*.

Restrictions in Maintenance Mode

In Unity Pro XLS Software the maintenance mode is entered when the mode of a connected PLC is switched from safety mode to maintenance mode.

It is not possible to connect to a safety PLC, which already runs in maintenance mode. The reason for this is that a safety PLC will switch to safety mode if the connection to the Unity Pro XLS Software gets lost.

In maintenance mode the online functions of Unity Pro XLS Software are almost equal to Unity Pro XLS Software connected to a non-safety PLC (functions are limited by the user rights). This means that the restrictions of the safety mode (*Restrictions in Safety Mode, page 27*) do not exist.

But even in maintenance mode the following functions are not available:
- transferring data from file to PLC
- transferring data from PLC to file

It is possible to use animation in maintenance mode.

Switching Between Safety and Maintenance Mode

Overview

Switching a safety PLC from maintenance mode to safety mode is not possible if
- the PLC is in debug mode,
- a breakpoint is activated or
- a watchpoint is set.

When the debug mode is not active, no breakpoint is activated and no watchpoint is set, it is possible to switch to the safety mode.

Before switching from maintenance to safety mode, Unity Pro XLS Software will ask for confirmation.

Switching Between the Modes

Two additional buttons in the toolbar are used to switch between safety mode and maintenance mode.

This new buttons are only available if you select a configuration with a safety PLC type.
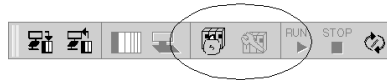
New buttons

Button	Function
	Clicking this button switches to safety mode.
	Clicking this button switches to maintenance mode.

Switching can also be done via the main menu **PLC** →**Safety/Maintenance** or using the key combination CTRL+SHIFT+M.

Confirm Switching

Before switching between safety and maintenance mode, you are asked for confirmation:
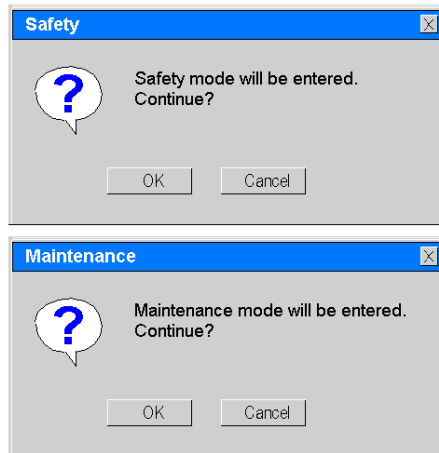
Status Bar Information

The status bar displays information about the current mode.

See *Status Bar of Unity Pro XLS Software, page 97*.

Forced Variables

When switching to safety mode, forced variables will not be unforced.

⚠ **WARNING**
RISK OF PROCESSING FORCED DATA - UNEXPECTED EQUIPMENT OPER-ATION
Make sure your data are correct when switching from maintenance Mode to safety Mode. The PLC proceeds using the forced data. Check your data in the animation tables.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

In case of switching to safety mode you are asked for confirmation:
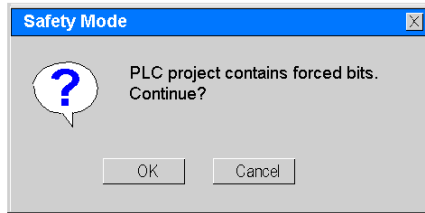
NOTE: This message is also shown, if Unity Pro XLS Software disconnects from a PLC and in the PLC there are forced variables. It does not care if the Unity Pro XLS Software is in safety mode or in maintenance mode.

Monitoring Mode

Overview

If a PC running Unity Pro XLS Software programming software is connected to a PLC in either safety mode or maintenance mode then any other PC running Unity Pro XLS Software software can only connect to the same PLC in monitoring mode.

It is possible to connect to a safety PLC in monitoring mode even if the PLC is not connected to Unity Pro XLS.

In monitoring mode the animation functions of Unity Pro XLS Software can be used.

In monitoring mode, it is not possible to set either breakpoints or watch points.

Restrictions in Monitoring Mode

In monitoring mode the following functions of Unity Pro XLS Software Software are not available:
- run/stop
- download changes
- debugging mode
- setting a breakpoint
- setting a watch point
- transferring project to PLC
- transferring project from PLC
- transferring data from file to PLC
- transferring data from PLC to file

Connecting To A Safety PLC

Overview

Unity Pro XLS Software can be connected to a PLC with or without an opened project.

An option, configured by computer and not saved in the project, lets you choose between programming or monitoring mode.

- Use the programming mode to modify a project. This mode is based on the reservation mechanism.
- Use the monitoring mode to watch a project without changing the program.

NOTE: No upload is available in monitoring mode on a safety PLC.

Availability in Safety Mode

The following table shows the availability of the different controls in safety mode.

Unity Pro XLS (Safety Project)	PLC	User Action on Connection	Run/ Stop	Switch to Maintenance	Upload	Download
no project opened	configured safe	enter PLC password	+	+	-	-
project opened equal	configured safe	nothing (reservation automatically taken with same password as for open)	+	+	-	-
project opened different	configured safe	enter PLC password	+	+	-	-
project opened different	NoConf	nothing (reservation automatically taken with same password as for open and PLC accepts any password in NoConf)	-ncf	-ncf	-ncf	Download is possible only if the front panel key is unlocked.

+ available

- Not available because the safety PLC is in safety mode.

-ncf In NoConf state key locked (equal safety mode), no action is possible with Unity Pro XLS Software except connection.

PLC State is Safety Mode

The basic PLC state is running in safety mode. Even if Unity Pro XLS Software was used to switch to maintenance mode, at disconnection PLC automatically switches to safety mode.

That is why at each connection, a not empty PLC is always in safety mode.

Replace Init Value

Update Init Values with Current Values is unavailable on safety CPU, in maintenance and in safety mode.

PLC Reserved

Connecting Unity Pro XLS Software to a safety PLC means that the PLC is reserved after the connection has been established.

No further Unity Pro XLS Software can connect to an already reserved PLC.

Connecting to the PLC Simulator

Overview

The PLC simulator supports password protection for connection and the new modes (maintenance and safety) of safety PLCs.

Unity Pro XLS Software can build a safety project that can be downloaded to PLC simulator. With this you can check the programmed logic on the PLC simulator and verify the results of this programming.

The PLC simulator will not behave like a real safety PLC in terms of safety behavior (e.g. no double code execution).

Transferring a Safety Project to a Safety PLC

Preconditions

Unity Pro XLS Software is in connected programming mode with an opened project and the safety PLC is stopped.

You have already entered a valid password.

There are two main cases:
- PLC in safety mode
- PLC in maintenance mode

PLC in Safety Mode

In safety mode the transfer is not possible. The button and menus are not available with an explanation in the status bar.

This is the default case just after the connection. In order to do any modification, you must switch to maintenance mode (see *Switching Between Safety and Maintenance Mode, page 30*).

PLC in Maintenance Mode

In any case (configured or not, equal or different) it is possible to transfer the safety project to the safety PLC.

Non-Safety PLC

You can use Unity Pro XLS Software to program non-safety projects and to connect to a non-safety PLC.

But it is not possible to transfer a non-safety project to a safety PLC.

Transferring a Safety Project from a Safety PLC

Preconditions

Unity Pro XLS Software is connected to a PLC and no project is opened.

If a project was opened, it is first closed.

The password was checked at connection.

PLC in Maintenance Mode

In maintenance mode the **Transfer Project from PLC** button is available.

You can transfer the project from PLC by using this button.

To transfer the project from PLC in monitoring mode is not possible with Unity Pro XLS Software, as it is not possible to connect without reservation.

Starting and Stopping a Safety Project

Starting PLC After Download

After transferring a safety project to the PLC, proceed as follows to start the PLC.

Step	Action
1	To start the PLC, ● either select the menu command **PLC →Run** ● or click the **Run** button in the toolbar. **Result:** A dialog box is displayed where you have to confirm the starting of the PLC.
2	Confirm the starting of the PLC by clicking **OK**. **Result:** The PLC is started and enters run state in safety mode.

Performing Cold Start

For a cold start, proceed as follows.

Step	Action
1	Power on your Quantum safety PLC. **Result:** Unity Pro XLS Software performs self-tests and your project is initialized.
2	To start the project, ● either select the menu command **PLC →Run** ● or click the **Run** button in the toolbar. **Result:** The PLC is started and enters run state in safety mode.

Automatic Start

If you have configured the Quantum safety PLC to automatically start in run (in the CPU configuration dialog), it will start automatically after the initialization.

Stopping PLC in Safety Mode

If you want to stop a project, running in safety mode, proceed as follows.

Step	Action
1	Unlock the key switch.
2	To stop the PLC, ● either select the menu command **PLC →Stop** ● or click the **Stop** button in the toolbar. **Result:** A dialog box is displayed where you have to confirm the stopping of the PLC.
3	Confirm the stopping of the PLC by clicking **OK**. **Result:** The PLC is stopped.

Stopping PLC in Maintenance Mode

To stop a project running in maintenance mode,

● either select the menu command **PLC →Stop**
● or click the **Stop** button in the toolbar.

Project Properties and Password for Unity Pro XLS Software

<div style="text-align: right">

3

</div>

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to project properties and the password protection feature.

What Is in This Chapter?

This chapter contains the following topics:

Project Properties for Unity Pro XLS Software

At a Glance

Whichever view is displayed, you can access the project properties by using the **Properties** command from the context menu (which can be reached by right-clicking the mouse on the station folder). This gives you access to a dialog box which allows you to

- access information on the current project,
- define certain parameters of the project.

The following dialog box can be accessed from the structural view of the project:
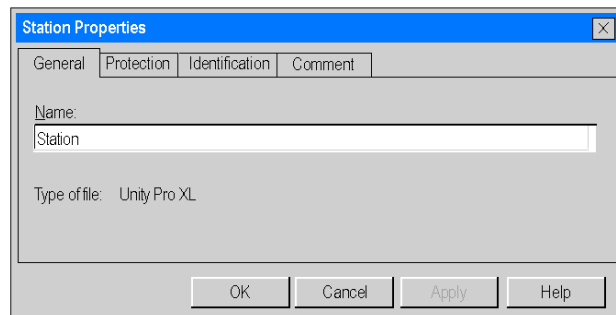
Description of the Tabs

The dialog box has 4 tabs allowing the actions given below:

Tab	Setting	Description
General	Name	Allows you to define the name of the project (Station by default).
	Type	Indicates the type of Unity Pro software used.
Protection	Protection active	By checking this box, you activate the protection of the sections.
	Change Password	Allows you to change the password.
	Clear Password	Allows you to clear the password.
Identification	Current version	Allows you to identify the project.
	Last rebuild all	
	Last partial build	
Comment	-	Allows a comment to be associated with the project.

NOTE: By default, the dialog box is called **Properties of Station**. If you give the project another name, this dialog box is called **Properties of "new name"**.

Identification Tab for Unity Pro XLS Software

The following dialog box can be accessed by clicking the **Identification** tab.

Elements of the **Identification** tab:

Element	Description
Last rebuild all	product which generated this project file and date when this project file was generated
Last partial all	product which modified this project file last and date when this project file was modified
Current version	version number For Unity Pro the check box **Automatically incremented** can be selected/cleared. For Unity Pro XLS Software the check box **Automatically incremented** is selected and cannot be changed by the user. For safety PLCs the version number will always be in auto increment mode. Each build/rebuild will automatically increase the version number.

Protection of a Safety Project with Unity Pro XLS Software

Overview

The project **Protection** feature is accessible via **Project Browser** →**Station** → **Properties**.

NOTE: Password protection for safety projects is always activated.

Default Password

A safety project is automatically password protected. By default an empty password is set and is a valid one.

It is possible to change password at any time.

The password is either empty or must have a size between 4 and 16 alphanumeric characters.
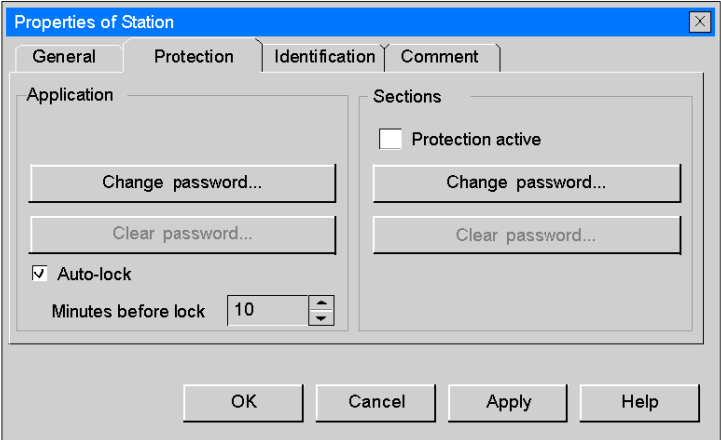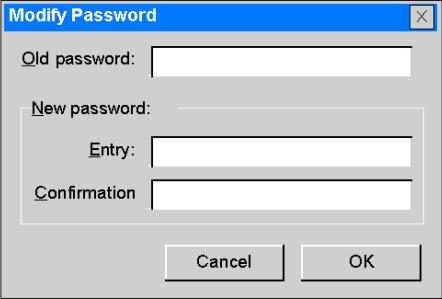
Password Access Rights

To create or to modify the application password is restricted by access rights. (See *Security Management for Unity Pro XLS Software, page 14*.

