HIMA

SMART SAFETY.

Programming Tool Manual
First Steps

SILworX®

The Efficient Programming Tool for HIMax®, HIMatrix® and HIQuad X®

Contact

HIMA Paul Hildebrandt GmbH
P.O. Box 1261
68777 Brühl, Germany
Phone: +49 6202 709-0
Fax: +49 6202 709-107
E-mail: info@hima.com

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Table of Contents

1 Introduction

This manual provides all information required by users to familiarize themselves with major SILworX features, either during a training course or self-study.

SILworX is the programming and debugging tool (PADT) developed by HIMA, which can be used to configure the HIMax, HIMatrix and HIQuad X system families. The tool also enables online access to systems for diagnostics, forcing, and other purposes.

1.1 Scope of Delivery

The SILworX scope of delivery includes:

- This manual

  The First Steps manual provides a compact introduction to SILworX allowing users to quickly familiarize themselves with the software. To this end, it offers an overview of SILworX functionalities, provides step-by-step instructions for creating projects and starting up a HIMax, HIQuad X or HIMatrix system, and presents the major online features in more detail.
- A DVD

  In addition to the SILworX software, the HIMA DVD also contains some tools and the documentation for the programmable electronic systems (PES) hardware.
- The software copy protection, as a hardlock (dongle) or a license number (software license).

1.2 Structure of the Document

This manual describes SILworX Version 11 and includes explanations and additions for previous operating system versions of the controllers. For older versions of SILworX, use the manual for V6 or previous. Discontinued systems are no longer considered in this manual, even if they can still be used. For these cases, also use older versions of the First Steps manual.

- Chapter 2 describes how to install and uninstall SILworX.
- Chapter 3 describes the basic operations and functions of SILworX. Users with no prior knowledge should read this chapter thoroughly.
- Chapter 4 describes the most important steps for creating a new project.
- Chapter 5 describes in detail how to commission a HIMax, HIMatrix or HIQuad X system.
- Chapter 6 describes all online functions and is primarily intended for users working on-site (operators).
- Chapter 7 describes how to create the project documentation.
- Chapter 8 describes the project backup.
- The annex provides the glossary and the index.

This manual is part of the documentation used for the SILworX seminars at the HIMA training center. Due to the very large scope of SILworX, it only presents the most important software features.

HIMA recommends attending a training course to deepen the required knowledge.

1.3 Additional Manuals

This manual describes the initial steps to be performed when programming or operating a HIMA system with SILworX. For further information refer to the following manuals:

Safety manual	for HIMax, HIQuad X and HIMatrix
System manual	for HIMax, HIQuad X and HIMatrix
Communication manual	
Automation security manual	
Manuals for the individual modules	

1.4 Writing Conventions

To improve readability and comprehensibility, the following writing conventions are used in this document:

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	Parameters, system variables and other references.
`Courier`	Literal user inputs.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references are integrated in the PDF edition of this manual as hyperlinks. Click a hyperlink to jump to the corresponding position in the document.

Safety notices and operating tips are specially marked.

1.4.1 Safety Notices

Safety notices are marked in a special way. They must be strictly observed to ensure the lowest possible operating risk. They have the following structure:

- Signal word: risk, warning, caution or notice.
- Type and source of risk.
- Consequences of the risk.
- Risk prevention.

The signal words have the following meanings:

- Risk indicates hazardous situations which, if not avoided, will result in death or serious injury.
- Warning indicates hazardous situations which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or moderate injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ SIGNAL WORD

Type and source of risk!
Consequences of the risk.
Risk prevention.

NOTICE

Type and source of damage!
Damage prevention.

1.4.2 Operating Tips

Additional information is structured as presented in the following example:

i	The text giving additional information is located here.

Useful tips and tricks appear as follows:

TIP	The tip text is located here.

1.5 Safety Lifecycle Services

HIMA provides support throughout all the phases of the plant's safety lifecycle, from planning and engineering through commissioning to maintenance of safety and security.

HIMA's technical support experts are available for providing information and answering questions about our products, functional safety and automation security.

To achieve the qualification required by the safety standards, HIMA offers product or customer-specific seminars at HIMA's training center or on site at the customer's premises. The current seminar program for functional safety, automation security and HIMA products can be found on HIMA's website.

Safety Lifecycle Services:	
Onsite+ / On-Site Engineering	In close cooperation with the customer, HIMA performs changes or extensions on site.
Startup+ / Preventive Maintenance	HIMA is responsible for planning and executing preventive maintenance measures. Maintenance actions are carried out in accordance with the manufacturer's specifications and are documented for the customer.
Lifecycle+ / Lifecycle Management	As part of its lifecycle management processes, HIMA analyzes the current status of all installed systems and develops specific recommendations for maintenance, upgrading and migration.
Hotline+ / 24 h hotline	HIMA's safety engineers are available by telephone around the clock to help solve problems.
Standby+ / 24 h call-out service	Faults that cannot be resolved over the phone are processed by HIMA's specialists within the time frame specified in the contract.
Logistic+/ 24 h spare parts service	HIMA maintains an inventory of necessary spare parts and guarantees quick, long-term availability.

Table 1-1: Lifecycle Services

Contact details:	
Safety Lifecycle Services	https://www.hima.com/en/about-hima/contacts-worldwide/
Technical Support	https://www.hima.com/en/products-services/support/
Seminar program	https://www.hima.com/en/products-services/seminars//

Table 1-2: Contact Details

2 Installation

The following section describes the system requirements for SILworX as well as the procedure for installing and uninstalling the software.

2.1 System Requirements

SILworX can only be installed on a personal computer (PC) with Microsoft Windows operating system.

The minimum requirements for the PC used to run SILworX are specified on the corresponding installation DVD.

With very large projects, old PCs may require long processing times and be inappropriate for this task. Therefore, state-of-the-art PCs should be used whenever possible. Enhanced hardware features, such as computing power and memory space, result in improved performance.

Observe the instructions in the automation security manual, both during project engineering and when connecting the PC to a HIMA system.

2.2 Installing SILworX

- Place the delivered DVD in the DVD drive. The software usually starts automatically. Otherwise, double-click *Index.html* in the DVD directory.
- Select **Product, SILworX**.
- Search through the list to find the entry **SILworX V11**.
- To the left of the list, click on the symbol for the "ZIP" files.

  The ZIP directory of SILworX opens. This directory contains the installation software, the installation notes and the release notes. HIMA recommends reading the installation notes first (Install_Notes).

- Copy the contents and save them locally to your PC.
- Open the Installation directory and then Setup directory with double clicks.
- Double-click SILworX_setup.exe.
- Follow the installation instructions.

If you do not have a DVD drive, you can download the software from our extranet after registering. You can do this via Downloads on our homepage.

2.3 Uninstalling SILworX

In the Windows start menu, select **Control Panel, Programs and Functions, Add and Delete Programs**. Choose the required SILworX version from the list, press the right mouse button and select **Uninstall** from the context menu.

2.4 License

SILworX is either activated with a hardlock license (i.e., USB stick dongle) or a softlock license.

Insert the USB stick into one of the USB ports on your PC. No additional action is required. The USB stick automatically provides a valid SILworX license.

The USB stick is portable and can be used on any PC. In contrast to the softlock license, which is permanently connected to an individual PC, the hardlock license is bound to the USB stick.

The softlock license is only valid for one individual PC with a specific Windows installation. It is stored on that given PC and contains its individual data.

The softlock license requires a valid license key. This license key can be obtained via e-mail upon request.

2.4.1 License Versions

The license model introduced with SILworX V6.114.0 includes the following license versions:

License	Description
Full license	All HIMA systems are available.
HIMatrix license	Only HIMatrix and remote I/Os are available.
Maintenance license	Write-protected access to all project data. All HIMA systems are available. Online access to the system in accordance with the specifications in the user management scheme.

2.4.2 Requesting and Activating the Softlock License or Upgrade

Perform the following steps to request and activate the HIMA softlock license or upgrade the existing license. To upgrade the hardlock license, the corresponding USB stick must be in place.

- Click the question mark symbol on the menu bar.
- Select **License Management, Request License**.

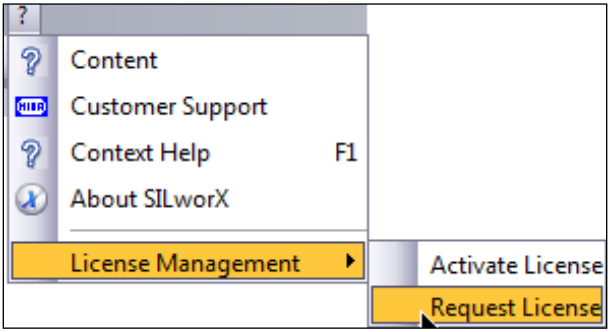


Figure 2-1: Requesting the License

- In the dialog box, enter the license number (noted in the confirmation of order) and complete the remaining text fields.

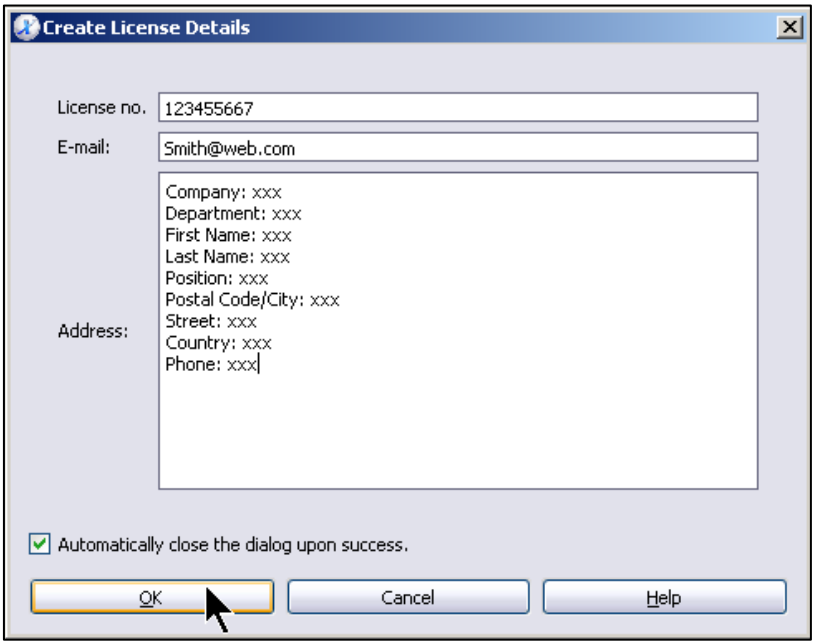


Figure 2-2: Entering the License Data

- Click **OK**. A request file is created and must be sent to the following e-mail address:

  silworx.registration@hima.com

  An activation file is provided after commercial clarifications.

To upgrade a hardlock, proceed as follows:

- In the hardlock, open the **Olicense** directory.
- Back up the previous activation file in another directory.
- In the hardlock, save the new activation file in the **Olicense** directory.

To activate a softlock license, proceed as follows:

- Click the question mark symbol on the menu bar.
- Select **License Management, Activate License**.

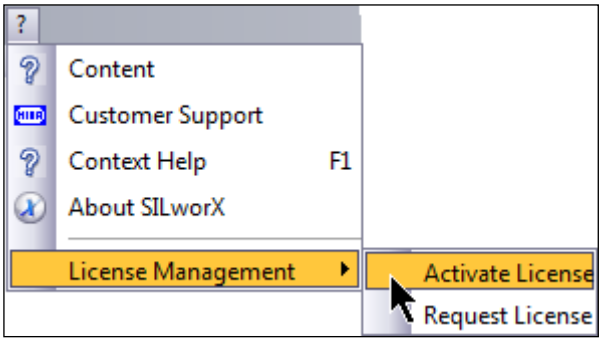


Figure 2-3: License Activation

- In the following window, select the license file received via e-mail and saved to the PC.
- Click **Open** to read and activate the activation file.