Changing the Password
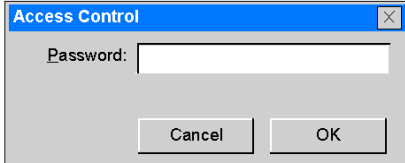
The following table shows the procedure for changing the application protection password.

Step	Action
1	In the project browser select the **Station** directory.
2	Select the **Properties** command from the context menu.

Step	Action
3	Select the **Protection** tab. **Result**: The following dialog box is displayed: **Properties of Station** ⊠ General / Protection / Identification / Comment Application — Sections □ Protection active Change password... — Change password... Clear password... — Clear password... ☑ Auto-lock Minutes before lock 10 OK Cancel Apply Help
4	In the **Application** field select the **Change Password...** button. **Result**: The **Modify Password** dialog box is displayed: **Modify Password** ⊠ Old password: New password: Entry: Confirmation Cancel OK
5	Enter the previous password in the **Old password** field.
6	Enter the new password in the **Entry** field.
7	Enter the confirmation of the new password in the **Confirmation** field.

Clearing the Password

The following table shows the procedure for deleting the application protection password.

Step	Action
1	In the project browser select the **Station** directory.
2	Select the **Properties** command from the context menu.
3	Select the **Protection** tab.
4	Select the **Clear password...** button. **Result**: The **Access control** dialog box is displayed: Access Control [×] Password: [_____] Cancel OK
5	Enter the previous password in the **Password** field.
6	Click **OK** to confirm your choice and to delete the password.

Auto-Lock Feature

There is an optional feature to limit access to the Unity Pro XLS Software programming tool after a configured time of inactivity.

After that time of inactivity a modal dialog box is displayed and asks you to enter the application password.

Behind the modal dialog box the current opened editors remain opened in the same position. That means that anybody can read the current content of the Unit Pro XLS windows but can not continue to work with Unity Pro XLS.

You can activate the auto-lock feature with the check box **Auto-lock** and select the time-out for the time of inactivity via **Minutes before lock**. After this time of inactivity the Unit Pro XLS lock mechanism is activated and you are asked to enter the application password.

The default values are
● **Auto-lock** is activated
● **Minutes before lock** are 10 minutes
The minimum value is 1. The maximum value is 999.

Application (Project) Password Request

Overview

In different situations (open application, auto-lock, connect) you are asked to enter the case sensitive application (project) password.

There are 3 similar dialog boxes for this, depending on the situation.

Open Application (Project)

In case of **Open Application (Project)** the following dialog box is shown:
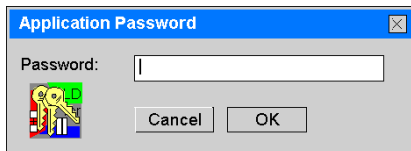
If...	Then...
you choose **OK**	Unity Pro XLS Software checks the entered password with the one in the source application.
the password is correct	the selected action is done.
the password is wrong	a message informs you and the dialog box is displayed again.
you choose **Cancel**	the application (project) is not opened.

Auto-lock

In case of **Auto-lock** (when time is expired) the following dialog box is shown:
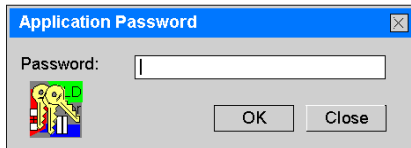
If...	Then...
you choose **OK**	Unity Pro XLS Software checks the entered password with the one in the source application.
the password is correct	Unity Pro XLS Software becomes active again.
the password is wrong	a message informs you and the dialog box is displayed again.
you choose **Close**	the application (project) is closed without saving. In case you modified the application there will be a confirmation dialog.

PLC Application Password

When trying to **Connect** to the PLC the following dialog box is shown:
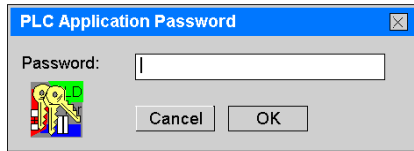
If...	Then...
you choose **OK**	the PLC compares the entered password with the one in the PLC.
the password is correct	the connection is done.
the password is wrong	a message informs you that the action can not be done.
you choose **Cancel**	the action you want to do (connecting for example) is not done.

If the project has been opened with Unity Pro XLS Software before and the project is equal to the one in the PLC, you do not have to enter the password again, because you already entered it when opening the project.

Therefore you must only enter the **PLC Application Password** if the project is different from the one in the PLC or if no project has been opened in Unity Pro XLS.

Loss of Password

Overview

If you forget your password, contact the Schneider Support.
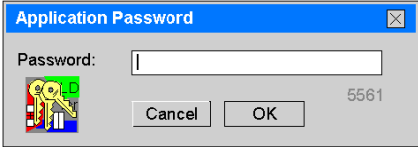
There are two cases:
- You forgot the password of the application (project) in Unity Pro XLS Software needed to open a project or at the auto-lock situation.
- You forgot the password of the application that is in the PLC.

Local Application Password

- At open time, the **Open** dialog box is displayed. You choose the application and then the **Application Password** dialog box is displayed.
  Or
- At auto-lock time, you are asked for the password. You must close the application because you do not remember your password. Then you reopen the application and the **Application Password** dialog box is displayed.

The following table shows the procedure for resetting the application protection password.
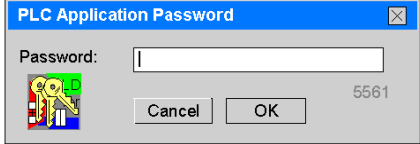
Step	Action
1	**Condition:** The **Application Password** dialog box is displayed.
2	Press SHIFT+F2. **Result:** A grayed number (5561 in the example) is displayed in the dialog box.
3	Give this number to Schneider Support.
4	Receive the generated password from Schneider Support. **Note:** The password is a temporary password, available as long as you do not modify the application.
5	Enter this password.
6	Now it is very important that you modify the password (old password = the one provided by Schneider Support).
7	Click **Build** →**Build Changes**.
8	**Save** the application.

PLC Application Password

The following table shows the procedure for resetting the PLC application password, if the respective *.STU* file **is available**.

Step	Action
1	Open the respective *.STU* file.
2	When the password dialog box is displayed press SHIFT+F2. **Result:** A grayed number is displayed in the dialog box.
3	Give this number to Schneider Support.
4	Receive the generated password from Schneider Support. **Note:** The password provided by Schneider Support is a temporary password, available as long as you do not modify the application.
5	Enter this password.
6	Now it is very important that you modify the password (old password = the one provided by Schneider Support).
7	**Connect** to the PLC.
8	Click **Build →Build Changes**.
9	**Save** the application.

The following table shows the procedure for resetting the PLC application password, if the respective *.STU* file **is not available**.

Step	Action
1	**Condition:** At connection time, the **PLC Application Password** dialog box is displayed:
2	Press SHIFT+F2. **Result:** A grayed number is displayed in the dialog box.
3	Give this number to Schneider Support.
4	Receive the generated password from Schneider Support. **Note:** The received password is just used to unlock the situation. When you connect to the PLC, the old password is used to connect. Anyway, the password provided by Schneider Support is a temporary password, available as long as you do not modify the application.
5	Enter this password.
6	Upload the application from PLC.

Step	Action
7	**Save** the application.
8	Modify the password (old password = the one provided by Schneider Support).
9	Click **Build** →**Build Changes**.
10	**Save** the application.

Network Configuration with Unity Pro XLS Software

4

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to network configuration.

What Is in This Chapter?

This chapter contains the following topics:

Safety PLC Write Protection

Overview

IEC 61508 requires that non-safety devices cannot write into a safety PLC without control of the safety PLC.

In safety mode a write protection of the safety data is activated in the safety PLC.

The write protection is independent of the protocol (e.g. Modbus Plus or Ethernet) and also independent of other devices (e.g. HMI or other PLC).

Write protection is not activated in maintenance mode.

There is no restriction for other devices to read data from a safety PLC.

Write Data to Safety PLC

In some cases it is required to write data to the safety PLC, e.g. to change set points.

For safety projects, to allow writing from an HMI or other PLCs, there are dedicated **Unrestricted Memory Areas** for bits (%M) and for words (%MW).

These memory ranges are not write protected and are located at the beginning of the complete memory range.

You can define a contiguous area of %M and %MW for which the safety PLC allows write access.

Unlocated variables cannot be used in safety projects.

Unrestricted Memory Areas

The **Unrestricted Memory Areas** can be defined in the **Configuration** tab of the rack configuration dialog.

There you can define the size of these non-protected areas (starting from the beginning, with an end index) in %M and %MW.

The values entered must be inside the configured area of %M and %MW (state non-protected areas must be adapted.

For further information please refer to *Configuration of Quantum Processors with Unity Pro XLS Software, page 75*.

New Function Blocks

The values from the unrestricted memory areas cannot be used directly in the safety logic.

Instead, the new function blocks S_SMOVE_BIT and S_SMOVE_WORD have to be used.

For further information please refer to *Unity Pro Safety Block Library*.

Restrictions Configuring Quantum Networks with Unity Pro XLS Software

Overview

In the Quantum network configuration the communication with other PLCs, but also with field I/O (Ethernet I/O, Modbus Plus I/O, e.g. Momentum), is configured.

Communication with other PLCs is allowed (in a restricted way), while the usage of Ethernet I/O and Modbus Plus I/O is prohibited.

Since the communication to other PLCs is configured in the same ways as the field I/O - the communication is configured by specifying the address of the other device - Unity Pro XLS Software cannot check this rule.

Ethernet and Modbus Plus I/O are not allowed in safety PLCs and you are responsible to obey this rule.

Modbus Plus Network (Peer Cop Service)

The communication on a Modbus Plus network can be either specific (peer-to-peer) or global (broadcast). Reading (input) and writing (output) are configured independently.

Since there is no restriction for a safety PLC to write data to another PLC the configuration for specific output and global output is the same as with the standard version of Unity Pro.

For reading from another PLC (either global or specific) a destination address range has to be specified where the received data will be stored.

The reading from another PLC is only allowed into the unrestricted memory area (similar to HMI writing, see *Safety PLC Write Protection, page 54*).

During analyze time Unity Pro XLS Software checks that only addresses from the unrestricted memory area are used for the destination reference. Otherwise an error is created to indicate that receiving ModbusPlus data is only allowed in the unrestricted memory area.

If an error is detected **Build** is not possible.

Ethernet Network (I/O Scanning Service)

The communication on an Ethernet network can be peer-to-peer (I/O scanning).

Since there is no restriction for a safety PLC to write data to another PLC the configuration for writing is the same as with the standard version of Unity Pro.

For reading from another PLC a destination address range has to be specified where the received data will be stored.

The peer-to-peer communication can be done with a SIL3 level by configuring a specific configuration *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*. The reading from another PLC is only allowed into the unrestricted memory area (similar to HMI writing, see *Safety PLC Write Protection, page 54*).

During analyze time Unity Pro XLS Software checks that only addresses from the unrestricted memory area are used for the destination reference. Otherwise an error is created to indicate that receiving Ethernet data is only allowed in the unrestricted memory area.

So, the %M and %MW should be in the unrestricted memory area. And the %I and %IW values are forbidden.

If an error is detected **Build** is not possible.

Ethernet Network (Global Data Service)

The communication on an Ethernet network can also be global (global data, broadcast). Reading (subscribe) and writing (publish) are configured independently.

Since there is no restriction for a safety PLC to write data to another PLC, variables can be published in the same way as with the standard version of Unity Pro.

For reading from another PLC the variable has to be set to **subscribe** in the data editor.

Subscribing a variable from another PLC is only allowed if its address is in the unrestricted memory area (similar to HMI writing, see *Safety PLC Write Protection, page 54*).

During analyze time Unity Pro XLS Software checks that only addresses from the unrestricted memory area are used for the subscribed variables. Otherwise an error is created to indicate that receiving Ethernet data is only allowed in the unrestricted memory area.

If an error is detected **Build** is not possible.

Ethernet Network (Messaging Service)

Messaging communication is used with special communication function blocks, which are not certified and therefore cannot be used in safety logic.

Therefore it's not possible to read data via messaging in the safety PLC.

Programming with Unity Pro XLS Software

5

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to programming editors.

What Is in This Chapter?

This chapter contains the following topics:

Program Structure Restrictions for Safety Projects

Overview

For a safety project, at analyze time, Unity Pro XLS Software checks that restrictions applied to the program structure are fulfilled. Otherwise a build is not possible.

If a build is not possible an error message is displayed.

Program Structure Restrictions

There are the following restrictions for Quantum safety program structure:
- no other tasks than the MAST task
- no sub-routines (SR)
- no I/O event
- no timer event

With Unity Pro XLS Software working with Quantum safety PLCs it is not possible to create other objects than sections in the MAST task.

Import of a Project

With Unity Pro XLS Software you can import data that may not be correct (e.g. hardware modules which are not allowed in safety projects).

If during import or partial import objects that are not allowed are detected, they are ignored (not imported) and error messages are displayed.

Language Restrictions

There are the following language restrictions for Quantum safety:
- no other sections than FBD and LD sections

At creation time only FBD and LD section are available for sections.

At import time, only LD and FBD sections are imported. Other sections generate error messages, but do not stop the import.

No RIO Parallelism

There are the following RIO restrictions for Quantum safety:
- no remote I/O associated with a section

If Unity Pro XLS Software detects a remote I/O associated with a section at analyze time, a build is not possible.

If such a RIO assignment is detected an error message is displayed.

In safety projects, the RIO are read at cycle start and written at the end of the cycle. No parallel call will be done using section RIO association.

If a task is imported, with such a RIO assignment, it will be skipped.

Import Restrictions for Safety Projects

Overview

With Unity Pro XLS Software you can import data that may not be correct (e.g. using hardware modules which are not allowed in safety projects).

If during import or partial import objects that are not allowed are detected, they will be ignored (not imported) and error messages are displayed.

Objects that are not allowed are described in Program Structure Restrictions for Unity Pro XLS Software *(see page 58)* and Sections and Data Type Restrictions for Unity Pro XLS Software *(see page 61)*

Only FBD and LD Sections

At import time, only LD and FBD sections are imported. Other sections will generate error messages, but will not stop the import.

RIO Import

If Unity Pro XLS Software detects a remote I/O associated with a section at import time an error messages is displayed and a build is not possible.

If a task is imported, with such a RIO assignment, it will be skipped.

Partial Import

It is not possible to partially import a safety PLC program into a non-safety project and vice versa *(see page 72)*.

FFB Import

The import of FFBs which are not available in safety projects results in type errors in the language editor.

For further information on safety FFBs please refer to *Unity Pro Safety Block Library*.

DFB Import

It is possible to import a DFB type from the safety library into a safety application.

Diagnostic DFB Import

It is not possible to import a diagnostic DFB type into a safety application. Trying to import a diagnostic DFB type into a safety application will be unsuccessful.

An error will be displayed (Diagnostic DFB types are not allowed into safety project. Import failed).

Unlocated Variables Import

As unlocated variables can be created through source file import an error message will also be displayed at analyze time.

Sub-Routines (SR) Import

As sub-routines (SR) can be created through source file import an error message will also be displayed at analyze time.

Variables from Unrestricted Memory Area Import

As Variables from the unrestricted memory area can be created through source file import an error message will also be displayed at analyze time.

ST Expressions Import

As ST expressions can be created through source file import an error message will also be displayed at analyze time.

Data Types

As variables of a forbidden type (e.g. `STRING`) can be created through source file import an error message will also be displayed at analyze time.

DDT Import

As DDTs can be created through source file import an error message will also be displayed at analyze time.

Sections and Data Type Restrictions for Safety Projects

Overview

For a safety project, at analyze time Unity Pro XLS Software checks that restrictions applied to sections and data types are fulfilled. Otherwise a build is not possible.

If a build is not possible an error message is displayed.

Safety FFBs Only

Only safety FFBs *(see Unity Pro, Safety, Block Library)* are allowed to be used in a safety project.

If a section contains one or more non-safety FFBs, an error is displayed (type not allowed).

The import of FFBs which are not available in safety projects results in type errors in the language editor.

DFBs

DFBs are allowed to be used in a safety project.

The creation of DFB is allowed in the Data Editor.

The user safety DFBs can be stored in the custom library and reused in a safety project.

It is possible to import a DFB type into a safety application.

No Diagnostic DFBs

Diagnostic DFBs are not allowed in a safety project.

Unity Pro XLS Software handles Diagnostic DFBs like common DFBs. If a section contains one or more Diagnostic DFBs an error message is displayed (type not allowed).

Located Variables Only

Only located variables are allowed to be used in a safety project.

Instances of variables are checked to verify they are located in a valid memory area. If an unlocated variable exists at analyze-time, an error message is displayed (unlocated variables are not allowed in a safety project).

As unlocated variables can be created through source file import this error message will also be displayed at analyze time.

No Sub-Routines (SR)

No sub-routines (SR) are allowed to be used in a safety project.

At analyze time Unity Pro XLS Software checks that there are no call-coils in LD sections and no sub-routine calls in FBD sections. Otherwise an error message is displayed (sub-routine calls are not allowed in a safety -project).

Variables from Unrestricted Memory Area

Variables from the unrestricted memory area are not allowed to be used in the logic except on the `IN` pin of the `S_SMOVE_*` EFBs.

LD Section Restrictions

In LD sections you are not allowed to use
- halt coils,
- call coils,
- returns,
- operate blocks,
- compare blocks.

No ST Expressions

No ST expressions are allowed (no compare and no operate blocks).

No Halt Coils/EFs

No halt coils and no halt EFs are allowed in a safety application

Data Types

Only elementary data types `BOOL`, `EBOOL`, `BYTE`, `WORD`, `DWORD`, `INT`, `UINT`, `DINT`, `UDINT`, `TIME`, `REAL` and one dimensional arrays of these types are allowed to be used in a safety project.

Variables must be one of these types. At analyze time, if a variable of a forbidden type (e.g. `STRING`) is detected, an error message is displayed (Type not allowed. Only whole numbers or boolean types can be used in safety projects).

No DDTs

No DDTs are allowed (exception: simple arrays are allowed).

Variables must be one of the data types mentioned above. DDTs cannot be created, if a variable of a DDT type is detected, an error message is displayed. (Type not allowed. Only whole numbers or boolean types can be used in a safety project).

It is not possible to import a DDT type into a safety application. Trying to import a DDT type into a safety application will be unsuccessful. An error will be displayed (DDT types are not allowed into safety project. Import failed).

Simple Arrays

Simple arrays are allowed for global data only.

The use of simple arrays is allowed inside safety applications for integration of global data. Simple arrays can only have a static index-parameter.

The meaning of simple arrays is:
- only vectors (1 dimension) allowed
- the type of the elements must be 1 of the elementary types listed above
- an array must be contained completely either in the unrestricted memory area or in the safety memory area (an array is not allowed to overlap different memory areas)
- the index of a simple array can only be a literal
- no nested arrays are allowed
- simple arrays can be used for global data only

Direct Addresses

It is allowed to use direct addresses in a safety project.

E.g. %MW4000 can be written by a coil in ladder diagram.

General Settings for Safety Projects

Overview

The restrictions described in this section apply only to Unity Pro XLS Software projects working with Quantum safety PLCs.
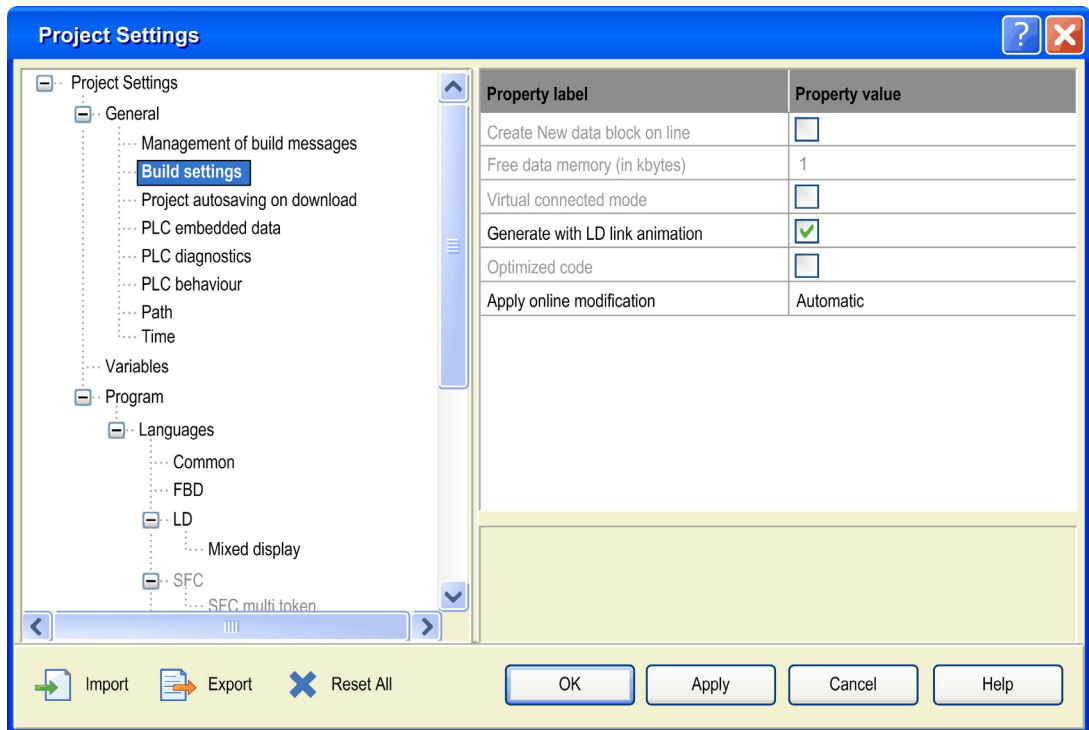
For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the General Dialog section

The **Build settings** dialog box used to modify the project generation settings can be accessed via **Tools** →**Project Settings** →**General**.

General Project Settings

The dialog box below shows the build project settings:

Availability for Safety Projects

The following settings are not available for safety projects:

Setting	Availability	Comment
Build Settings		
Create New data block on line	Not available Default value = FALSE	Not applicable for safety projects
Free data memory (in kbytes)	Not available Default value = 1K	The default value (1k) is sufficient because it is only used for link animation hidden variable (1 per section).
Virtual connected mode	Not available Default value = FALSE	Not applicable for safety projects
Optimized Code	Not available Default value = FALSE	This optimized code removes some run-time checks on array. This is not applicable for safety projects.
PLC embedded data		
Data dictionary	Not available Default value = FALSE	
Optimize data on-line change	Not available Default value = FALSE	
PLC diagnostics		
Application diagnostics	Not available Default value = FALSE	No diagnostic FFBs allowed for safety projects
Rack Viewer diagnostics information	Not available Default value = FALSE	Not applicable for safety projects
Program Viewer information	Not available Default value = FALSE	Not applicable for safety projects
PLC behaviour		
Reset %M on Stop->Run transition	Not available Default value = FALSE	Not applicable for safety projects

Variable Settings for Safety Projects

Overview

The restrictions described in this section apply only to Unity Pro XLS Software projects working with Quantum safety PLCs.
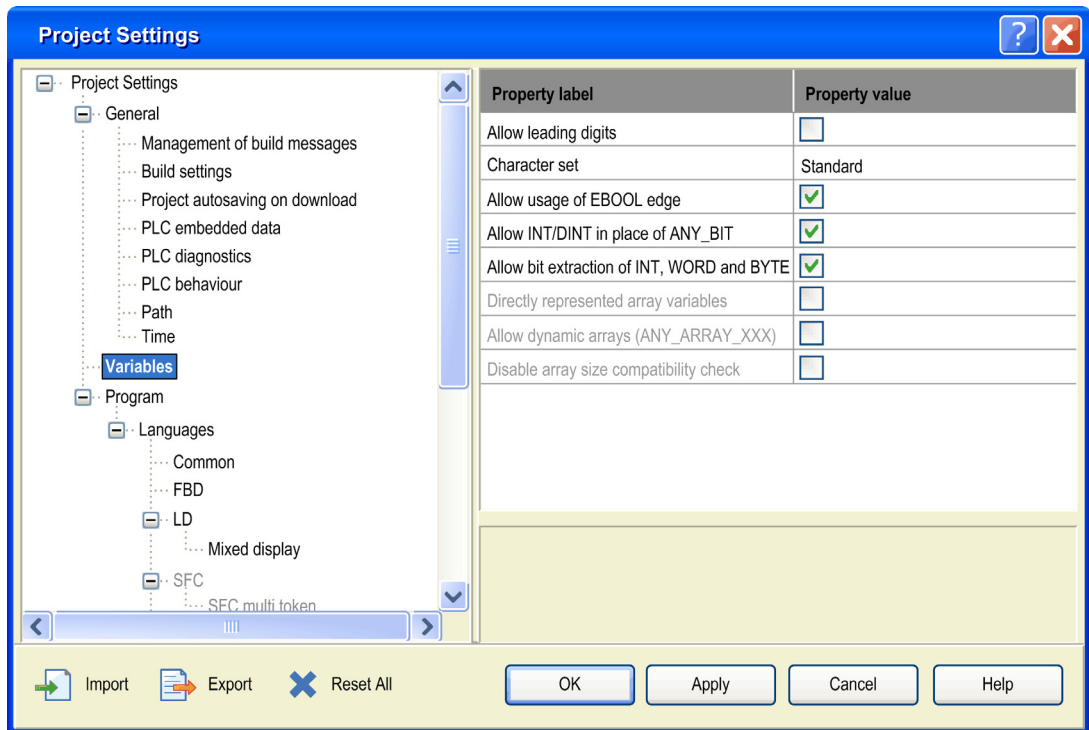
For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the General Dialog Section

The **Variables** dialog box used to modify the project generation settings can be accessed via **Tools →Project Settings →Variables**.