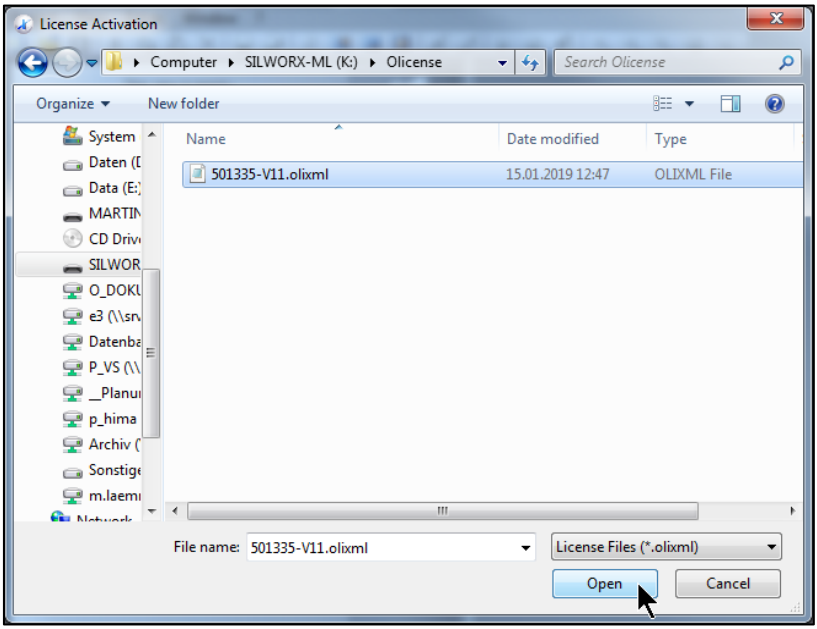


Figure 2-4: Reading-in the License File

The softlock license depends on the PC hardware and the Windows installation.

The softlock license is no longer valid after re-installing Windows. If necessary, please contact HIMA customer support.

3 Starting to Operate with SILworX

For the following instructions, use the *X-Lib.E3* demo project available on the HIMA DVD.

On the DVD, the demo project is located under **Products → SILworX → X-Lib**. Copy the project to the local PC and then open it as follows:

- In the **Project** menu, click **Open.**
- In the *Open Project* dialog box, click the button to the right of the *Project File* field.
- Select the project and click **Open**.

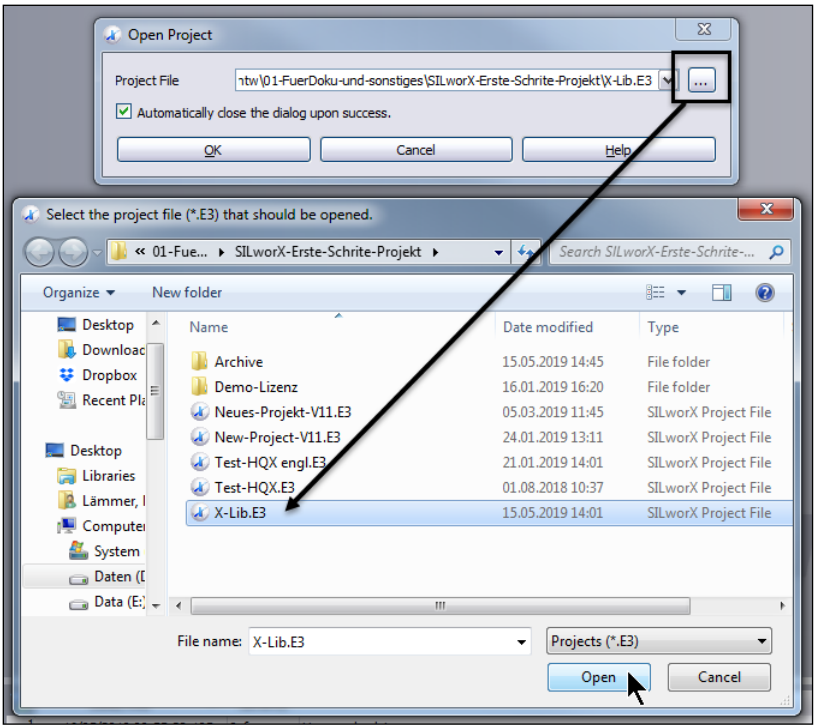
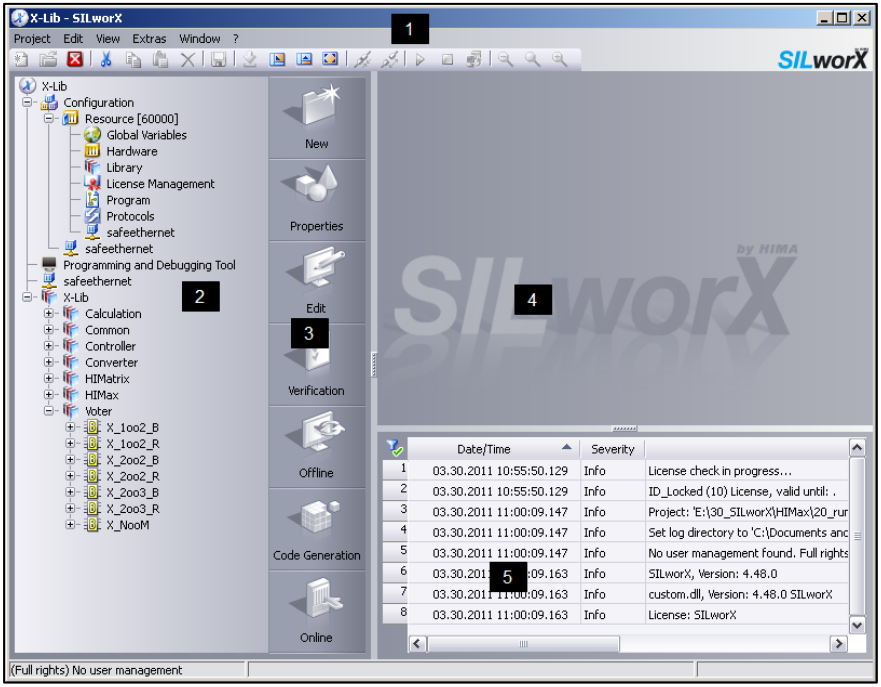


Figure 3-1: Opening the Project

3.1 Screen Layout and Operation



1 Menu and Symbol Bar
2 Structure Window with Structure Tree
3 Action Bar
4 Workspace
5 Logbook

Figure 3-2: Screen Layout

Move the separator lines to modify the screen layout.

Figure 3-3: Moving the Separator Line

3.1.1 Operating Concept

With SILworX, HIMA has implemented a simple and intuitive operating concept.

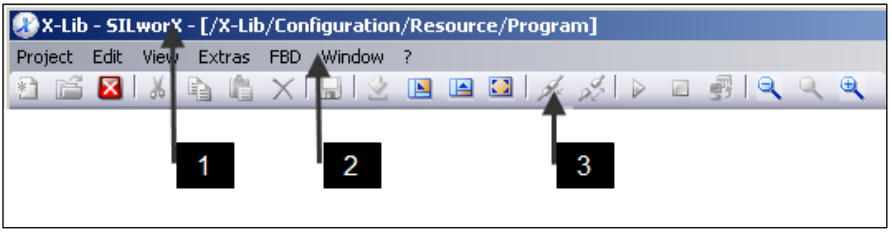
- In the structure tree, select the element to be edited.
- Select the required action from the Action Bar.

  EXAMPLE:

Program → **Edit**	To open the editor for the program.
Program → **Online**	To open the program in online mode.
Program → **Properties**	To open the program properties.

The result of the action appears in the workspace.

3.1.2 Menu Bar, Symbol Bar



1 Project Name or Element Currently Open

2 Menu Bar

3 Symbol Bar

Figure 3-4: Menu and Symbol Bar

Menus and icons are highlighted when they are available for the selected item. Menus and symbols that are not available are greyed out.

The get information about the function of an icon, a column title, etc., place the mouse pointer over the object for a moment until a tooltip appears.

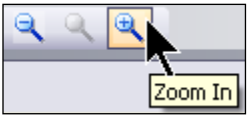


Figure 3-5: Tooltip for Symbols

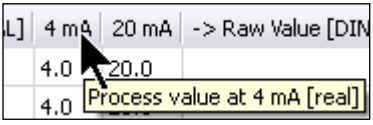


Figure 3-6: Tooltip for Shortened Column Titles

3.1.3 Structure Tree

The structure tree shows all elements of a SILworX project.

Click the [+] symbol next to the node to expand the tree like in Windows Explorer.

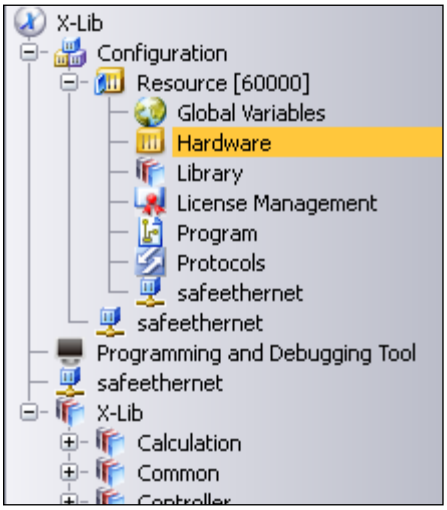


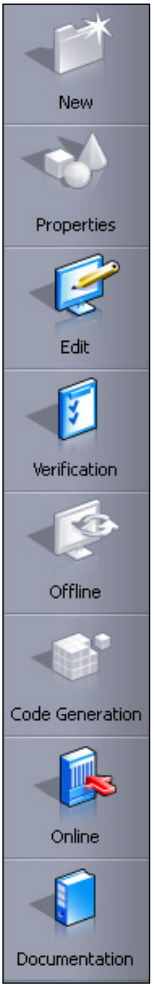
Figure 3-7: Structure Tree

Right-click the structure tree object to open the corresponding context menu and select functions such as **Copy**, **Paste** or **Delete**.

Figure 3-8: Context Menu

3.1.4 Action Bar

To choose the element for the next action, click the corresponding structure tree object.



To create new objects

To edit the object properties

To edit the objects

To check (verify) objects

To open objects in the offline simulation

To start the code generation for an object

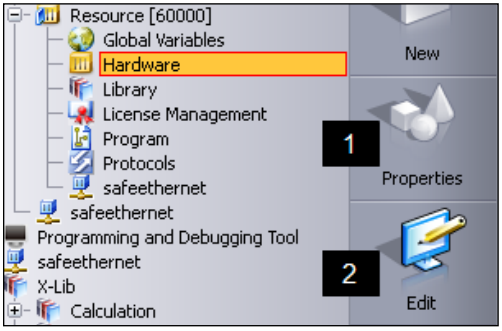
To establish an online connection to a PES or open the object in online mode

To document and print out the object

Figure 3-9: Action Bar

The actions are displayed top-down following the operation sequence (New, Edit, Test, Document).

The actions available for the selected structure tree object are enabled. Disabled functions are grayed out.



1 not available **2** available

Figure 3-10: Availability of Actions

All actions can also be carried out in the same way via the context menu (right mouse click).

3.1.5 Workspace

In the workspace, the content of an element is displayed in editing or online mode.

To open an element, select the required element in the structure tree, e.g., **X-LimH** in the **X-Lib,** and click **Edit** on the Action Bar.

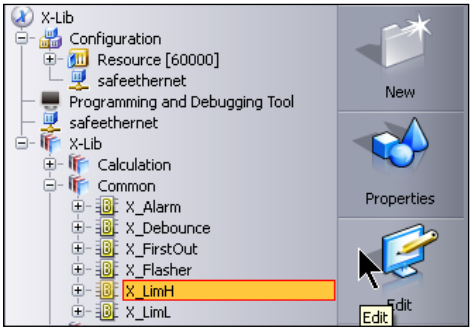
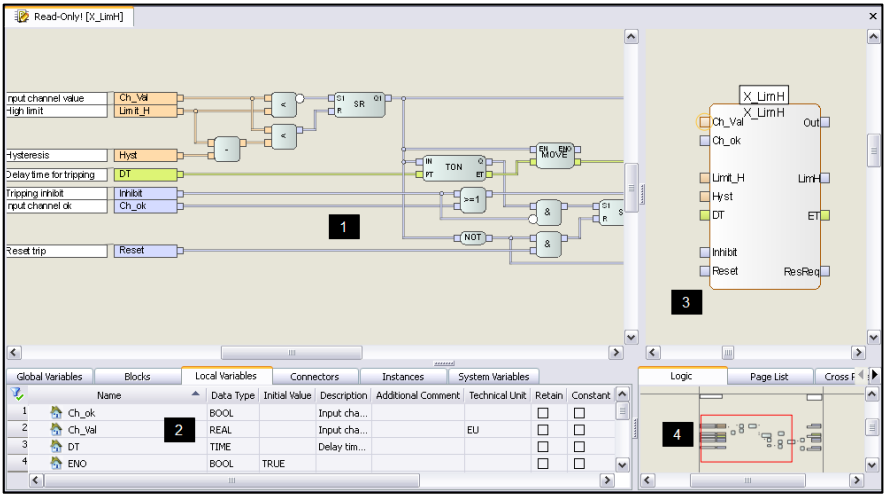


Figure 3-11: Opening an Element for Editing

All the objects available for the editor opened in the drawing area can be dragged from the different tabs of the Object Panel into the drawing area and used there. The objects cannot be dragged directly from the structure tree into the drawing area!