Variable Settings

The dialog box below shows the Variables project settings:

Availability for Safety Projects

The following settings are not available for safety projects:

Setting	Availability	Comment
Directly represented array variables	Not available Default value = 1K	Not allowed for safety projects
Allow dynamic arrays [ANY_ARRAY_XXX]	Not available Default value = FALSE	Not allowed for safety projects
Disable array size compatibility check	Not available Default value = FALSE	Not allowed for safety projects

Language Settings for Safety Projects

Overview

The restrictions described in this section apply only to Unity Pro XLS Software projects working with Quantum safety PLCs.
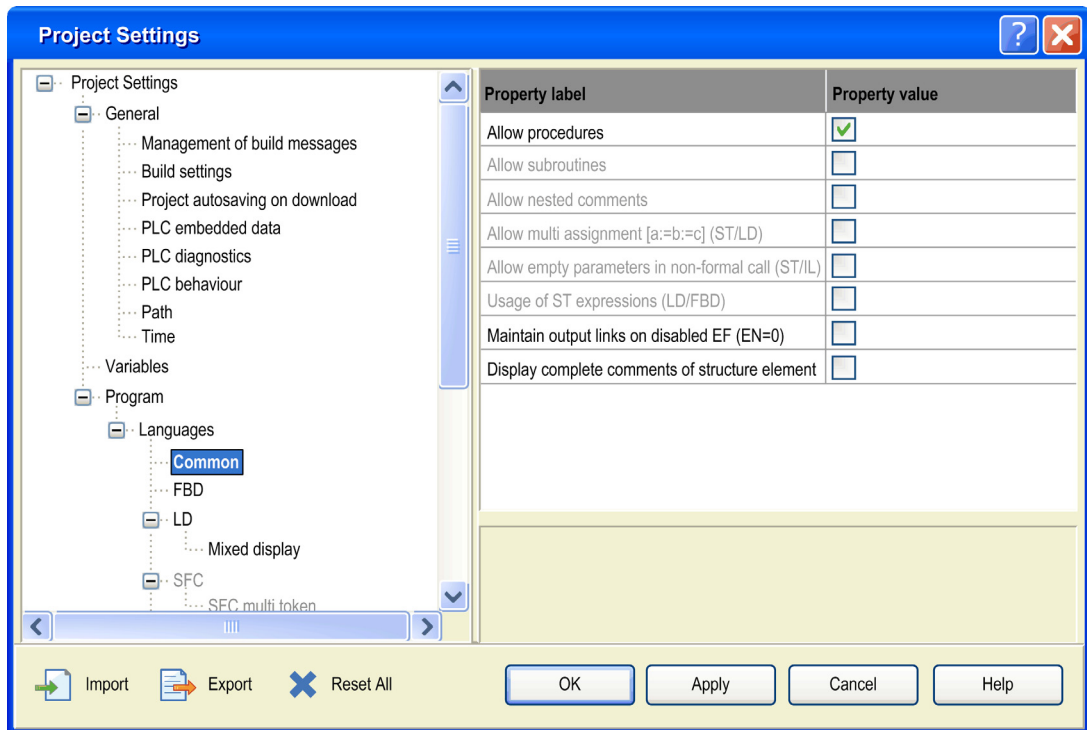
For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the Language Extensions Dialog Box

The **Languages** dialog section can be accessed via **Tools** →**Project Settings** → **Program** →**Languages**.

Languages Settings

The dialog box below shows the **Languages** settings:

Availability for Safety Projects

The following **Languages** settings are not available for safety projects:

Setting	Availability	Comment
Common		
Allow subroutines	Not available Default value = FALSE	Subroutines are not allowed in safety projects
Allow nested comments	Not available Default value = FALSE	Nested comments are not allowed in safety projects
Allow multi assignment [a:=b:=c] (ST/LD)	Not available Default value = FALSE	Multi assignment [a:=b:=c] (ST/LD) is not allowed in safety projects
Allow empty parameters in non-formal call (ST/IL)	Not available Default value = FALSE	Empty parameters in non-formal call (ST/IL) are not allowed in safety projects
Usage of ST expressions (LD/FBD)	Not available Default value = FALSE	ST expressions (LD/FBD) are not allowed in safety projects
SFC		
SFC (Sequential Function Chart)	Not available	SFCs are not allowed in safety projects
ST		
ST (Structured Text)	Not available Default value = FALSE	ST expressions are not allowed in safety projects **Note:** This implies that compare blocks and operate blocks are not allowed. So numerical operations are possible only via graphical FFB.
LL984		
LL984	Not available Default value = TRUE	LL984 is not allowed in safety projects

Project Configuration with Unity Pro XLS Software

6

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to PLC configuration.

What Is in This Chapter?

This chapter contains the following topics:

Restrictions Configuring Quantum Safety PLCs with Unity Pro XLS

Overview

For a safety project, at analyze time Unity Pro XLS checks that restrictions applied to safety hardware configurations are fulfilled. Otherwise a build is not possible.

If a build is not possible an error message is displayed.

Restrictions for Safety Hardware Configuration

There are the following restrictions for Quantum safety hardware configurations:
- only safety modules and non-interfering modules are allowed
- DIO field busses are not allowed (RIO field busses are allowed)
- extension racks are not allowed
- other field busses are not allowed
- I/O module sniffing is allowed

Module Definition

Module	Description
Safety Module	modules used to control the safety functions
Non-interfering Module	modules used to control the non-safety functions, but do not interfere with the safety modules
Non-Safety Module	other modules that can not be mixed with safety modules

For detailed information please refer to the *Quantum Safety PLC Safety Manual*, section Safety Certification *(see Modicon Quantum, Quantum Safety PLC, Safety Reference Manual)*.

From the Unity Pro XLS point of view there is no difference between safety and non-interfering modules. System designers, programmers and users must ensure that non-interfering modules are not used as part of the safety loop. The values from non-interfering input modules must not be used to calculate safety output and only safety output modules have to be used for safety outputs.

It is allowed to use non-interfering modules. You are responsible to use these non-interfering modules only for non-safety parts of the controlled process.

Unity Pro XLS offers modularization by means of sections. Therefore it is recommended to use the non-safety-related logic and I/O in dedicated sections.

Non-interfering modules can then be placed in the local rack and mixed with safety modules, and/or placed in Remote I/O drops (except the NOE).

Safety- and Non-Interfering Modules

If...	Then...
the configured PLC is a safety PLC	the configuration editor will prevent adding any module without the safety- or non-interfering attribute.
the configured PLC is a non-safety PLC	the configuration editor will prevent adding any module with the safety attribute.

DIO Field Busses

DIO field busses are not allowed.

The DIO check box in the module editor on the Modbus Plus port inside the PLC will be unchecked and disabled if the configured PLC is a safety PLC.

RIO Field Busses

RIO field busses are allowed.

Extension Racks

Extension racks are not allowed.

No extension racks are allowed, neither for local rack nor for remote drops.

No empty rack connection point for extension racks exists in the bus editor if the configured PLC is a safety PLC. The local rack is shown as any non-extensible rack. It is not possible to add an extension rack in the bus editor.

Other Field Busses

Other field busses are not allowed.

Bus master modules of other field busses neither have the safety- nor the non-interfering attribute. Therefore it is not possible to add them in a bus editor.

I/O Module Sniffing

I/O module sniffing is allowed even with a safety project.

If the PLC configured in the project is a safety PLC and the existing PLC is a non-safety PLC then sniffing is not allowed. And vice versa.

Sniffing may introduce non-safety modules in the project but this will be detected at analyze time.

PLC Replacement

The following rules apply to PLC replacements:
- A safety PLC can only be replaced by a safety PLC.
- A non-safety PLC can only be replaced by a non-safety PLC.
- The version of the PLC cannot be downgraded (a Safety PLC V1.00 replacing a Safety PLC V2.00) unless there are not any of the new floating point FFBs/REAL variables (Unity Pro 4.1) in the application.

Unity Pro XLS checks the new PLC before replacing the old one.

If replacement is not possible, an error message is displayed.

Partial Import

The same restrictions as to PLC replacement apply to partial import.

It is not possible to partially import a safety PLC into a non-safety project and vice versa.

Configuration of Quantum Processors with Unity Pro XLS Software

Overview

The restrictions described in this section only apply to Unity Pro XLS Software projects working with Quantum safety PLCs.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the Configuration Dialog Box

The Quantum PLC **Configuration** dialog box can be accessed via:

Edit →**Open module** when the PLC is selected in the Bus Editor

Accessing the Configuration Dialog Box

To access the Quantum PLC **Configuration** dialog box proceed as described below.

Step	Action
1	Access the rack configuration screen.
2	Select the processor.
3	Using the context menu, click **Open Module**.
4	Select the **Configuration** tab.

Processor Configuration

The following figure shows a Quantum processor configuration dialog box:

| Overview | Summary | Configuration | Modbus Port | Animation | I/O Objects |

Operating Mode On Cold Start

☐ Automatic start in Run

☑ %MWi Reset
   (Use this feature carefully, see documentation)

☐ Cold Start Only

Memory Cards
A: No memory card selected

B: No memory card selected

Communication

Maximum Unity Data exchanged by Plc Scan
(Potential impact on cycle time (if > 4x256), see documentation)   4x256 ▼   Bytes

State RAM

Mem usage   3%

	0x		4x
%M	256	%MW	1024
	1x		3x
%I	256	%IW	1024

Viewer

Unrestricted Memory Areas

	0x		4x
%M	0	%MW	0

Unrestricted Memory Areas

This feature is only available for Unity Pro XLS Software working with Quantum safety PLCs.

For safety projects, to allow writing from an HMI or other PLCs there are dedicated unrestricted memory areas for bits (%M) and for words (%MW).

These memory ranges are not write protected and are situated at the beginning of the complete memory range.

You can define a contiguous area of %M and %MW for which the safety PLC allows write access.

More information is available about unrestricted memory areas *(see page 53)*.

State RAM Viewer

In the processor configuration dialog box click on **Viewer** to open the state RAM viewer.
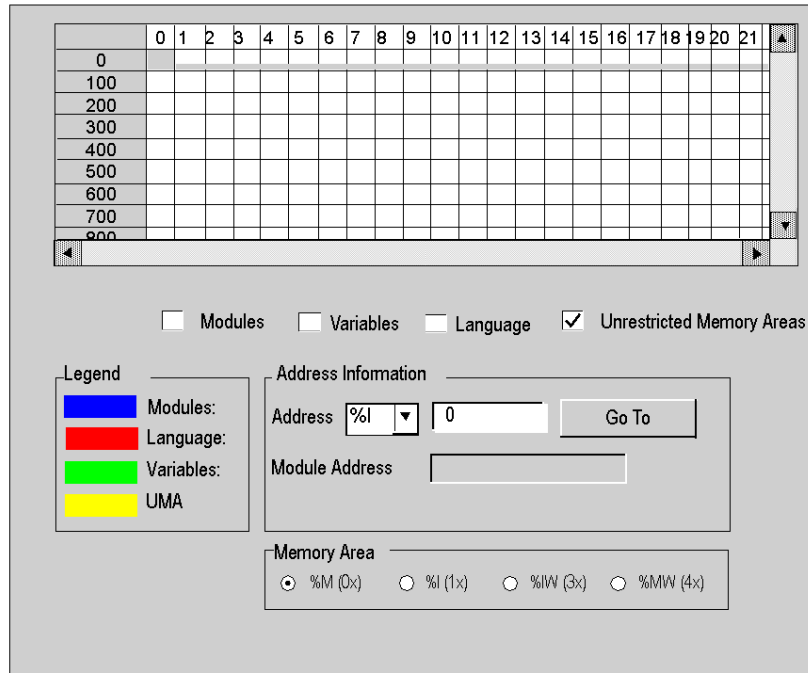
Elements of the state RAM viewer

Element	Description
Table	This table represents the mapping of the memory area selected in the **Memory Area** field. The occupied memory addresses are marked by dashes: ● blue: for module type objects ● red: for objects entered in the program ● green: for objects defined in the variable editor ● yellow: for unrestricted memory areas (UMA), only available in Unity Pro XLS Software The scroll bars can be used to access the entire memory area.
Modules, **Variables Language** and **Unrestricted Memory Areas** check boxes	These check boxes are used to filter the information displayed in the table. If, for example, **Modules** is the only thing checked, only module-type information will be displayed.

Element	Description
Address Information	By entering the object and its address in the **Address** fields and clicking on the **Go To** button, you display directly the address in the table (without using the scroll bars). This zone also has a display function; it displays the object and address of the box selected in the table. For module-type objects, it also gives the topological address of the module concerned.
Memory Area option buttons	These option buttons are used to select the memory area to display in the table: ● **%M (0x)** output module bits and internal bits ● **%I (1x)** internal module bits ● **%IW (3x)** input/output register words and internal words ● **%MW (4x)** I/O module output words and internal words

Using Data from the Unrestricted Memory Area

Data from Unrestricted Memory Area

To use data from the unrestricted memory area, that is to transfer them to the safety memory area, proceed as follows:

Step	Action
1	Declare variables of type EBOOL or WORD.
2	Map the declared variables to the unrestricted memory areas as follows: ● EBOOL variables to %M ● WORD variables to %MW
3	For transfer to the safety memory area, use ● the S_SMOVE_BIT function block to move BOOL variables, ● the S_SMOVE_WORD function block to move WORD variables.
4	Use the data in the safety memory area.

S_SMOVE_*** Function Blocks

For further details on the S_SMOVE_*** function blocks please refer to the *Unity Pro Safety FFB Library*.

Configuring I/O Modules for Safety Projects

Maximum Consecutive CRC Error

To configure the maximum consecutive CRC error of safety I/O modules, proceed as follows:

Step	Action
1	In the **Project Browser** double-click the **Configuration** folder to open it.
2	Double-click the **Local Bus** or the **RIO Bus**. **Result:** The **Local Bus** or **RIO Bus** window is displayed.
3	Click the input or output module concerned.
4	Open the module by selecting the menu command **Edit →Open Module**. **Result:** The **Config** tab of the module window is displayed.
5	In the **Parameter Name** column, double-click the **MAX CONSECUTIVE CRC ERROR** row.
6	In the **Value** column, type the number of errors that you want your module to maximally accept before entering safe state. **Note:** You can configure a value of 0, 1, 2, or 3 for each I/O module. Setting it to 0 means that the module enters safe state as soon as the CRC error is detected. Setting it to n means that n consecutive CRC errors are accepted before the module enters safe state.
7	Close the module window. **Result:** A validation dialog box is displayed.
8	Validate your selection by clicking **Yes**.
9	Save your project.

Timeout State of Output Modules

To configure the timeout state of a safety digital output module, you first must open the module as described above, then proceed as follows:

Step	Action
1	In the **Parameter Name** column, double-click the **MODULE TIME OUT** row.
2	In the **Value** column, type the number of ms that you want to pass by before your module enters fallback state.
3	In the **Parameter Name** column, open the **TIMEOUT STATE** folder by clicking the plus sign button. **Result:** Each channel is displayed in a row.
4	Open the **CHANNEL 1** row by clicking the plus sign button.

Step	Action
5	In the **Value** box in the **Value** column, select the value that you have chosen. **Note:** If you select **USER DEFINED**, a default value of 0 is set. To change it: ● Open the **CHANNEL 1** row by clicking the plus sign button. ● In the **Value** column, double-click the **Value** row. ● Type 1, as this is the only alternative value.
6	Repeat steps 4 and 5 to configure the timeout states of the other channels.
7	Close the module window. **Result:** A validation dialog box is displayed.
8	Validate your selection by clicking **Yes**.
9	Save your project.

Debugging the Program with Unity Pro XLS Software

7

Overview

This chapter describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to debugging features.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
7.1	PLC Debug Screen for Unity Pro XLS Software	84
7.2	PLC Simulator for Unity Pro XLS Software	90

7.1   PLC Debug Screen for Unity Pro XLS Software

Overview

This section describes the specifics of Unity Pro XLS Software, working with Quantum safety PLCs, referring to debug screen (associated with the PLC).

For standard (non-safety) features concerning debug screen please refer to the standard *Unity Pro XL Software documentation*.

What Is in This Section?

This section contains the following topics:

Task Tab: Task Field

Overview

The restrictions described in this section only apply to Unity Pro XLS Software projects working with Quantum safety PLCs.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the PLC Screen

The task tab of the **PLC Screen** dialog box can be accessed via **Tools →PLC Screen →Task**.

Task Checking Field

This field gives you access to the display and settings of the task periods and the various task execution commands.

	Programmed Period	Adjusted Period	Minimum Duration	Current Duration	Maximum Duration	Watchdog	Operating Mode	Cmd	State	Activation Task	Init Duration
MAST		CYCLIC	20	0	198	250	Stop Mai	RUN	E	Disable	Init

This field may be extended according to the tasks configured in the project: one line per auxiliary task may be displayed in addition to those in the above screen.

Minimum Duration

This value defines the minimum duration of task execution, measured from the last cold restart or re-initialization using the **Init Duration** command.

NOTE: The minimum duration of a safety project is 20 ms.

Availability

The following table shows the values and the availability of different controls depending on the PLC (safety/non-safety) and the safety mode.

Control	Non-Safety PLC	Safety PLC in Maintenance Mode	Safety PLC in Safety Mode
Operating Mode	RUN/STOP	enhanced with RUN MAINTENANCE STOP MAINTENANCE	enhanced with RUN SAFE STOP SAFE
Cmd	RUN/STOP	RUN/STOP	It is not possible to run/stop the task in safety mode.

Control	Non-Safety PLC	Safety PLC in Maintenance Mode	Safety PLC in Safety Mode
Activation Task	ENABLE/DISABLE	It is not possible to disable the task for safety projects.	It is not possible to disable the task for safety projects.
Events	available	not available	not available

For further information on safety mode please refer to *Safety Mode with Unity Pro XLS Software, page 27*.

Task Tab: Operating Mode

Overview

The restrictions described in this section only apply to Unity Pro XLS Software projects working with Quantum safety PLCs.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the PLC Screen

The task tab of the **PLC Screen** dialog box can be accessed via **Tools →PLC Screen →Task**.

Operating Mode Field

This field gives you access to a simulation button:

This field also indicates the date, time and cause of the last PLC stop.
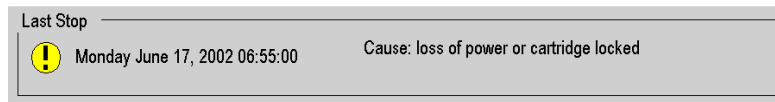
Description

Button and function

Button	Function
Cold start	Click on this button to perform a cold start of the PLC. This initializes the data, the system, and sets the %S0 bit to 1 which (in this case) is used for example to command a specific initialization program.

Info Tab

Overview

The restrictions described in this section only apply to Unity Pro XLS Software projects working with Quantum safety PLCs.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Accessing the Information Tab

The **Information** tab can be accessed via **Tools** →**PLC Screen** →**Information**.

Information Tab

The **Information** tab is composed of 2 areas:

● the browser, which is used to choose the subject
● the display area in which information concerning the chosen subject is displayed.
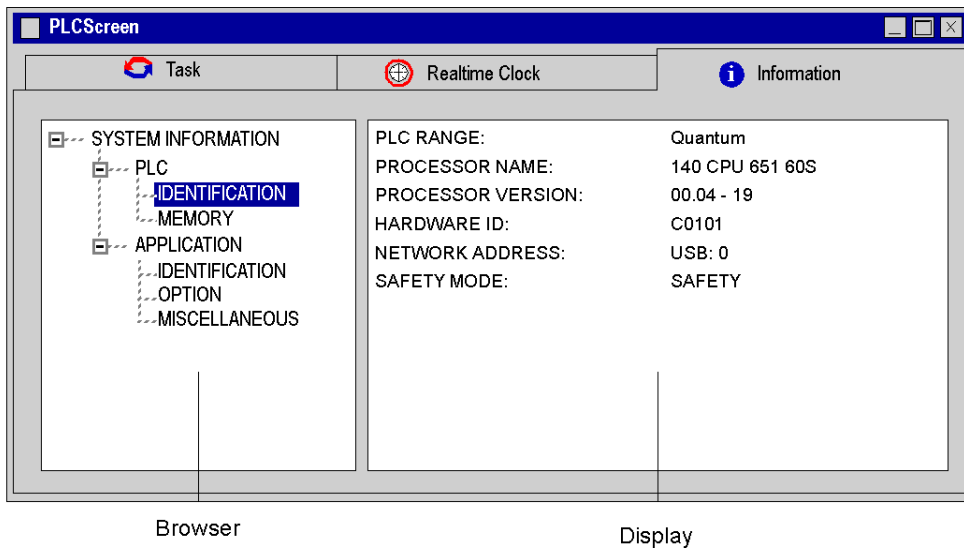
PROCESSOR NAME

If a safety PLC is connected, this is indicated by a capital S at the end of the processor name (e.g. 140 CPU 651 60S).

SAFETY/MAINTENANCE MODE

This information is only shown for Quantum safety PLCs. The current mode of the connected PLC is displayed (maintenance or safety).

For Unity Pro XLS Software this information is also shown in the status bar.

7.2 PLC Simulator for Unity Pro XLS Software

Simulator Control for Quantum Safety PLC

Introduction

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

Representation of the dialog box
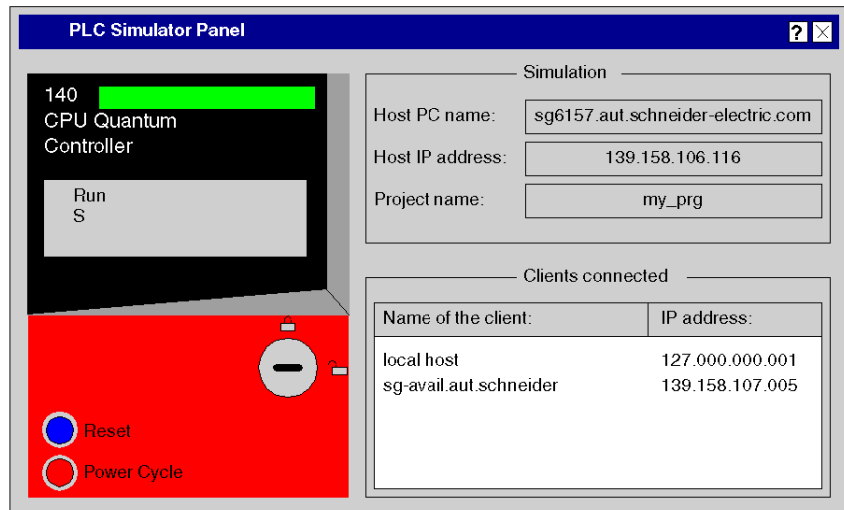
PLC Front Plate

The virtual PLC front plate shows the current state of the safety PLC in a display.

Text in the Display	The Simulated PLC 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 PLC has not been started or reset with the **Reset** command button.

Text in the Display	The Simulated PLC is in State...	Meaning
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 PLC must be re-initialized or reset using the **Reset** command button.
Err	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.
S	Safety Mode	The project is running in safety mode. For further information on the different modes please refer to the *Unity Pro XLS Software Specifics* manual.
M	Maintenance Mode	The project is running in maintenance mode. For further information on the different modes please refer to the *Unity Pro XLS Software Specifics* 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 Unity Pro XLS Software is only possible, if the simulator´s 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 Unity Pro XLS Software is disconnected from the simulator, it is automatically set to safety mode.

NOTE: The PLC 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 with the mouse on the switch symbol, various switch positions can be simulated.

Meaning of the switch positions

Switch Position	Switch Position on Real CPU	Meaning
	Start	PLC unlocked ● project can be loaded ● PLC can be started or stopped
	Mem Prt	PLC locked ● project can not be loaded ● As opposed to the key switch on a real CPU, the PLC 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 command button, you can reset the simulated PLC (and the simulator). This corresponds to a cold start of the PLC (the connection between the Unity Pro and simulator is broken, project variables are reset).

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

Power Cycle

With the command button, you simulate a cold start of the PLC (since a safety PLC does not support warm start), i.e. the connection between Unity Pro and the simulator is broken, the simulator goes into the state RUN (autostart active) or STOP (autostart deactivated).

This command button corresponds to the unplugging and plugging in of a power supply.

Host PC name

This text field shows the DNS name of the host PC for the simulator.

If the PC has multiple network cards, only the first is shown.