1 Drawing Area

2 Object Panel

3 POU Interfaces

4 Navigation Panel

Figure 3-12: Open POU in the Workspace

The tabs available in the Object Panel depend on the editor:

- The FBD Editor includes, for instance, *Variables, Blocks, Connectors*.
- The Hardware Editor includes *Racks*, *Modules* and the *Variables* to be connected.

3.1.6 Navigation Panel

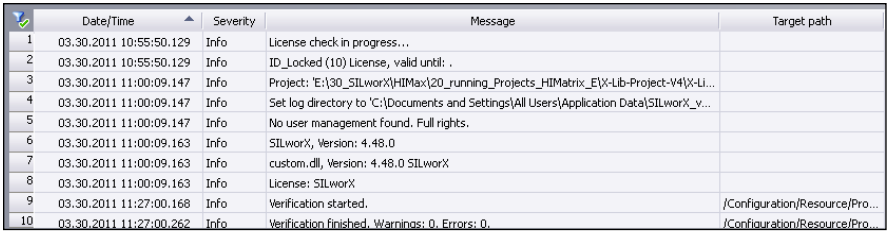
The Navigation Panel is located on the right, next to the Object Panel and is used to quickly access the logic parts and the variables used.

For more practical details, refer to Chapter 6.4.3.

3.1.7 Logbook

The logbook is located below the workspace and is used to report SILworX messages, for example:

- Logging of important operating steps such as code generation, forcing or loading.
- Code generation results.
- Indications of operating errors.
- Verification results.



	Date/Time	Severity	Message	Target path
1	03.30.2011 10:55:50.129	Info	License check in progress...	
2	03.30.2011 10:55:50.129	Info	ID_Locked (10) License, valid until: .	
3	03.30.2011 11:00:09.147	Info	Project: 'E:\30_SILworX\HIMax\20_running_Projects_HIMatrix_E\X-Lib-Project-V4\X-Li...	
4	03.30.2011 11:00:09.147	Info	Set log directory to 'C:\Documents and Settings\All Users\Application Data\SILworX_v...	
5	03.30.2011 11:00:09.147	Info	No user management found. Full rights.	
6	03.30.2011 11:00:09.163	Info	SILworX, Version: 4.48.0	
7	03.30.2011 11:00:09.163	Info	custom.dll, Version: 4.48.0 SILworX	
8	03.30.2011 11:00:09.163	Info	License: SILworX	
9	03.30.2011 11:27:00.168	Info	Verification started.	/Configuration/Resource/Pro...
10	03.30.2011 11:27:00.262	Info	Verification finished. Warnings: 0, Errors: 0.	/Configuration/Resource/Pro...

Figure 3-13: Logbook

3.2 Table Handling

Many settings in SILworX are performed in tables. The functions are described in the following chapters.

- For testing purposes, double-click the **Global Variables** structure tree element located below the resource to open the Global Variable Editor. Press the insert key multiple times to create several global variables.

3.2.1 Editing Cells

- To edit the cell content, double-click the cell and overwrite the existing text.

  Cells that are grayed out are disabled and cannot be edited.

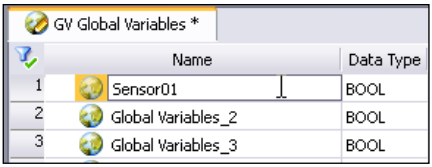


Figure 3-14: Overwriting the Cell Content

3.2.2 Selecting from Drop-Down Lists

Some data fields contain drop-down lists, from which an object can be selected. Double-click a drop-down list to activate it and click again to open it.

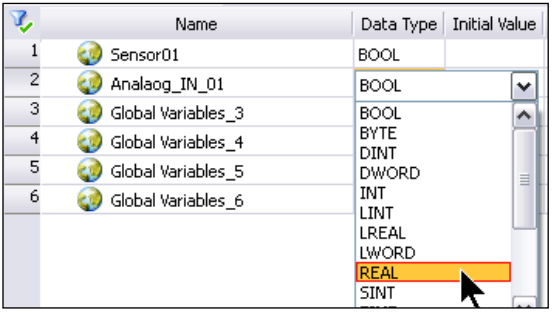


Figure 3-15: Drop-Down List

3.2.3 Selecting Checkboxes

Checkboxes are connected to conditions: TRUE (checkbox is ticked) or FALSE (checkbox is not ticked). Click the checkbox to change the condition.

Click a checkbox again to toggle the condition.

Figure 3-16: Activated Checkbox

3.2.4 Performing Context Menu Functions

Standard context menu functions such as **Copy** and **Paste** can be applied to a complete line (to do so, previously select the line number) or individual cells.

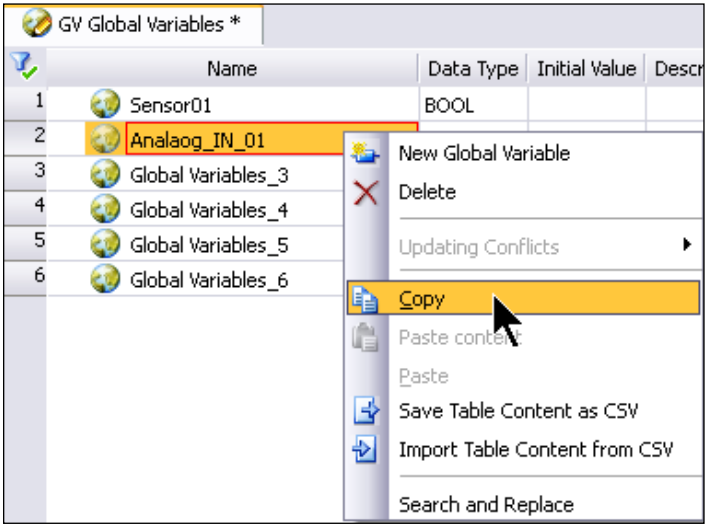


Figure 3-17: Context Menu

3.2.5 Filtering the Table Contents

Click the filter symbol on the left upper side of the table to toggle the filter function.

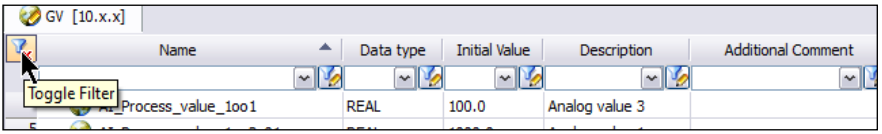


Figure 3-18: Setting Filters

In each column, filters can be set individually and then cascaded. The search string is automatically completed with wildcard characters at its beginning and end.

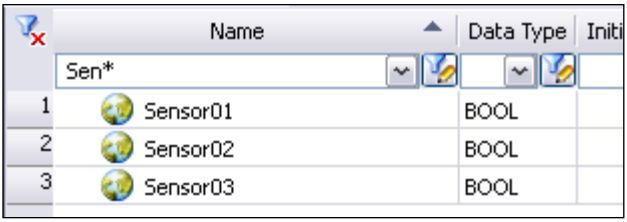


Figure 3-19: Active Filter Criterion

3.2.6 Sorting Columns

Click the column title to sort the entire table contents alphabetically, in ascending or descending order. The sorting order is displayed by the arrow on the right-hand side of the column header.

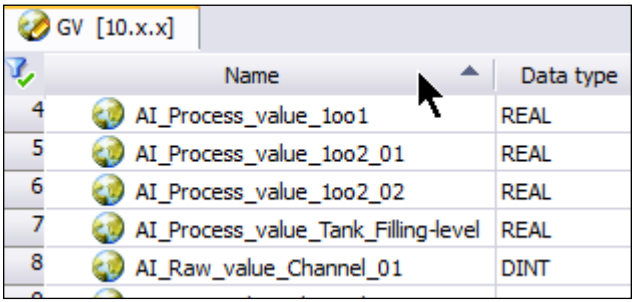


Figure 3-20: Table Sorted in Ascending Order by the Name Column

3.3 Variables

Variables are used to store data and to exchange data between program parts and between controllers. SILworX uses global variables and local variables.

3.3.1 Global Variables

As soon as a new resource is created, a *Global Variables* element is added to the structure tree. Global variables can also be created in the parent structure tree elements, *Configuration* or *Project*, and are then available in all resources of this configuration or project.

Global variables have the same value wherever they are used and can be forced in all their uses.
Global variables can be forced in the Force Editor using the *Global Forcing* function.

Global variables are required for the following tasks:

- **HARDWARE:** to store and further process the values of inputs and outputs.
- **COMMUNICATION:** to exchange data between controllers via different protocols, e.g., Modbus, OPC or safe**ethernet**.
- **SYSTEM VARIABLES:** to store and further process the values of system variables.
- **PROGRAMMING:** to exchange data between programs or function blocks within the user program.

3.3.2 Local Variables

Local variables are part of a POU (program or logic block) and are only available within that POU. For this reason, they cannot be assigned to hardware inputs or outputs, or used for communication. Local variables can be forced in the Force Editor using the *Local Forcing* function.

In the FBD Editor for a given POU, the **Local Variables** tab displays the variables used locally within that specific POU. Global variables used there are displayed as VAR_EXTERNAL. VAR_EXTERNAL variables are not local variables in the sense used in this chapter.

i Local variables are only:
VAR, VAR_TEMP, VAR_INPUT and VAR_OUTPUT

3.3.2.1 Typical Uses of Local Variables

Local variables are used, e.g., as input and output variables for a POU interface.

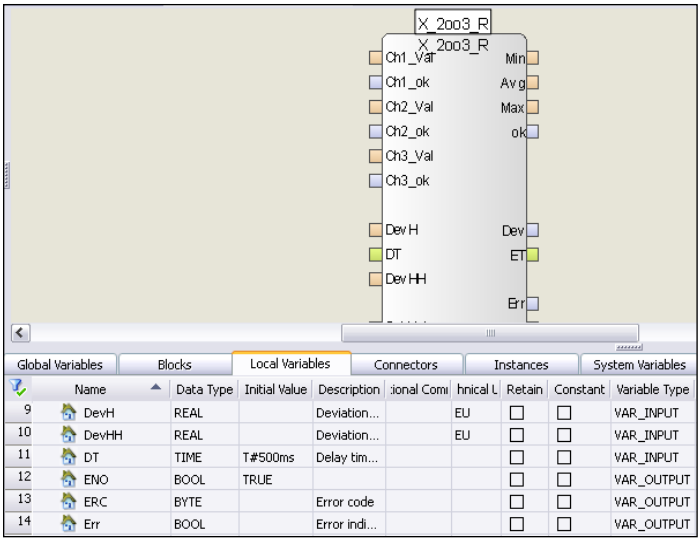


Figure 3-21: Local Variables as Interface Variables (VAR_INPUT, VAR_OUTPUT)

Additionally, local variables can be used as a preset value for timers or comparators. The preset value is given by the initial value. In this case, the *Constant* attribute should be set.

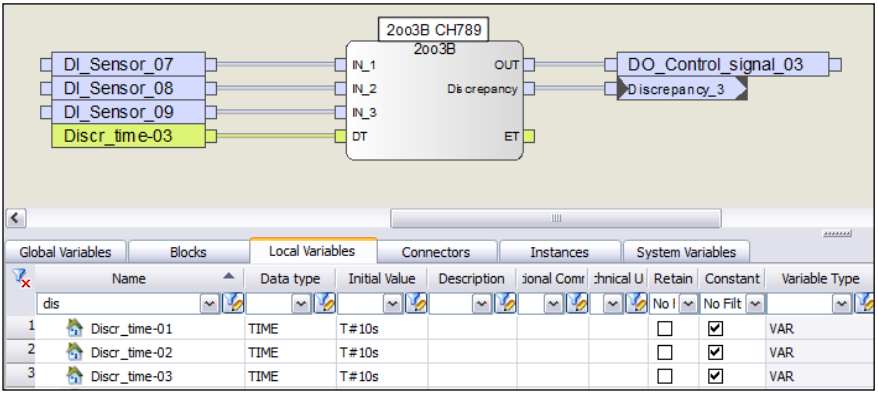


Figure 3-22: Variables with Initial Value as Parameter

In addition to connectors, local variables can also be used to connect different logic parts. Thus, complex logic programs can be better structured and the network size can be constrained. Clearly structured networks are easier to review and test.