Host IP address

This text field shows the TCP/IP address of the host PC for the simulator.

If the PC has multiple network cards, only the first is shown.

Project name

This text field shows the name of the loaded project.

Clients connected

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

Appendices

Overview

This part describes the specifics of Unity Pro XLS Software ergonomics compared to Unity Pro XL Software and the system objects (system bits and words).

What Is in This Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	User Interface of Unity Pro XLS Software	97
B	System Objects	99

User Interface of Unity Pro XLS Software

A
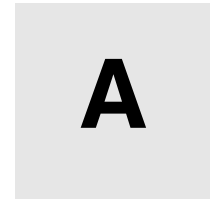
Status Bar of Unity Pro XLS Software

Overview

The additional features described in this section only apply to Unity Pro XLS Software projects working with Quantum safety PLCs.

For standard (non-safety) features please refer to the standard *Unity Pro XL Software documentation*.

Displayed Information

The status bar displays information about the current project on the PC, about the PLC and about the software status.

Example: Online status bar

| Ready | HMI R/W mode | EQUAL | | STOP | READ INFO OK | UNT:SYS | | MAINTENANC | Not generated | ♀ | | |

1

1 Current Mode

Maintenance/ Safety Mode

In addition to information displayed in the status bar of standard Unity Pro XL Software, for Unity Pro XLS Software projects working with Quantum safety PLCs the current mode (maintenance/safety) of the connected PLC is displayed.

This information is available in connected mode even if no project or a different project is opened.

System Objects

B

Introduction

This chapter describes the system bits and words of the Quantum Safety PLC.

Note: The symbols associated with each bit object or system word mentioned in the descriptive tables of these objects are not implemented as standard in the software, but can be entered using the data editor.

It is suggested that the symbol names associated with the system bits and system words that appear on the following pages be implemented to provide continuity and ease of understanding. Example: %S0 COLDSTART (the user can select another word to replace COLDSTART).

What Is in This Chapter?

This chapter contains the following sections:

B.1 System Bits

Introduction

This section describes the system bits of the Quantum Safety PLC.

For your convenience, all system bits of standard Quantum PLCs are listed but only explained further if used in the Quantum Safety PLC.

What Is in This Section?

This section contains the following topics:

System Bit Introduction

General

The Quantum PLCs use %Si system bits which indicate the state of the PLC, or they can be used to control how it operates.

These bits can be tested in the user program to detect any functional development.

Some of these bits must be reset to their initial or normal state by either the program or the user. Other bits are automatically reset by the system. Finally, there are bits which only display the status of the PLC.

Description of the System Bits %S0 to %S13

Detailed Description

NOTE: Not all of the system bits can be used in the Quantum Safety PLC. The unusable system bits are marked in the **Quant. Safety** column with no.

The following table gives a description of the system bits %S0 to %S13:

Bit Symbol	Function	Description	Initial State	Write Access	Quant. Safety
%S0 COLDSTART	cold start	Normally at 0, this bit is set to 1 by: ● power restoration with loss of data (battery related), ● the user program, ● the terminal, ● a change of cartridge, 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. %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.	1 (1 cycle)	no	yes
%S1 WARMSTART	warm restart	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	no	no
%S4 TB10MS	time base 10 ms	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no
%S5 TB100MS	time base 100 ms	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no
%S6 TB1SEC	time base 1 s	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no
%S7 TB1MIN	time base 1 min	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no

Bit **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%S10 `IOERR`	input/output fault	Normally at 1, this is set to 0 when an I/O fault on an in-rack module or device on Fipio is detected (e.g. non-compliant configuration, exchange fault, hardware fault, etc.). The %S10 bit is reset to 1 by the system as soon as the fault disappears.	1	no	yes
%S11 `WDG`	watchdog overflow	Normally at 0, this is set to 1 by the system as soon as the task execution time becomes greater than the maximum execution time (i.e. the watchdog) declared in the task properties.	0	no	yes
%S12 `PLCRUNNING`	PLC in RUN	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.).	0	no	yes
%S13 `1RSTSCANRUN`	first cycle after switching to RUN	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.	-	no	yes

⚠ **WARNING**

UNINTENDED EQUIPMENT OPERATION

On Quantum Safety PLCs, communication interruptions from NOE, CRA or CRP modules are not reported on bit %S10.

Make certain that these system bits are used correctly.

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

Description of the System Bits %S15 to %S21

Detailed Description

NOTE: Not all of the system bits can be used in the Quantum Safety PLC. The unusable system bits are marked in the **Quant. Safety** column with no.

The following table gives a description of the system bits %S15 to %S21:

Bit **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%S15 `STRINGERROR`	character string fault	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%S16 `IOERRTSK`	task input/output fault	Normally set to 1, this bit is set to 0 by the system when a fault occurs on an in-rack I/O module or a Fipio device configured in the task. This bit must be reset to 1 by the user.	1	yes	yes
%S17 `CARRY`	rotate or shift output	normally at 0 During a rotate or shift operation, this bit takes the state of the outgoing bit.	0	no	yes
%S18 `OVERFLOW`	overflow or arithmetic error	Normally set to 0, this bit is set to 1 in the event of a capacity overflow if there is ● a result greater than + 32 767 or less than - 32 768, in single length, ● 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. 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.	0	yes	yes

Bit **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%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.	0	yes	yes
%S20 INDEXOVF	Index overflow	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.	0	yes	no
%S21 1RSTTASKRUN	first task cycle	Tested in a task (Mast, Fast, Aux0, Aux1, Aux2 Aux3), the bit %S21 indicates the first cycle of this task. %S21 is set to 1 at the start of the cycle and reset to zero at the end of the cycle. **Notes**: The bit %S21 does not have the same meaning in PL7 as in Unity Pro.	0	no	yes

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

On Quantum Safety PLCs, communication interruptions from NOE, CRA or CRP modules are not reported on bit %S16.

Make certain that these system bits are used correctly.

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

Description of the System Bits %S30 to %S51

Detailed Description

NOTE: Not all of the system bits can be used in the Quantum Safety PLC. The unusable system bits are marked in the **Quant. Safety** column with no.

The following table gives a description of the system bits %S30 to %S51:

Bit Symbol	Function	Description	Initial State	Write Access	Quant. Safety
%S30 MASTACT	activation/deactivation of the master task	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	1	yes	no
%S31 FASTACT	activation/deactivation of the fast task	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%S32 **%S33** **%S34** **%S35**	activation/deactivation of the auxiliary tasks 0-3	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%S38 ACTIVEVT	enabling/inhibition of events	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	1	yes	no
%S39 EVTOVR	saturation in event processing	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%S50 RTCWRITE	updating of time and date via words %SW50 to %SW53	Normally set to 0, this bit is set to 1 by the program or the terminal: ● set to 0: update of system words %SW50 to %SW53 by the date and time supplied by the PLC real-time clock, ● set to 1: system words %SW50 to %SW53 are no longer updated, therefore making it possible to modify them. ● The switch from 1 to 0 updates the real-time clock with the values entered in words %SW50 to %SW53.	0	yes	yes
%S51 RTCERR	time loss in real-time clock	This system-managed bit set to 1 indicates that the real-time clock is missing or that its system words (%SW50 to %SW53) are meaningless. If set to 1, the clock must be reset to the correct time.	-	no	yes

Description of the System Bits %S59 to %S122

Detailed Description

NOTE: Not all of the system bits can be used in the Quantum Safety PLC. The unusable system bits are marked in the **Quant. Safety** column with no.

The following table gives a description of the system bits %S59 to %S122:

Bit `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%S59 `RTCTUNING`	incremental update of the time and date via word %SW59	Normally set to 0, this bit can be set to 1 or 0 by the program or the terminal: ● set to 0: the system does not manage the system word %SW59, ● set to 1: the system manages edges on word %SW59 to adjust the date and current time (by increment).	0	yes	yes
%S67 `PCMCIABAT0`	state of the application memory card battery	This bit is used to monitor the status of the main battery when the memory card is in the upper PCMCIA slot (all the Atriums, Premiums, and on the Quantums): ● set to 1: main voltage battery is low (application is preserved but you must replace the battery following the so-called predictive maintenance procedure), ● set to 0: main battery voltage is sufficient (application is preserved). Bit %S67 is managed: ● on the PV06 small and medium capacity RAM memory cards (product version written on the card label), i.e. offering memory size under Unity =#768K: TSX MRP P 128K, TSX MRP P 224K TSX MCP C 224K, MCP C 512K, TSX MRP P 384K, TSX MRP C 448K, TSX MRP C 768K, ● under Unity whose version is ≥ 2.02.	-	no	yes
%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: ● set to 0: battery present and operational, ● set to 1: battery missing or non-operational.	–	no	yes
%S75 `PCMCIABAT1`	state of the data storage memory card battery	This bit is used to monitor the status of the main battery when the memory card is in the lower PCMCIA slot, see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*. **Note:** Data stored on a memory card in slot B are not processed in SIL3 projects.	–	no	no

Bit Symbol	Function	Description	Initial State	Write Access	Quant. Safety
%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.	0	no	yes
%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.	0	no	yes
%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.	0	yes	yes
%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.	0	yes	yes
%S94 SAVECURRVAL	saving adjustment values	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%S118 REMIOERR	General Remote I/O fault	Normally set to 1, this bit is set to 0 by the system when a fault occurs on a device connected to the RIO (Fipio for Premium or Drop S908 for Quantum) remote input/output bus. This bit is reset to 1 by the system when the fault disappears. This bit is not updated if an error occurs on the other buses (DIO, ProfiBus, ASI).	–	no	yes
%S119 LOCIOERR	General inrack I/O fault	Normally set to 1, this bit is set to 0 by the system when a fault occurs on an I/O module placed in 1 of the racks. This bit is reset to 1 by the system when the fault disappears.	–	no	yes
%S120 **%S121** **%S122**	DIO bus faults	see chapter "System Bits" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	–	no	no

B.2 System Words

Introduction

This section describes the system words of the Quantum Safety PLC.

For your convenience, all system words of standard Quantum PLCs are listed but only explained further if used in the Quantum Safety PLC.

What Is in This Section?

This section contains the following topics:

Description of the System Words %SW0 to %SW21

Detailed Description

> **NOTE:** Not all of the system words can be used in the Quantum Safety PLC. The unusable system words are marked in the **Quant. Safety** column with no.

> The following table gives a description of the system words %SW0 to %SW21:

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%SW0 `MASTPERIOD`	master task scanning period	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%SW1 `FASTPERIOD`	fast task scanning period	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%SW2, **%SW3**, **%SW4**, **%SW5**	auxiliary task scanning period	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%SW8 `TSKINHIBIN`	acquisition of task input monitoring	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%SW9 `TSKINHIBOUT`	monitoring of task output update	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no
%SW10 `TSKINIT`	first cycle after cold start	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	no	no
%SW11 `WDGVALUE`	watchdog duration	Reads the duration of the watchdog. The duration is expressed in milliseconds (20...990 ms). This word cannot be modified.	-	no	yes

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%SW12 `APMODE`	mode of application processor	This word indicates the operating mode of the application processor. Possible values are: • 16#A501: application processor is in Maintenance Mode. • 16#5AFE: application processor is in Safety Mode. Any other value is interpreted as an error. This system word is not available for the standard Quantum CPU.	16#A501	no	yes
%SW13 `INTELMODE`	mode of Intel processor	This word indicates the operating mode of the Intel Pentium processor. Possible values are: • 16#501A: application processor is in Maintenance Mode. • 16#5AFE: application processor is in Safety Mode. Any other value is interpreted as an error. This system word is not available for the standard Quantum CPU.	16#501A	no	yes
%SW14 `OSCOMMVERS`	commercial version of PLC processor	This word contains the commercial version of the PLC processor. **Example:** 16#0135 version: 01; issue number: 35	-	no	yes
%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.	-	no	yes
%SW16 `OSINTVERS`	firmware version number	This word contains the Firmware version number in hexadecimal of the PLC processor firmware. **Example:** 16#0017 version: 2.1; VN: 17	-	no	yes
%SW17 `FLOATSTAT`	error status on floating operation	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual* %SW17.1: Flag not managed by Quantum Safety.	0	yes	yes
%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.	0	yes	yes

Word **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%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.	0	no	yes

Description of the System Words %SW30 to %SW59

Detailed Description

NOTE: Not all of the system words can be used in the Quantum Safety PLC. The unusable system words are marked in the **Quant. Safety** column with no.

The following table gives a description of the system words %SW30 to %SW59:

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%SW30 `MASTCURRTIME`	master task execution time	This word indicates the execution time of the last master task cycle (in ms).	-	no	no
%SW31 `MASTMAXTIME`	maximum master task execution time	This word indicates the longest master task execution time since the last cold start (in ms).	-	no	yes
%SW32 `MASTMINTIME`	minimum master task execution time	This word indicates the shortest master task execution time since the last cold start (in ms).	-	no	yes
%SW33 to %SW35	fast task execution times	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no
%SW36	NTP number of seconds (LSB)	This word indicates the number of seconds passed since January 1st, 1980 at 00:00 (LSB part). It reflects the NTP time coming from the 140 NOE 771 11 module. This word is refreshed internally between two NTP synchronizations.	0	no	yes
%SW37	NTP number of seconds (MSB)	This word indicates the number of seconds passed since January 1st, 1980 at 00:00 (MSB part). It reflects the NTP time coming from the 140 NOE 771 11 module. This word is refreshed internally between two NTP synchronizations.	0	no	yes
%SW38	NTP number of milliseconds	This word indicates the number of milliseconds added to the NTP number of seconds (%SW36 and %SW37). It reflects the NTP time coming from the 140 NOE 771 11 module. This word is refreshed internally between two NTP synchronizations.	0	no	yes

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety

%SW39	status of the NTP timestamps in ms	Meaning of the different bits of `%SW39` word:
		● `%SW39.0` (managed by the controller):
		  ● =0, the time value is not available or the time has not been updated within last 2 minutes
		  ● =1, the time value is available or the time has been updated within last 2 minutes
		
		● `%SW39.1` (managed by the 140 NOE 771 11 status):
		  ● =0, the NTP server time value is not available
		  ● =1, the updated time value is received from the NTP server and has been sent to the module (at least once)
		
		● `%SW39.2` (managed by the CPU):
		  ● =0, the time value in `%SW36` to `%SW38` words differs from the last NTP server time received by more than 2 seconds. The last NTP server time received has been ignored.
		  ● =1, the time value in `%SW36` to `%SW38` words are consistent with the last NTP server time received (less than 2 seconds difference). The time value in `%SW36` to `%SW38` words is filtered with a slope of 1ms/s to reach the last NTP server time received.
		
		● `%SW39.3` to `%SW39.7`: not used
		● `%SW39.8` (control that can be set by the application):
		  ● =0, no action
		  ● =1. When set to 1, the CPU will accept the next NTP server time received without filtering (1 ms/s) and without consistency check (difference between time value in `%SW36` to `%SW38` words and NTP server time). After the next NTP server time is received, the `%SW39.8` bit is automatically reset to 0 by the controller.
		
		● `%SW39.9` to `%SW39.15`: not used
			0	yes	yes

%SW40 to %SW47	auxiliary tasks execution times	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	-	no	no

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%SW48 `IOEVTNB`	number of events	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0	yes	no

%SW49
`DAYOFWEEK`
 	
%SW50
`SEC`
 	
%SW51
`HOURMIN`
 	
%SW52
`MONTHDAY`
 	
%SW53
`YEAR`
	real-time clock function	System words containing date and current time (in BCD):
		● %SW49: day of the week:
		 ● 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).
		
		These words are managed by the system when the bit %S50 is set to 0.
		These words can be written by the user program or by the terminal when the bit %S50 is set to 1.
			-	yes	yes

%SW54
`STOPSEC`
 	
%SW55
`STOPHM`
 	
%SW56
`STOPMD`
 	
%SW57
`STOPYEAR`
 	
%SW58
`STOPDAY`
	real-time clock function on last stop	System words containing date and time of the last power outage or PLC stop (in Binary Coded Decimal):
		● %SW54: Seconds (00SS),
		● %SW55: Hours and Minutes (HHMM),
		● %SW56: Month and Day (MMDD),
		● %SW57: Year (YYYY),
		● %SW58: 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:
		 ● 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.
			-	no	yes

Word **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%SW59 `ADJDATETIME`	adjustment of current date	Contains 2 8-bit series to adjust the current date. The action is performed on the rising edge of the bit. This word is enabled by bit %S59=1. In the following illustration, bits in the left column increment the value, and bits in the right column decrement the value: 	0	yes	yes

Description of the System Words %SW60 to %SW127

Detailed Description

> **NOTE:** Not all of the system words can be used in the Quantum Safety PLC. The unusable system words are marked **no** in the **Quant. Safety** column.

> The following table gives a description of the system words %SW60 to %SW127:

Word Symbol	Function	Description	Initial State	Write Access	Quant. Safety

%SW60
HSB_CMD
	Quantum Hot Standby command register	Meaning of the different bits of the word %SW60:
		● %SW60.0=1 invalidates the commands entered in the display (keypad).
		● %SW60.1
		  ● =0 sets PLC A to OFFLINE mode.
		  ● =1 sets PLC A to RUN mode.
		● %SW60.2
		  ● =0 sets PLC B to OFFLINE mode.
		  ● =1 sets PLC B to RUN mode.
		● %SW60.3=0 forces Standby PLC to OFFLINE mode if the applications are different.
		● %SW60.4
		  ● =0 authorizes an update of the firmware only after the application has stopped.
		  ● =1 authorizes an update of the firmware without the application stopping.
		● %SW60.5=1 application transfer request from the Standby to the primary.
		● %SW60.8
		  ● =0 address switch on Modbus port 1 during a primary swap.
		  ● =1 no address switch on Modbus port 1 during a primary swap.
			0	yes	no

Word **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety

%SW61
`HSB_STS`
	Quantum status register	Meaning of the different bits of the word `%SW61`:
		● `%SW61.0` und `%SW61.1` PLC operating mode bits:
		  ● `%SW61.1`=0, `%SW61.0`=1: OFFLINE mode.
		  ● `%SW61.1`=1, `%SW61.0`=0: primary mode.
		  ● `%SW61.1`=1, `%SW61.0`=1: secondary mode (Standby).
		● `%SW61.2` and `%SW61.3` operating mode bits from the other PLC
		  ● `%SW61.3`=0, `%SW61.2`=1: OFFLINE mode.
		  ● `%SW61.3`=1, `%SW61.2`=0: primary mode.
		  ● `%SW61.3`=1, `%SW61.2`=1: secondary mode (Standby).
		  ● `%SW61.3`=0, `%SW61.2`=0: the remote PLC is not accessible (switched off, no communication).
		● `%SW61.4`=0 the applications are identical on both PLCs.
		● `%SW61.5`
		  ● =0 the PLC is used as unit A.
		  ● =1 the PLC is used as unit B.
		● `%SW61.7`
		  ● =0 same PLC OS version.
		  ● =1 different PLC OS version.
		● `%SW61.8`
		  ● =0 same Copro OS version.
		  ● =1 different Copro OS version.
		● `%SW61.12`
		  ● =0 information given by bit 13 is not relevant.
		  ● =1 information given by bit 13 is valid.
		● `%SW61.13`
		  ● =0 NOE address set to IP.
		  ● =1 NOE address set to IP + 1.
		● `%SW61.15`
		  ● =0 Hot Standby not activated.
		  ● =1 Hot Standby activated.
			0	no	yes

Word **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%SW62 HSBY_REVERSE0 **%SW63** HSBY_REVERSE1	transfer word	These 2 words may be written by the user in the first section of the master task. They are then transferred automatically from the Standby processor to update the primary PLC. They may be read on the primary PLC and be used as primary application parameters.	0	yes	yes
%SW70 WEEKOFYEAR	real-time clock function	System word containing the number of the week in the year: 1 to 52.	–		yes
%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. ● %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.	0	no	yes
%SW75 TIMEREVTNB	timer-type event counter	see chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*	0		no
%SW76 DLASTREG	diagnostics function: recording	Result of the last registration: ● = 0 if the recording was successful, ● = 1 if the diagnostics buffer has not been configured, ● = 2 if the diagnostics buffer is full.	0		yes
%SW77 DLASTDEREG	diagnostics function: non-recording	Result of the last deregistration: ● = 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.	0		yes
%SW78 DNBERRBUF	diagnostics function: number of errors	Number of errors currently in the diagnostics buffer.	0		yes

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety

%SW80
`MSGCNT0`
 	
%SW81
`MSCNT1`
	message management	These words are updated by the system, and can also be reset using `%S80`.
		● `%SW80`: Number of Modbus messages sent by the system as client on all communication ports except USB and Ethernet copro.
		NOTE: Modbus messages sent by the system as Master are not counted in this word.
		● `%SW81`: Number of Modbus messages received by the system as client on all communication ports except USB and Ethernet copro.
		NOTE: Modbus messages received as response to the requests sent by the system, as Master, are not counted in this word.
			0	yes	yes

%SW87 `MSTSERVCNT`	communication flow management	Number of requests processed by synchronous server per master (MAST) task cycle.	0		yes
%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 does not work. If a value that is outside of the range is entered, it is the value N that is taken into account. See also chapter "System Objects" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual.*	0	yes	yes
%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.	0	no	yes
%SW110	number of unrestricted memory area for %M	This system word gives information on the size of the unrestricted memory area for %M. This system word is not available for the standard Quantum CPU.	–	no	yes
%SW111	number of unrestricted memory area for %MW	This system word gives information on the size of the unrestricted memory area for %MW. This system word is not available for the standard Quantum CPU.	–	no	yes

Word `Symbol`	Function	Description	Initial State	Write Access	Quant. Safety
%SW124 `CPUERR`	type of system fault	This system word is updated if the PLC is set to error state. The possible values are as follows: ● 0x0065: execution of HALT instruction impossible ● 0x0080: system watchdog If the PLC is set to Safety error state, the content of `%SW125` is updated and can be read after the next restart of the PLC (see below).	–	no	yes

Word **Symbol**	Function	Description	Initial State	Write Access	Quant. Safety
%SW125 `BLKERRTYPE`	last fault detected	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 activated independently of `%S78`: ● 16#0002: PCMCIA signature not verified ● 16#2258: execution of HALT instruction ● 16#2302: call to a not 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#DEF1: character string transfer error (`%S15`) ● 16#DEF2: arithmetic or division by 0 error (`%S18`) ● 16#DEF3: index overflow (`%S20`) **Note:** The codes 16#8xxx and 16#7xxx do not stop the application and indicate an error on function blocks. In case of a SIL3 related error, the PLC stops. After power off and restart of the PLC, %SW 125 contains the code of the cause of the error: ● 0x5AF1: sequence check error (unpredictable execution in CPU) ● 0x5AF2: error in memory (corrupt address) ● 0x5AF3: comparison error (execution results of Intel and application processor differ) ● 0x5AF4: real-time clock error ● 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 (corrupt RAM) **Note:** `%SW125` is only reset after `init` or complete download or restart (it always contains the last fault detected).	–	no	yes

Word Symbol	Function	Description	Initial State	Write Access	Quant. Safety
%SW126 ERRADDR0 **%SW127** ERRADDR1	blocking fault instruction address	Address of the instruction that generated the application blocking fault. For 16 bit processors: ● %SW126 contains the offset for this address, ● %SW127 contains the segment number for this address. For 32 bit processors: ● %SW126 contains the least significant word for this address, ● %SW127 contains the most significant word for this address. The content of %SW126 and %SW127 is for Schneider Electric use only.	0	no	yes

For the description of the system words %SW128 to %SW339 and %SW535 to %SW640, see the chapter "Quantum Specific System Words" *(see Unity Pro, Program Languages and Structure, Reference Manual)* in the *Unity Pro Program Languages and Structure Reference Manual*. The system words %SW340 to %SW534 are not used in Quantum Safety PLCs.

Glossary
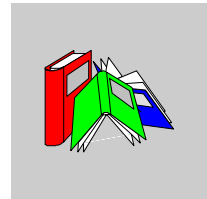
0-9

!

NOTE: For terms taken from the IEC 61508 standard, refer to the standard for complete definitions.

1002D diagnostic configuration

X out of Y

For example 1 out of 2. Voting and redundancy capacity of a Safety-Related System.

D in 1oo2D refers to diagnostics. Hence, D in 1oo2D means 1 out of 2 with diagnostics.

A

ALARP

as low as is reasonably practicable

(Definition IEC 61508)

Intolerable region

Risk cannot be justified except in extraordinary circumstances.

The ALARP or tolerability region

(Risk is undertaken only if a benefit is desired.)

Tolerable only if further risk reduction is impracticable or if its cost is grossly disproportionate to the improvement gained.

As the risk is reduced, so is the necessity to incur cost to reduce the risk further in order to fulfil ALARP. The triangle illustrates the concept of diminishing proportion.

Broadly acceptable region

(No need for detailed working to demonstrate ALARP)

It is necessary to maintain safeguards so as to keep risk at this level.

Negligible risk

C

CCF

common cause failure

failure, which is the result of 1 or more events, causing coincident failures of 2 or more separate channels in a multiple channel system, leading to system failure

(Definition IEC 61508)

The common cause factor in a dual channel system is the crucial factor for the probability of failure on demand (PFD) for the whole system.

cold start

Cold start refers to starting the computer from power off.