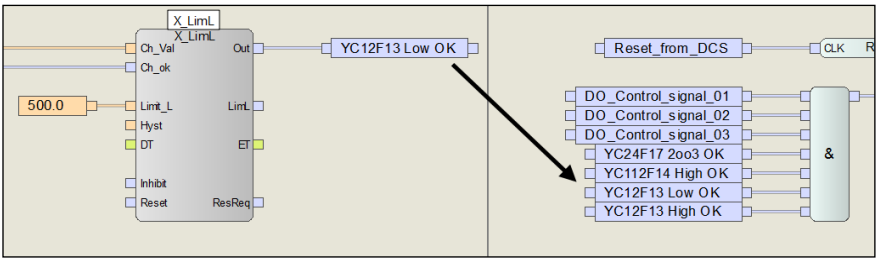


Figure 3-23: Logic Parts Connected to Local Variables

i Observe the rules of sequential processing when structuring the networks!

4 Creating and Configuring a New Project

The following chapters explain all steps required for creating a new project. In SILworX, only one project can be open at a time.

4.1 Creating a New Project

To create a new project, proceed as follows:

- In the **Project** menu, click **New.**
- In the *Open Project* dialog box, click the button to the right of the *Project Directory* to navigate to the required directory.
- Enter a name in the *Project Name* field.
- Check the option **Automatically close the dialog upon success** to avoid that further dialog boxes appear after the action was successful.
- Click **OK** to confirm the action.

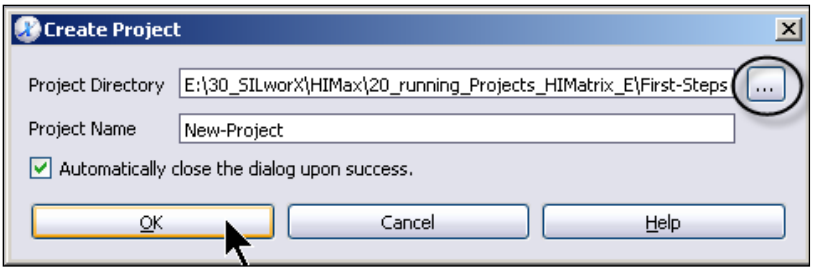


Figure 4-1: Creating a New Project

The new project already contains all relevant objects and their default settings in the structure tree. The project name is displayed as the topmost object within the structure tree.

Supplementary objects can now be added to the project and configured in accordance with the user requirements.

4.2 Resource Properties

The *Resource* element in the structure tree represents the system where one or multiple programs will be processed. The *Resource* contains all properties, programs, communication settings and hardware assignments.

To use a resource in a project, adjust the default settings to the specific requirements.

Take the resource type into account when setting the parameters.

To configure the resource properties, proceed as follows:

- In the structure tree, click **Resource**.
- Click the **Properties** button on the Action Bar.

A dialog box appears where the resource can be configured in accordance with the user requirements.

The following list only contains the most important parameters.

Parameters	Description
Name	Enter a meaningful name for the resource.
System ID [SRS]	The system ID is the unique number identifying a resource within a configuration. The default value 60000 must be changed!

Parameters	Description
Safety Time [ms]	Set the values in accordance with the application requirements. Strictly observe the relevant instructions in the safety manual for the respective system!
Watchdog Time [ms]	
Minimum Configuration Version	Set this parameter in accordance with the loaded operating system version, see Table 4-2.

Table 4-1: Important Resource Parameters

TIP For an initial test (no multitasking, normal communication load, no conversion from previous versions), all settings may retain the default values. Users only need to specify a different value for the system ID.

4.3 Overview of the Minimum Configuration Version

Required settings in the resource properties include the minimum configuration version. The following table provides an overview of the minimum configuration version and corresponding mandatory minimum operating system versions:

	Minimum configuration version		V6	V7	V8	V9	V10	V11
Operating system versions	HIMax CPU and COM		6.x	7.x	8.x	9.x	9.x	11.x
	HIQuad X CPU and COM		n. a.	n. a.	n. a.	n. a.	10.x	11.x
	HIMatrix	CPU	10.x	11.x	12.x	13.x	13.x	15.x
		COM	15.x	15.x	16.x	18.x	18.x	20.x
n.a.: not applicable								

Table 4-2: Operating Systems Required for SILworX Versions

NOTICE

If you later open a project in a newer SILworX version and thus convert it, leave the minimum configuration version unchanged. Newly selected features can still be used. The code is automatically generated in accordance with the higher configuration version.

The configuration version is displayed immediately after the CRC value (CRC 0xnnnnnnnn-**V5**). The information after the CRC value refers to the SILworX version, and must be in accordance with the loaded operating system, irrespective of the resource properties settings (in the above example: V5).

4.4 Program Properties

As seen for the resource properties, the program properties must be adjusted to the individual requirements. Proceed as follows:

- In the structure tree, click *Program*.
- Click the **Properties** button on the Action Bar.

A dialog box appears in which the program can be configured in accordance with the user requirements. Observe the requirements specified in the safety manual as well as those dictated by the responsible test authority.

The following list only contains the most important parameters.

Parameters	Description
Name	Enter a meaningful name for the program.
Program ID	The program ID must be unique.
Test Mode Allowed	This parameter may only be used under laboratory conditions. For safety-related operation, this parameter must be deactivated!
Code Generation Compatibility	Set this parameter in accordance with the loaded operating system version, see Table 4-2.

Table 4-3: Important Program Parameters

For a first test, the default settings may be used for all the parameters not specified here.

4.5 Creating Global Variables (GV)

Global variables are created in the Global Variable Editor, which is opened as follows:

- In the structure tree, click **Global Variables** to select the *Global Variables* element.
- Click the **Edit** button on the Action Bar.

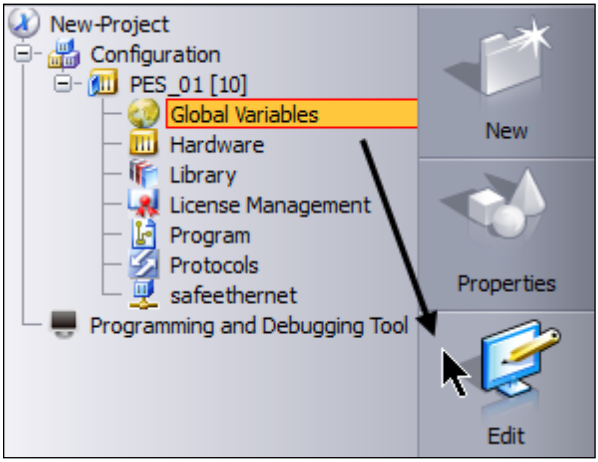


Figure 4-2: Opening Global Variables for Editing

The Global Variable Editor appears in the workspace on the right-hand side, next to the Action Bar. The Global Variable Editor is structured as a table and is empty as long as no global variables have been created.

To create global variables, proceed as follows:

- Right-click within the table, and select **New Global Variable** from the context menu.

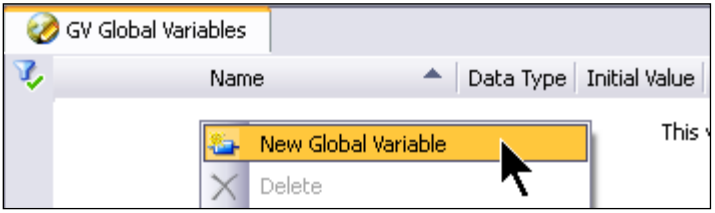


Figure 4-3: New Global Variable

A new global variable is created with a default name and default settings.

TIP Use the Insert key to quickly create additional variables.

- Change the name of the variable assigned by SILworX by double-clicking the *Name* field and overwriting the existing name.
- Double-click the *Data Type* field to activate the drop-down list. Click the drop-down list once again and select a data type.
- If required, double-click the *Initial Value* field and enter an initial value. Note that the initial value must match the data type. If the field is empty, the default value 0 applies.

CAUTION

The initial value must be the safe value of the variable!

If a fault occurs, global variables connected to physical inputs are set to their initial value. If communication fails, global variables connected to communication inputs are set to their initial value (normally configurable), refer to the communication manual (HI 801 101 E) for details.

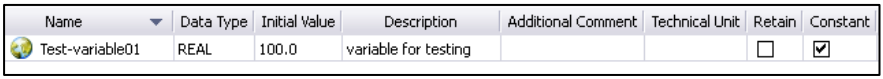
- Double-click *Description* and add a text, e.g., describing the function of the variable.

> **TIP** In the FBD Editor, the description can be displayed in an *Assigned Comment Field* located next to the variable.
>
> *Technical Unit* can be used to represent the physical dimension in the OLT field such as [bar], [A] etc.

- If required, set the *Retain* or *Constant* attribute.

  RETAIN: In case of a power outage, the variable is buffered. For this property, the variable in the logic requires both read and write access.

  CONSTANT: The variable is read-only and cannot be written to. This setting is particularly useful for parameters.



Name	Data Type	Initial Value	Description	Additional Comment	Technical Unit	Retain	Constant
Test-variable01	REAL	100.0	variable for testing			☐	☑

Figure 4-4: Example of Variable Definition

- To continue practicing, create additional global variables and save them by clicking the floppy disk symbol. The asterisk * in the editor tab indicates unsaved contents!

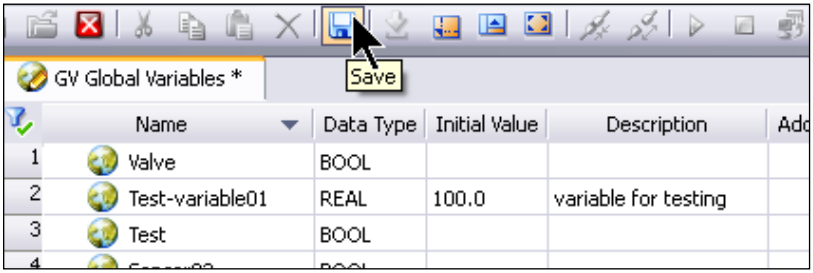


Figure 4-5: Saving Global Variables

4.5.1 Moving Global Variables to Another Scope

The following section describes how to move a global variable to another level without losing its references.

A global variable defined at resource level is already in use in a program or is assigned to a hardware element. The scope of the variable is limited to the resource.

During the project, if the global variable is needed for communicating via safe**ethernet** or OPC, it must be moved to the configuration or project level.

Proceed as follows:

- Copy the variable to be moved as complete record:
  - Click the corresponding line number.
  - Press and hold the control key while clicking to select individual variables, or press and hold the shift key to mark a range of variables.
  - Then, right-click the variable(s) and select *Copy* from the context menu.

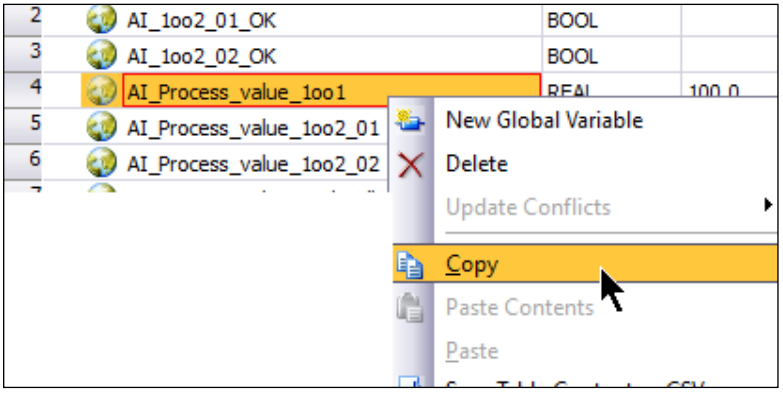


Figure 4-6: Copying the Entire Global Variable Record

- In the structure tree, select the *Global Variables* element (scope) where you want to copy the global variable.
- Click **Edit** on the Action Bar. The Global Variable Editor appears.
- Right-click in the Global Variable Editor and select *Paste* from the context menu.
- Save the change.
- Switch to the original editor and delete the copied variable(s).
- Save the change.
- Close all the editors.

4.5.1.1 Connecting References (for SILworX Versions prior to V10)

For SILworX versions prior to V10, references have to be connected:

- In the structure tree, click the project name and select **Connect References** from the **Extras** menu. If errors occur, the references are not connected. Note the messages in the logbook and correct the errors. Then, reconnect the references.