CPU

central processing unit

CRC

cyclic redundancy check

D

DC

diagnostic coverage

fractional decrease in the probability of dangerous hardware failures resulting from the operation of the automatic diagnostic tests

(Definition IEC 61508)

The fraction of the possible dangerous failures λ_D is divided into failures which are detected by diagnostics and failures which remain undetected.

$\lambda_D = \lambda_{DD} + \lambda_{DU}$

The diagnostic coverage (DC) defines the fraction of the dangerous failures which are detected.

$\lambda_{DD} = \lambda_D \cdot DC$

$\lambda DU = \lambda_D (1 - DC)$

The definition may also be represented in terms of the following equation, where DC is the diagnostic coverage, λ_{DD} is the probability of detected dangerous failures and λ_D total is the probability of total dangerous failures:

$$DC = \frac{\sum \lambda_{DD}}{\sum \lambda_{Dtotal}}$$

DDT

derived data type

A derived data type is user defined.

DFB

derived function block

DIO

distributed input/output

DLL

dynamic link library

E

E/E/PES

electrical/electronic/programmable electronic system

(Definition IEC 61508)

System for control, protection or monitoring based on 1 or more electrical/electronic programmable electronic (E/E/PE) devices. This includes elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices.

EDT

elementary data type

An elementary data type is predefined.

EF

elementary function

EFB

elementary function block

EMC

electromagnetic compatibility

The term refers to the origin, control, and measurement of electromagnetic effects on electronic systems.

EN

European Norm

This is the official European standard.

error

discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition

(Definition IEC 61508)

ESD

emergency shutdown

EUC

equipment under control

(Definition IEC 61508)

This term designates equipment, machinery, apparatuses or plants used for manufacturing, process, transportation, medical or other activities.

F

failure

termination of the ability of a functional unit to perform a required function

(Definition IEC 61508)

fault

abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function

(Definition IEC 61508)

FBD

functional block diagram

This is an IEC 61131-3 programming language for PLC user logic.

FFB

function/function block

FMEA

failure modes and effects analysis

FMECA

failure modes and effects criticality analysis

Functional Safety

part of the overall safety relating to the EUC and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities

(Definition IEC 61508)

A system is defined functionally Safe if random, systematic and common cause failures do not lead to malfunctioning of the system and do not result in injury or death of humans, spills to the environment and loss of equipment or production:
● Functional Safety deals with the part of the overall Safety that depends on the correct functioning of the Safety-Related System.
● Functional Safety applies to products as well as organizations.

H

HALT

high accelerated life tests

HFT

hardware fault tolerance

(Definition IEC 61508)

A hardware fault tolerance of N means that N + 1 faults could cause a loss of the Safety Function, for instance:
● HFT = 0: The 1st failure could cause a loss of the Safety Function

● HFT = 1: 2 faults in combination could cause a loss of the Safety Function. (There are 2 different paths to go to a Safe state. Loss of the Safety Function means that a Safe state cannot be entered.)

HMI

human-machine interface

HSBY

Hot Standby

I

IEC

International Electrotechnical Commission

IEC 61508

The IEC 61508 standard is an international standard that addresses Functional Safety of electrical / electronic / programmable electronic Safety-Related Systems. It applies to any kind of Safety-Related System in any industry wherever there are no product standards.

IL

instruction list

This is an IEC 61131-3 programming language for PLC user logic.

L

LCD

liquid crystal display

LD

ladder diagram

This is an IEC 61131-3 programming language for PLC user logic.

M

MTBF

mean time between failures

MTTF

mean time to failure

MTTR

mean time to repair

N

NFPA

National Fire Protection Association

This is a body for establishing codes and standards for fire protection, electrical and machine Safety in the U.S.

non-interfering module

Non-interfering modules are modules that are not directly used to control the Safety Function. They do not interfere with the Safety modules (either during normal operation or if there is a fault).

NTP

Network Time Protocol

P

PELV

protected extra low voltage

PES

programmable electronic system

(Definition IEC 61508)

System for control, protection or monitoring based on 1 or more programmable electronic devices, including elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices.

PES is another term for a computer control system or PLC.

PFD

probability of failure on demand

(Definition IEC 61508)

For a single channel system the average probability of a failure on demand is calculated as follows:

$$\text{PFD(t)}_{Av} = \frac{1}{2} \; \lambda_{DU} \bullet t$$

For a dual channel system the average probability of a failure on demand is calculated as follows:

$$\text{PFD(t)}_{Av} = \; \lambda_{DUCH1} \bullet \lambda_{DUCH2} \bullet t^2 + CC$$

For a dual channel system, also the Common Cause effect (CC) must be considered. The common cause effect ranges from 1% to 10% of PFD_{CH1} and PFD_{CH2}. (=1/RRF).

PFH

probability of failure per hour

(Definition IEC 61508)

PLC

programmable logic controller

project

A project is a user application in Unity Pro XLS.

proof test

periodic test performed to detect failures in a safety-related system so that, if necessary, the system can be restored to an "as new" condition or as close as practical to this condition

(Definition IEC 61508)

proof test interval

The proof test interval is the time period between proof tests.

PRT

PLC reaction time

The PLC Reaction Time is the time which passes between a signal is detected at the input module terminal and the reaction is set at the output module terminal.

PS

power supply

PST

process safety time

The process safety time is defined as the period of time between a failure occurring in EUC or the EUC control system (with the potential to give rise to a hazardous event) and the occurrence of the hazardous event if the safety function is not performed.

(Definition IEC 61508)

Q

QSE

environment system qualification

R

RAM

random access memory

random hardware failure

failure, occurring at a random time, which results from 1 or more of the possible degradation mechanisms in the hardware

(Definition IEC 61508)

RIO

remote input/output

risk

combination of the probability of occurrence of harm and the severity of that harm

(Definition IEC 61508)

Risk is calculated using the following equation: R=S*H

The letters stand for:

Letter	Meaning
R	risk
S	extent of the damage
H	frequency of occurrence of the damage

RM

requirements management

RRF

risk reduction factor

(Definition IEC 61508)

The risk reduction factor equals 1/PFD.
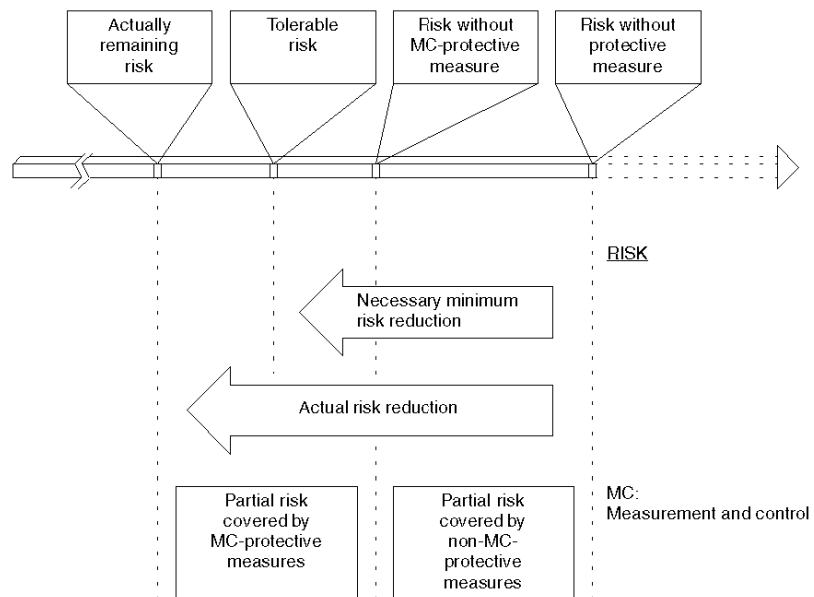
RTC

real-time clock

S

Safety Function

function to be implemented by an E/E/PE safety-related system, other technology safety-related system or external risk reduction facilities, which is intended to achieve or maintain a safe state for the EUC, in respect of a specific hazardous event

(Definition IEC 61508)

Safety Integrity

probability of a safety-related system satisfactorily performing the required safety functions under all the stated conditions within a stated period of time

(Definition IEC 61508)

Safety PLC

Quantum Safety PLC (140 CPU 651 60S or 140 CPU 671 60S)

Safety variable

variable used to implement a Safety Function in a Safety-Related System

Safety-Related System

This term designates a system that both
● implements the required Safety Functions necessary to achieve or maintain a Safe state for the EUC and
● is intended to achieve, on its own or using other E/E/PE Safety-Related Systems, other technology Safety-Related Systems, or external risk reduction facilities, the necessary Safety Integrity for the required Safety Functions.

SFC

sequential function chart

This is an IEC 61131-3 programming language for PLC user logic.

SFF

safe failure fraction

SFR

Safety Functional requirement

Safety Functional requirements are derived from the hazard analysis and define what the function does, for instance the Safety Function to be performed.

SIL

NOTE: For complete definitions and parameters related to SIL ratings refer to IEC 61508, "Functional safety of electrical/electronic/programmable electronic safety related systems". Provided here is a partial definition.

safety integrity level

discrete level (1 out of a possible 4) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

(Definition IEC 61508)

SIL2 project (application)

A project (application) that uses a Quantum Safety PLC (140 CPU 651 60S V1.00 or 140 CPU 671 60S V1.00) to implement Safety Functions in a Safety-Related System.

SIL3 project (application)

A project (application) that uses a Quantum Safety PLC (140 CPU 651 60S V2.00 or 140 CPU 671 60S V2.00) to implement Safety Functions in a Safety-Related System.

SIR

Safety Integrity requirement

Safety Integrity requirements are derived from a risk assessment and describe the likelihood of a Safety Function to be performed satisfactorily, for instance the degree of certainty necessary for the Safety Function to be carried out.

sniffing

reading the configuration out of a PLC

SRS

safety requirements specification

specification containing all the requirements of the safety functions that have to be performed by the safety-related systems

(Definition IEC 61508)

SSC

system Safety concept

This is a detailed description of the system architecture, configuration and diagnostics required to achieve Functional Safety.

ST

structured text

This is an IEC 61131-3 programming language for PLC user logic.

Statement of Consequence

This is the last line within all special messages. It begins with "**Failure to follow these instructions**..."

systematic failure

failure related in a deterministic way to a certain cause, which can only be eliminated by a modification of the design or of the manufacturing process, operational procedures, documentation or other relevant factors

(Definition IEC 61508)

T

TÜV

Technischer Überwachungsverein

(German for Association for Technical Inspection)

U

UMA

unrestricted memory area

It is a specially dedicated memory area for bits and words which is not write protected.

V

VDE

Verband Deutscher Elektroingenieure

This is the German equivalent of the IEEE.

W

warm start

Warm start refers to restarting the computer without turning the power off.

Index

D

data type, section restrictions
Quantum safety PLCs Unity Pro XLS Software, *61*
safety hardware Unity Pro XLS Software, *61*
Unity Pro XLS Software, *61*
data types
Unity Pro XLS Software, *60*, *62*
DAYOFWEEK, *115*
DDT import
Unity Pro XLS Software, *60*
DDTs
Unity Pro XLS Software, *62*
debug screen PLC
Unity Pro XLS Software, *84*
debugging the program
Unity Pro XLS Software, *83*
definition Unity Pro XLS
safety modules, *72*
delete password
Unity Pro XLS Software, *46*
DFB import
Unity Pro XLS Software, *59*
DFBs
Unity Pro XLS Software, *61*
DIAGBUFFCONF, *108*
DIAGBUFFFULL, *108*
diagnostic DFB import
Unity Pro XLS Software, *59*
diagnostic DFBs
Unity Pro XLS Software, *61*
DIO field busses
Unity Pro XLS, *73*
direct addresses
Unity Pro XLS Software, *63*
DLASTDEREG, *119*
DLASTREG, *119*
DNBERRBUF, *119*

E

ERRADDRi, *123*
Ethernet network
Unity Pro XLS Software, *55*, *56*, *56*

event viewer (Microsoft Windows)
Unity Pro XLS Software, *20*
EVTOVR, *106*
expander
Unity Pro XLS, *73*
extension racks
Unity Pro XLS, *73*

F

FASTACT, *106*
FASTPERIOD, *110*
FBD/LD Import
Unity Pro XLS Software, *59*
FFB import
Unity Pro XLS Software, *59*
field busses
Unity Pro XLS, *73*
field busses DIO
Unity Pro XLS, *73*
field busses RIO
Unity Pro XLS, *73*
FLOATSTAT, *111*
FORCEDIOIM, *120*
forgot your password
Unity Pro XLS Software, *49*
function block
S_SMOVE_BIT Unity Pro XLS Software, *54*
function block Unity Pro XLS Software
S_SMOVE_WORD, *54*
safety, *54*

G

general presentation
Unity Pro XLS Software, *11*
global data service
Unity Pro XLS Software, *56*

H

halt coil
Unity Pro XLS Software, *62*