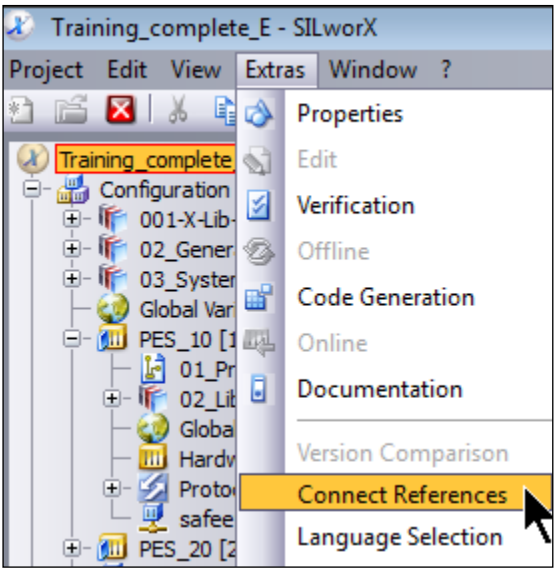


Figure 4-7: Connecting References

4.6 HIMax Hardware

For automatically or newly created resources, SILworX automatically adds a *Hardware* element in the structure tree under the resource. You must assign the same resource type to the *Hardware* element that you use in your system.

Depending on the resource type, additional settings are required.

The following chapters describe how to set up and configure a HIMax controller.

4.6.1 Resource Type, Racks and Modules

To assign the resource a resource type, use the *Hardware* element located in the structure tree.

- Select *Hardware* in the structure tree.
- Click **Edit** on the Action Bar.

Figure 4-8: Starting the Hardware Editor

- In the *Resource Type Selection* dialog box, select *HIMax*. The Hardware Editor appears on the right, next to the Action Bar.

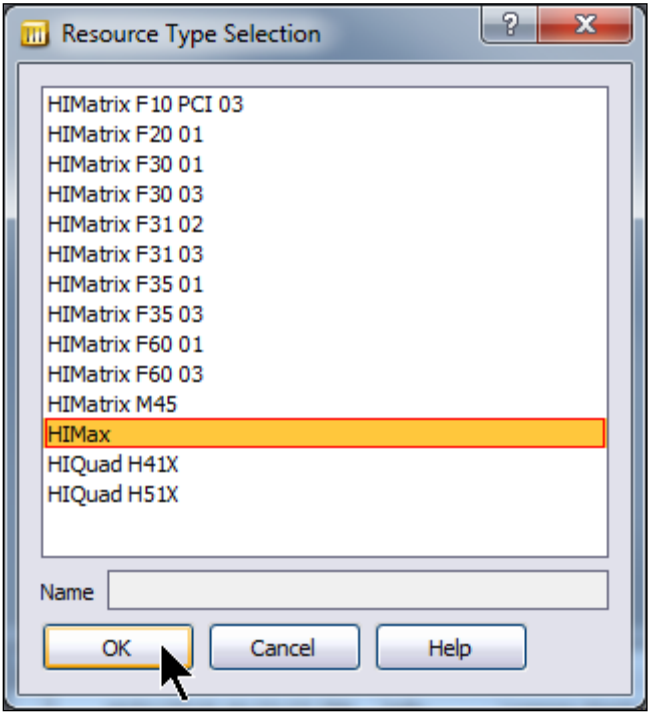


Figure 4-9: Specifying the Resource Type

HIMax is a modular system that can be configured in accordance with the user requirements. The required components can be selected and configured in the Hardware Editor.

4.6.1.1 Replacing Racks

By default, rack 0 is equipped with an X-BASE PLATE 15. If another rack type is required, replace it as follows:

- Drag a different X-BASE PLATE into the Hardware Editor from the **Base Plates** tab and drop it just below the rack ID.
- Replacing an existing X-BASE PLATE must be confirmed, since all previous settings are lost.

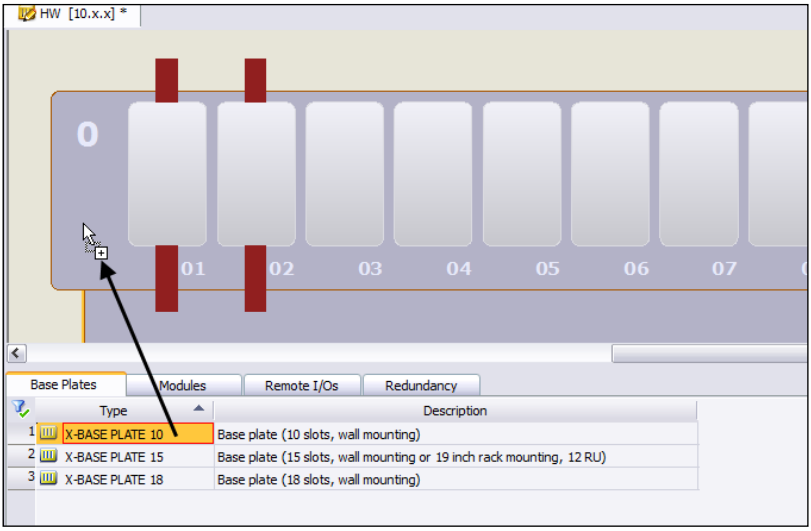


Figure 4-10: Replacing the X-BASE PLATE

4.6.1.2 Adding Extension Racks

If required, you can add extension racks as follows:

- Drag base plates above or below rack 0. To obtain the line structure (standard structure of the system bus), add new racks in direct consecutive sequence. The rack IDs are automatically assigned.
  - Racks located above rack 0 are assigned IDs as follows: 1, 3, 5…
  - Racks located below rack 0 are assigned IDs as follows: 2, 4, 6…
- If gaps are left between the racks, the user is responsible for entering a correct rack ID. To define the value, double-click the rack ID.
- Make sure that the racks that should be installed in the same control cabinet, are represented on the same sheet.
- Make sure that the vertical position of the racks reflects the mounting position within the control cabinet.

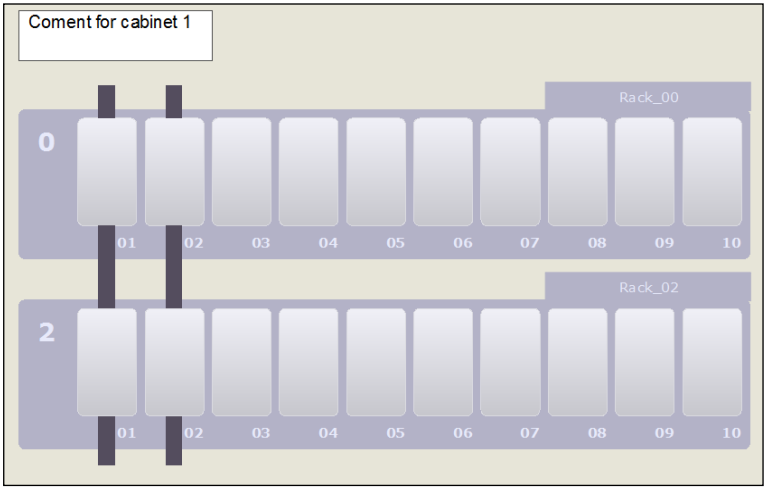


Figure 4-11: Adding Extension Racks

Changing a base plate of a rack already equipped with modules results in the deletion of all modules and corresponding settings!

Users can add comment fields, e.g., for information on the place of installation.

4.6.2 System Variables and Rack Settings

For each rack, individual properties can be set in the detail view of the rack. To open the detail view:

- Right-click the gray area representing the rack and select **Detail View** from the context menu.
- Alternatively, double-click the gray area, but not near the rack ID.

The detail view of the rack appears in the Hardware Editor.

4.6.2.1 Rack Settings

In the *Rack* tab, you can set the following parameters:

Parameters	Description
Name	Enter a name for the rack. Choose a short and significant name, including the rack ID, to facilitate future orientation.
Power Supply over	Set the rail for power supply: ▪ Rail 1 ▪ Rail 2 ▪ Rail 1+2 (redundant) For further information, refer to the *X-BASE PLATE* manual, keyword `Power Supply`.

Parameters	Description
Temperature Monitoring	Warning if the temperature thresholds are exceeded. Temperature threshold 1: > 40 °C. Temperature threshold 2: > 60 °C. If temperature monitoring is active and a module exceeds the temperature threshold, the ERR LED on the affected module is lit. The module symbol is displayed in yellow in the online representation of the Hardware Editor. For further information, refer to the HIMax system manual, keywords `Operating Requirements`, `Considerations about Heat` and `Temperature State`.

Table 4-4: Rack Properties

4.6.2.2 System Variables

The **System Variables** tab can be used to access system information or to write to certain variables.

Evaluate at least the following variables by assigning global variables:

- Forcing Active
- Temperature State
- Warning and Error Counter (not necessarily historic warnings and errors)

For further details, refer to the HIMax system manual.

4.6.3 Inserting Modules

If the Hardware Editor is opened for the first time, an existing X-BASE PLATE is replaced, or a new rack is added, this rack is empty.

To add modules to the rack, proceed as follows:

- In the Object Panel, select the **Modules** tab.
- Drag a module to the required slot in the rack. Observe the assignment rules specified in the system manual.

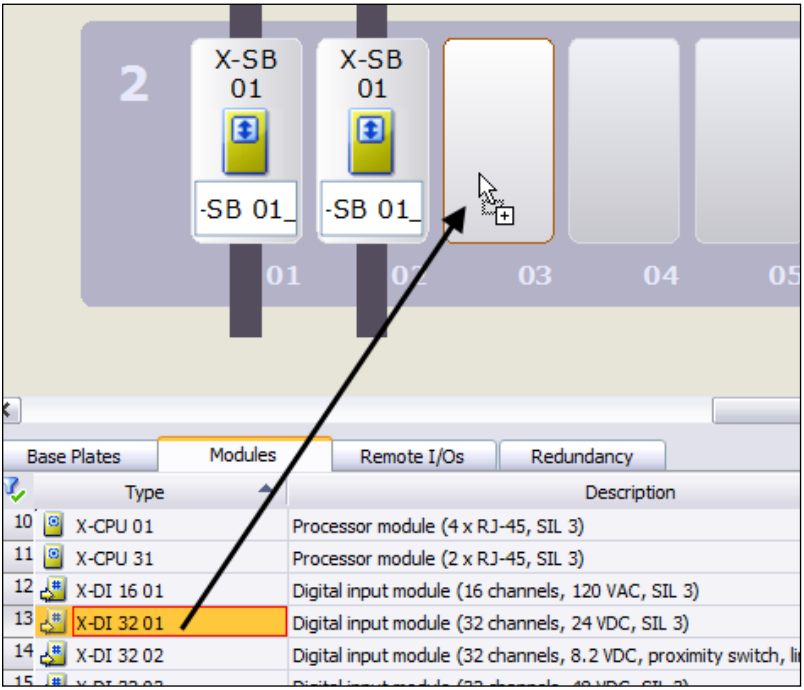


Figure 4-12: Inserting Modules

4.6.3.1 Basic Assignment Rules

Slot	Description
1 … 2	For system bus modules only, in rack 0 also for X-CPU 31 (observe potential restrictions applying to the X-CPU 31).
3 … 6	In rack 0, for X-CPU 01.
3 … 18	For I/O modules and COM modules.

If the selected HIMax system does not have the required number of I/O channels, it is also possible to use HIMatrix remote I/Os (the **Remote I/Os** tab), see Chapter 4.7.3.

4.6.4 Configuring Redundant I/O Modules

In a HIMax controller, the I/O modules can be connected redundantly. To this end, mono and dual connector boards are available and allow connection to the field level.

Dual I/O modules are automatically handled in SILworX. No additional logic must be programmed for these modules. In the Hardware Editor, it is sufficient to aggregate two modules of the same type to form a redundancy group.

If one of the redundant I/O modules fails, safe operation is automatically ensured by the second I/O module.

Proceed as follows:

- First, drag the left I/O module from the Object Panel to the required slot. Observe the assignment rules specified in the system manual.
- Right-click the new I/O module and select **Create Redundancy Group** from the context menu. The *Create Redundancy Group* dialog box appears.
- Select a slot for the redundant I/O module from the drop-down list. The default setting is the slot located directly to the right of the selected I/O module. If you use a redundant connector board, you must place the I/O modules of a redundancy group side by side.

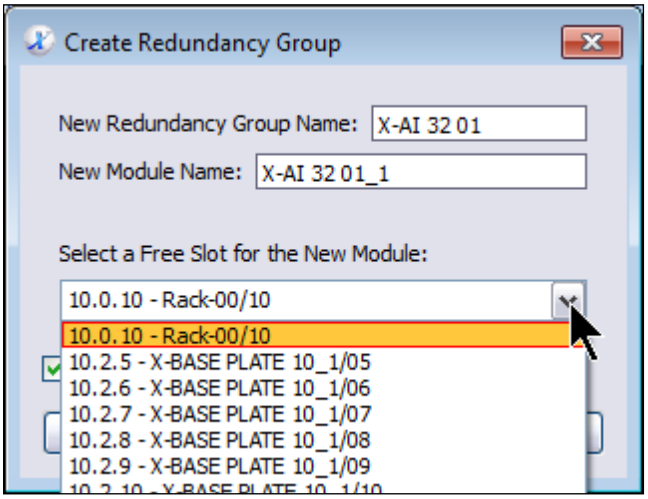


Figure 4-13: Slot Selection for the Redundant Module

- Click the **Redundancy** tab located in the Object Panel. The redundancy group just created appears.
- Right-click the new redundancy group and select **Detail View**. The detail view can be used to configure additional settings and assign the variables.
- Give a meaningful name to the redundancy group, e.g., (rack ID)_(slot no. 1st module)_(slot no. 2nd module).

If the two modules are located in different racks, also integrate the second rack ID into the name.

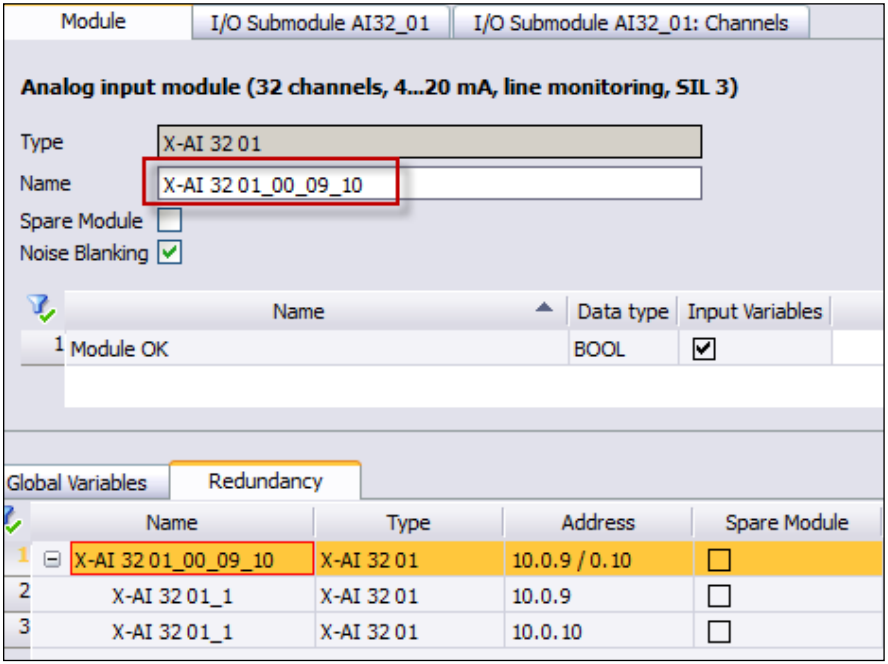


Figure 4-14: Defining the Name for a Redundancy Group

All variables assigned to the redundancy group automatically include the redundancy result, see also Chapter 4.6.6.

4.6.5 Module Settings

SILworX can be used to configure all settings allowed for the HIMax system. This manual, however, only outlines the most important settings.

Refer to the system manual and the module-specific manuals, for further details on settings, system variables and further options.

4.6.5.1 Setting the IP Address for SB, CPU or COM

A unique IP address must be assigned to all processor and communication modules to enable communication with the programming and debugging tool (PADT), other resources or remote I/Os.

Since system bus modules (SB) are not networked, but only connected to the PC through point-to-point connection, all the system bus modules may have an identical IP address.

Generally, no default values should be used for IP addresses.

For a first test, use the following IP addresses:

Module	Slot	Description
SB	01	IP: 192.168.0.10 (standard address).
SB	02	IP: 192.168.0.10 (standard address).
CPU	03	192.168.0.11
CPU	04	192.168.0.12
COM	05	192.168.0.13

Table 4-5: IP Addresses

Note that the IP address of the PC must be located in the same network as the IP addresses previously mentioned, see also Chapter 5.1.4.

To define the IP address for an SB, a CPU or COM module, proceed as follows:

- Right-click the module symbol and select **Detail View** from the context menu. The *Module* tab appears.
- Click the *IP Address* field and enter the IP address.
- If required, activate the **Standard Interface** option for a communication module. In doing so, this IP address is displayed as the preferred address during the login procedure. The *Standard Interface* option should only be activated in a single module of the system.

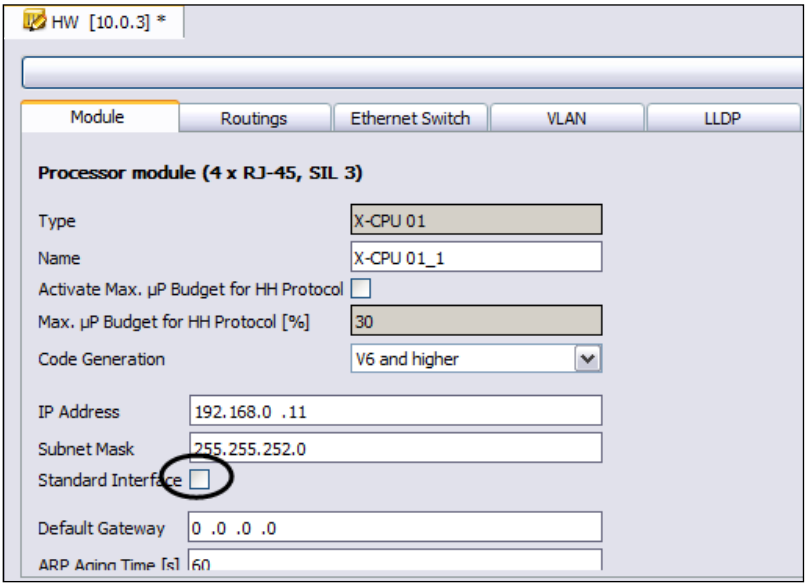


Figure 4-15: Setting the IP Address

- Keep the default settings for the other parameters.

  The default settings are configured to suit most applications and should only be modified by users with very good knowledge of network engineering.
- Use the same procedure to set the IP address of the other modules in accordance with the table above.

4.6.6 Assigning Variables to the Hardware

To use a physical input value in the logic, the input must be connected to a global variable of matching data type.

Create the required global variables in the Global Variable Editor as described in Chapter 4.5.

4.6.6.1 Settings for HIMax X-AI 32 01

This chapter uses the example of the HIMax analog X-AI 32 01 input module to explain how to assign global variables to the inputs and set the ranges of values.

> The examples mentioned below only provide a general explanation.
>
> For real projects, observe the relevant instructions in the manuals specific to the modules in use. The manuals also provide notes on the electrical connection and a description of the individual settings and parameters.

- If not yet done, create multiple global variables of REAL data type, see Chapter 4.5.
- If not yet done, add an analog X-AI 32 01 module to the rack in the Hardware Editor, see Chapter 4.6.3.
- Double-click the X-AI 32 01 module in the Hardware Editor to open the detail view.
- Click the **I/O Submodule AI32_01: Channels** tab. The list of inputs (= channels) appears.

- For the required inputs, drag a global variable of REAL data type from the **Global Variables** tab of the Object Panel onto the cells in the -> *Process Value [REAL]* column.
- To remove the assignment, double-click a table cell and delete the name of the corresponding variable.

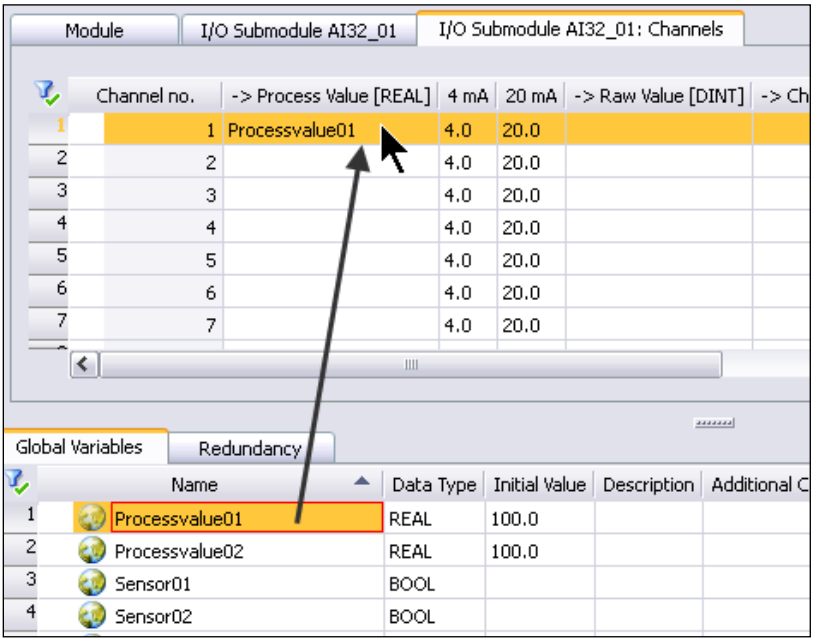


Figure 4-16: Variable Assignment

The process value can be scaled with the values specified in the columns *4 mA* (process value at 4 mA) and *20 mA* (process value at 20 mA). Additionally, monitoring for open-circuits and short-circuits is performed in accordance with the NAMUR thresholds.

-> Process Value [REAL]	4 mA	20 mA
Processvalue01	0.0	100.0

Figure 4-17: Process Value Scaling

If a fault occurs, the initial value of the assigned variable is used as substitute value.

Alternatively, *-> Raw Value [DINT]* (1 mA = 10000) can be used instead of *-> Process Value [REAL]*. If this applies, the value of *Channel OK* must be evaluated in the logic and the threshold must be monitored in the logic.

- For practicing, assign additional global variables. Afterwards, click **Close** to close the module detail view.
- Prior to closing the Hardware Editor, click the **Save** button on the Symbol Bar to save the changes performed.

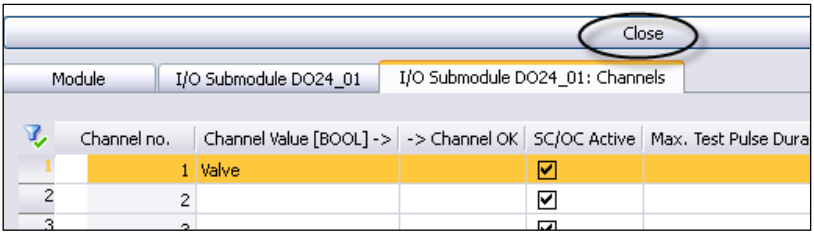


Figure 4-18: Assignment of Variables for a DO 24 01

4.6.7 Creating Additional Resources

If multiple controllers should be used in the project, further resources can be added to the configuration. To this end, proceed as follows:

- In the structure tree, select **Configuration** and click **New** on the Action Bar.

  Alternatively, right-click **Configuration** and select **New** from the context menu. The *New Object* dialog box appears.
- Select *Resource* and enter a resource name in the *Name* field.
- Click **OK** and a new resource with default settings is added to the structure tree.
- Configure the resource in accordance with the description beginning in Chapter 4.2.

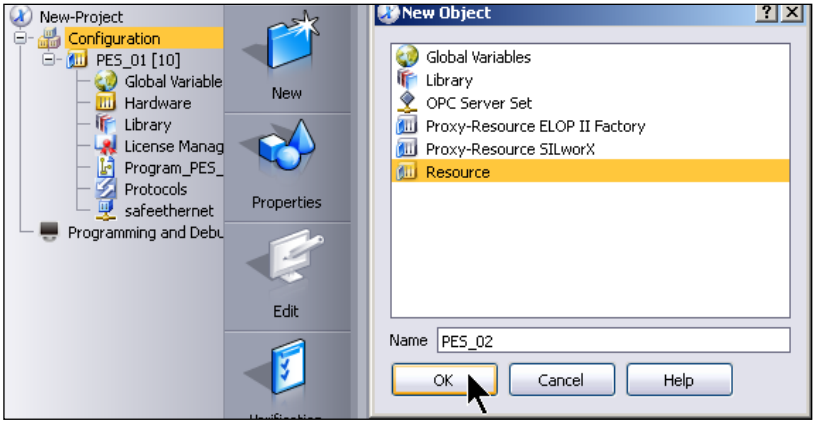


Figure 4-19: Creating a new Resource

4.7 HIMatrix Hardware

For automatically or newly created resources, SILworX automatically adds a hardware element in the structure tree under the resource. You must assign the same resource type to the hardware element that you use in your system.

Depending on the resource type, additional settings are required.

The following chapters describe how to set up and configure a HIMatrix controller.

4.7.1 Resource Type

To assign the resource a resource type, use the *Hardware* element located in the structure tree.

- Create a resource as described in Chapter 4.6.7.
- Configure the resource properties as described in Chapter 4.2.
- Follow the steps described in Chapter 4.4 to configure the properties of the program.
- Create a global variable as described in Chapter 4.5.
- Select the **Hardware** structure tree element and click **Edit** on the Action Bar.
- In the *Resource Type Selection* dialog box, select e.g., the entry **HIMatrix F35 03**.

  The HIMatrix F35 is a compact system (as opposed to a modular system) and already includes components such as processor, communication and I/O modules.

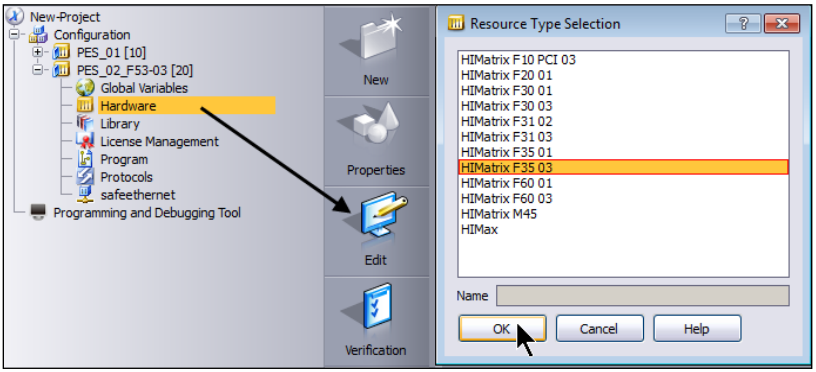


Figure 4-20: Specifying the Resource Type

- Click **OK** to confirm the selection. The Hardware Editor with the selected resource type appears on the right-hand side, next to the Action Bar.

4.7.2 System Variables

To assign global variables to system variables, proceed as follows:

- In the Hardware Editor, double-click the HIMatrix type designation. The detail view appears.
- Assign a global variable to at least the following system variables:
  - Forcing Active.
  - Temperature State.
  - Warning and Error Counter (not necessarily historic warnings and errors).

4.7.3 Adding Remote I/Os

If the selected HIMatrix system does not have the required number of I/O channels, it is also possible to use HIMatrix remote I/Os (tab: Remote I/Os), comparable to extension racks in a HIMax system.

> Remote I/Os can also be used in conjunction with HIMax or HIQuad X.

To add remote I/Os to a system, proceed as follows:

- Drag the required remote I/Os from the *Remote I/Os* tab of the Object Panel onto the light-gray area of the Hardware Editor.
- Objects can be placed in any position and moved at a later point in time.

> If remote I/Os are used, an SNTP server must be set up in the parent resource in the *Protocols* object to ensure the time synchronization of the remote I/Os.

4.7.3.1 System Variables and Parameters of Remote I/Os

To configure system variables and parameters, proceed as follows:

- In the Hardware Editor, double-click the remote I/O type designation. The detail view appears.
- Enter a suitable rack ID. Rack ID 0 always represents the parent resource, which can be a controller of the HIMax, HIQuad X or HIMatrix system family. If multiple remote I/Os are used, ensure that the rack IDs in use are unique. The permissible range of values for the rack IDs is 128 … 1023.
- If required, change the values for safety time and watchdog time as well.
- Assign a global variable to at least the *Temperature State* system variable.
- In the *safeethernet* tab, also monitor the connection status of the system variables. For further details, refer to the *safeethernet* chapter in the communication manual.

4.7.4 Equipping the HIMatrix F60 with Modules

After selecting the resource type *HIMatrix F60* (see Chapter 4.7.1), the system can be equipped with F60 modules and extended with remote I/Os.

Refer to Chapter 4.6.3 and Chapter 4.7.3 for the steps to be performed.

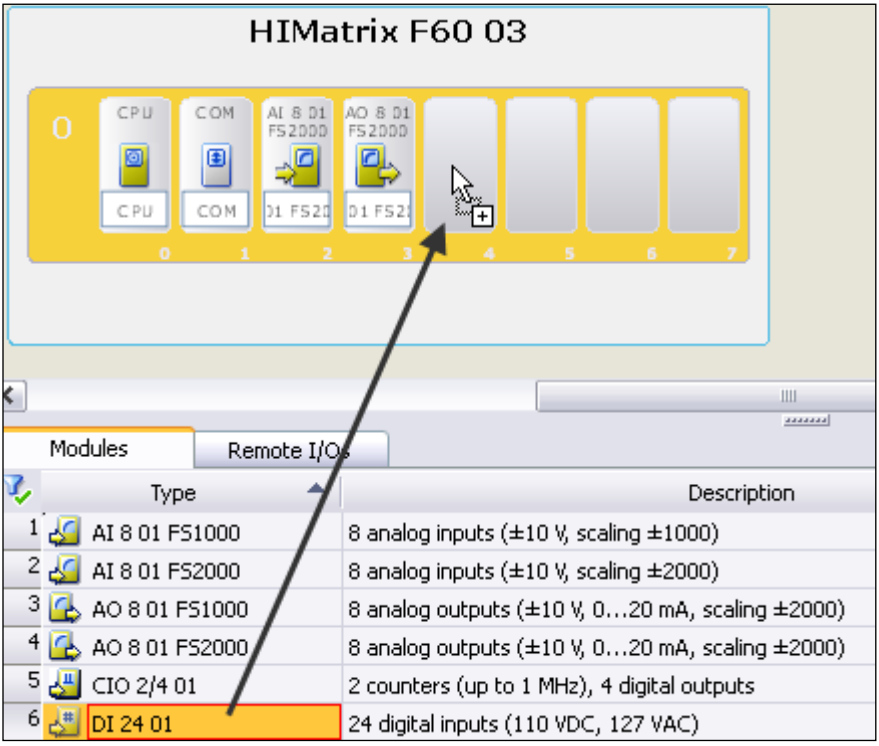


Figure 4-21: Adding Modules to an F60

Refer to the module-specific manuals for technical details on the modules. For example, the notations *FS1000* and *FS2000* refer to the implemented scaling (FS = Full Scale).

4.7.5 Module Settings

SILworX can be used to configure all settings allowed for the HIMatrix system. This manual, however, only outlines the most important settings.

Refer to the system manual and the manuals for the individual modules or compact devices, for further information on settings, system variables and further options.

4.7.5.1 Setting the IP Address

To ensure communication with the PADT, other resources or with remote I/Os, both the processor module and the communication module must be assigned an IP address which is unique within the entire network.

Generally, no default values should be used for IP addresses.

To set the IP address for a CPU or COM module, proceed as follows:

- Right-click the module icon and select **Detail View** from the context menu. The *Module* tab appears.

The examples mentioned below only provide a general explanation.

For configuring networks in real projects, observe the general rules for IP addressing and the requirements specified in the system manual!

- Click the *IP Address* field and enter the IP address, e.g., `192.168.0.20`.

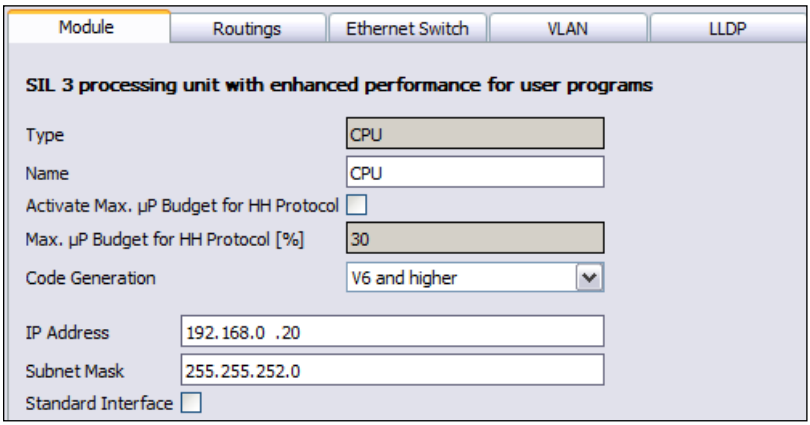


Figure 4-22: Setting the IP Address

- Keep the default settings for the other parameters.

  The default settings are configured to suit most applications and should only be modified by users with very good knowledge of network engineering.
- Enter an IP address for the communication module, e.g., `192.168.0.21`.
- Activate the **Standard Interface** option. In doing so, this IP address is displayed as the preferred address during the login procedure. The *Standard Interface* option should only be activated in a single module.
- If remote I/Os are used, the IP addresses of the CPUs must be defined in the remote I/Os.

4.7.6 Assigning Variables to the Hardware

This chapter uses the example of the mixed inputs of the HIMatrix F35 to explain how to assign global variables to the inputs and configure the ranges of values.

To use a physical input value in the logic, the input must be connected to a global variable of matching data type.

Create the required global variables in the Global Variable Editor as described in Chapter 4.5.

- If not yet done, create two global variables for each of the following data types: BOOL, INT and BYTE.
- Double-click the *MI 24/8 FS...* module in the Hardware Editor to open the detail view.
- In the *Module* tab, define the scaling type for the analog inputs. Select the required parameter from the *FS 1000 / FS 2000* drop-down list.

  This setting has no effect on digital inputs. Refer to the HIMatrix F35 manual for more details.

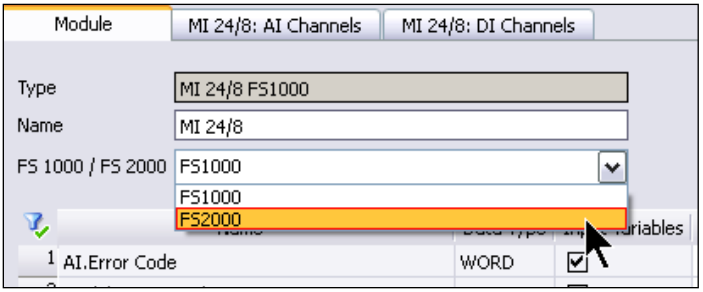


Figure 4-23: Setting the Full Scale

- Click the **MI 24/8 AI Channels** tab. The list of analog inputs (= AI channels) appears.

  The list includes eight analog input channels. For each channel, the parameters *Error Code and Value* can be connected to a global variable and evaluated in the user program.

- For the required channels, drag a global variable of matching data type from the *Global Variables* tab of the Object Panel to the table cells.

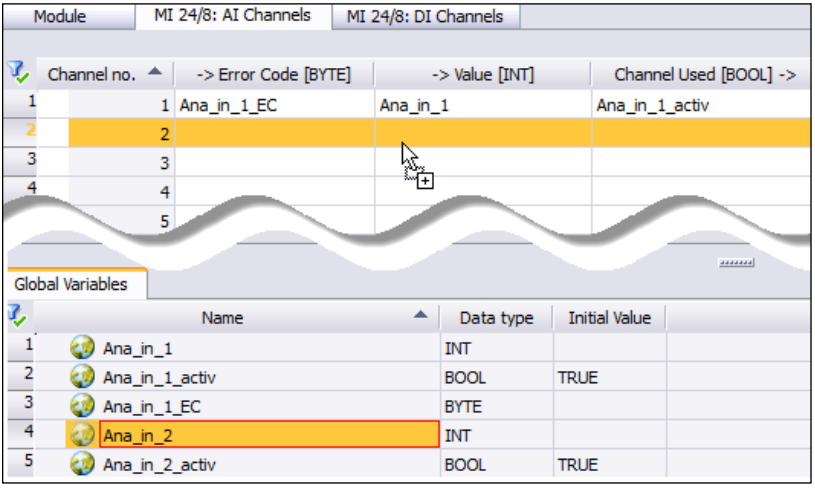


Figure 4-24: Assigning Variables and Channels

- Channels for analog measurement must be activated explicitly. Activate the analog channels that should be used. To this end, connect *Channel Used [BOOL] ->* to a global variable with the initial value TRUE.

> **i** In particular for analog values, *-> Error Code [BYTE]* must be used in addition to *-> Value [INT]*

- To remove the assignment, double-click a table cell and delete the name of the corresponding variable.

4.7.7 Creating Additional Resources

If multiple controllers should be used in the project, further resources can be added to the configuration. Refer to Chapter 4.6.7 for the corresponding procedure.

4.8 HIQuad X Hardware

For automatically or newly created resources, SILworX automatically adds a hardware element in the structure tree under the resource. You must assign the same resource type to the hardware element that you use in your system.

Depending on the resource type, additional settings are required.

The following chapters describe how to set up and configure a HIQuad X controller.

4.8.1 Resource Type

To assign the resource a resource type, use the *Hardware* element located in the structure tree.

- Create a resource as described in Chapter 4.6.7.
- Configure the resource properties as described in Chapter 4.2.
- Follow the steps described in Chapter 4.4 to configure the properties of the program.
- Create a global variable as described in Chapter 4.5.
- Select the **Hardware** structure tree element and click **Edit** on the Action Bar.
- In the *Resource Type Selection* dialog box, select, e.g., the entry **HIQuad H41X** or **HIQuad H51X**.

- Click **OK** to confirm the selection. The Hardware Editor with the selected resource type appears on the right-hand side, next to the Action Bar.

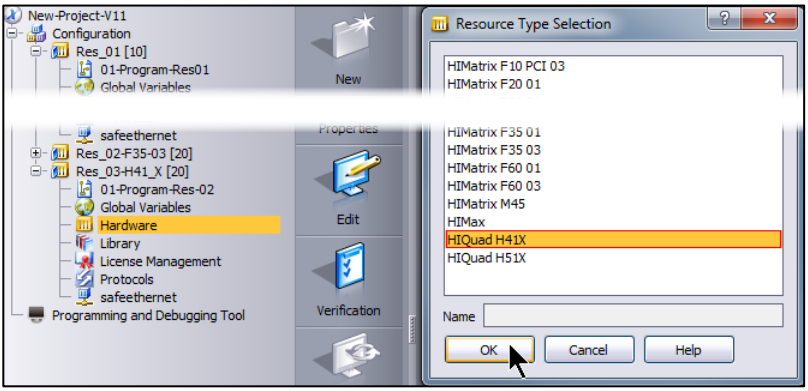


Figure 4-25: Specifying the Resource Type

4.8.2 System Variables and Rack Settings

For each rack, individual properties can be set in the detail view. To open the detail view:

- Right-click the gray area representing the rack and select **Detail View** from the context menu.
- Alternatively, double-click the gray area, but not near the rack ID.

The detail view of the rack appears in the Hardware Editor.

4.8.2.1 Rack Settings

In the *Rack* tab, you can set the following parameters:

Parameters	Description
Name	Enter a name for the rack. Choose a short and significant name, including the rack ID, to facilitate future orientation.
Power Supply over	Set the rail for power supply: ▪ Rail 1 ▪ Rail 2 ▪ Rail 1+2 (redundant) For further information, refer to the F-BASE RACK manual, keyword `Power Supply`.
Temperature Monitoring	Warning if the temperature thresholds are exceeded. Temperature threshold 1: > 40 °C. Temperature threshold 2: > 60 °C. If temperature monitoring is active and a module exceeds the temperature threshold, the ERR LED on the affected module is lit. The module symbol is displayed in yellow in the online representation of the Hardware Editor. For further information, refer to the HIQuad X system manual, keywords `Operating Requirements, Considerations about Heat` and `Temperature State`.

Table 4-6: Rack Properties

4.8.2.2 System Variables

The **System Variables** tab can be used to access system information or to write to variables.

Evaluate at least the following variables by assigning global variables:

- Forcing Active
- Temperature State
- Warning and Error Counter (not necessarily historic warnings and errors)

Refer to the HIQuad X system manual for further information.

4.8.3 Inserting Modules

If the Hardware Editor is opened for the first time, an existing F-BASE RACK is replaced, or a new rack is added, this rack is not empty. A processor module F-IOP 01 or a I/O processing module is already populated.

To add modules to the rack, proceed as follows:

- In the Object Panel, select the **Modules** tab.

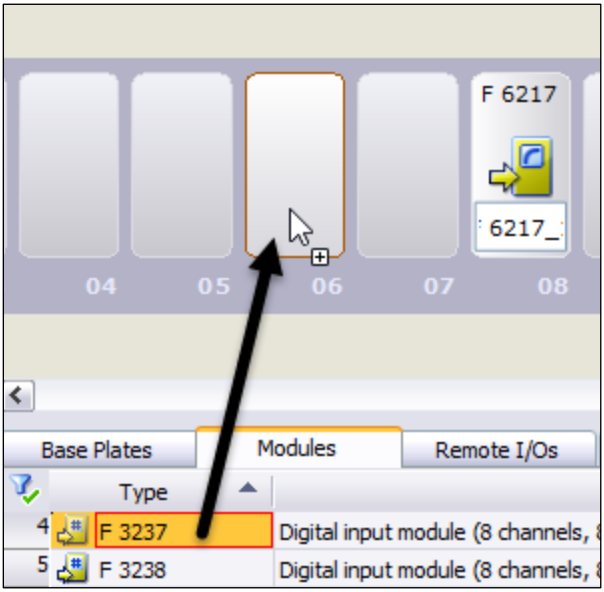


Figure 4-26: Inserting Modules

- Drag a module to the required slot. Observe the assignment rules specified in the system manual.

i If the selected HIQuad X system does not have the required number of I/O channels, it is also possible to use HIMatrix remote I/Os (tab: **Remote I/Os**), see Chapter 4.7.3.

4.8.4 Configuring Redundant I/O Modules

In a HIQuad X controller, the I/O modules can be connected redundantly. To this end, redundant front plugs are available that allow connection to the field level.

It makes sense to insert redundant modules in a different rack in the exact same slot. This rack should be positioned in the immediate vicinity so that the connection via the redundant front plugs can be easily implemented.

If one of the redundant I/O modules fails, safe operation is automatically ensured by the second I/O module. The values of the two modules are linked together in terms of availability and the assigned variables receive the redundancy result.

To this end, proceed as follows:

- First, drag an I/O module from the Object Panel to the required slot of the upper of the two redundant racks. Observe the assignment rules specified in the system manual.
- Right-click the new I/O module and select **Create Redundancy Group** from the context menu. The *Create Redundancy Group* dialog box appears.

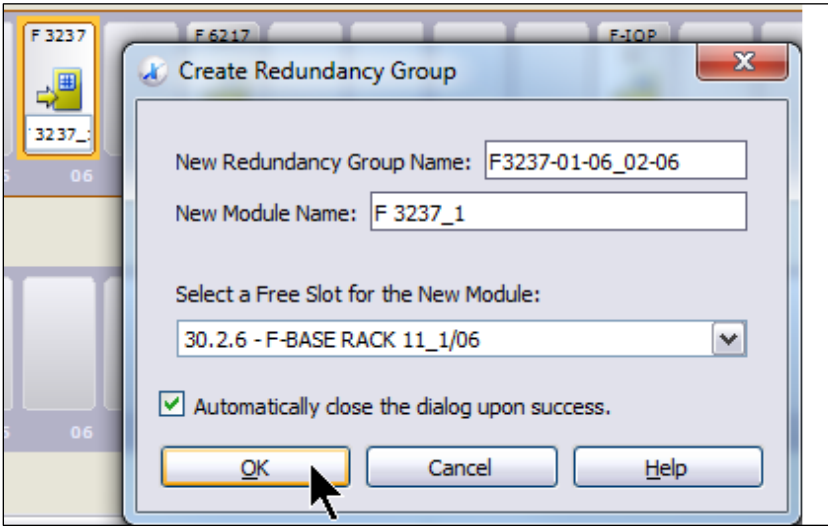


Figure 4-27: Slot Selection

- Give a meaningful name to the redundancy group, e.g., (rack ID)-(slot no. 1st module)_(rack ID)-(slot no. 2nd module).
- Select a slot for the redundant I/O module from the drop-down list. If possible, the dialog offers the same slot in the rack by default with the rack number increased by one.
- Click **OK**.
- Click the **Redundancy** tab located in the Object Panel. The redundancy group just created appears.

4.8.5 Module Settings

SILworX can be used to configure all settings allowed for the HIQuad X system. This manual, however, only outlines the most important settings.

Refer to the system manual and the module-specific manuals, for further details on settings, system variables and further options.

4.8.5.1 Setting the IP Address

To ensure communication with the PADT, other resources or with remote I/Os, both the processor module and the communication module must be assigned an IP address which is unique within the entire network.

Generally, no default values should be used for IP addresses.

To define the IP address for the CPU or COM module, proceed as follows:

- Right-click the module icon and select **Detail View** from the context menu. The *Module* tab appears.

The examples mentioned below only provide a general explanation.

For configuring networks in real projects, observe the general rules for IP addressing and the requirements specified in the system manual!

- Click the *IP Address* field and enter the IP address, e.g., `192.168.0.31`.

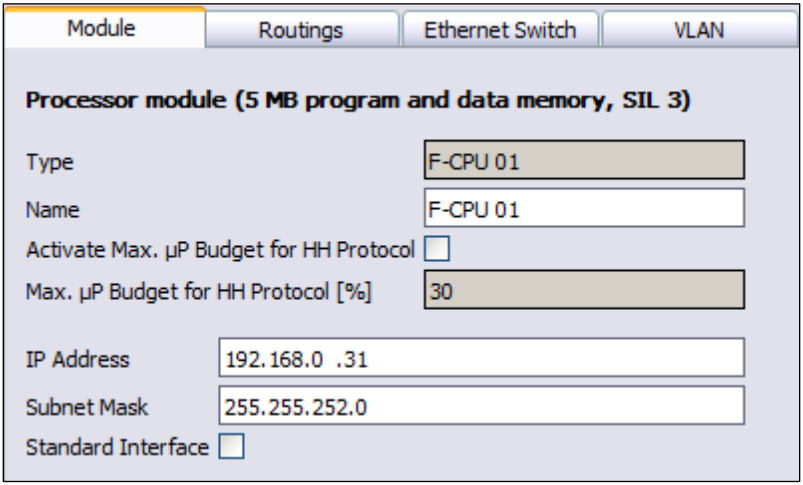


Figure 4-28: Setting the IP Address

- Keep the default settings for the other parameters.

  The default settings are configured to suit most applications and should only be modified by users with very good knowledge of network engineering.
- Enter an IP address for the second processor module, e.g., `192.168.0.32`.
- Also enter unique addresses for the communication modules.
- Activate the **Standard Interface** option for a communication module. In doing so, this IP address is displayed as the preferred address during the login procedure. The *Standard Interface* option should only be activated in a single module.

4.8.6 Assigning Variables to the Hardware

This chapter uses the example of the F 6217 to explain how to assign global variables to the inputs and configure the ranges of values.

To use a physical input value in the logic, the input must be connected to a global variable of matching data type.

- Create the required global variables in the Global Variable Editor as described in Chapter 4.5.
  - If not yet done, create two global variables for each of the following data types: BOOL and REAL, see Chapter 4.5.
- Double-click the *F 6217* module in the Hardware Editor to open the detail view.
- Click the **F 6217: Channels** tab. The list of analog inputs (= channels) appears.

  The list includes eight analog input channels. For each channel, the parameters *-> Process Value* and *-> Process Value OK* can be connected to a global variable and evaluated in the user program.
- For the required channels, drag a global variable of matching data type from the *Global Variables* tab of the Object Panel to the table cells.

The process value can be scaled with the values specified in the columns *4 mA* (process value at 4 mA) and *20 mA* (process value at 20 mA). Additionally, monitoring for open-circuits and short-circuits is performed in accordance with the NAMUR thresholds.

If a fault occurs, the initial value of the assigned variable is used as substitute value.

Alternatively, *-> Raw Value [DINT]* (1 mA = 10000) can be used instead of *-> Process Value [REAL]*. If this applies, the value of *Process value OK* must be evaluated in the logic and the threshold must be monitored in the logic.

- If required, assign additional global variables.
- To remove the assignment, double-click a table cell and delete the name of the corresponding variable.
- Afterwards, click **Close** to close the module detail view.
- Prior to closing the Hardware Editor, click the **Save** button on the Symbol Bar to save the changes performed.

4.8.7 Creating Additional Resources

If multiple controllers should be used in the project, further resources can be added to the configuration. Refer to Chapter 4.6.7 for the corresponding procedure.

4.9 Creating the Logic

User programs contain the logic required to control and monitor a process in connection with one or more programmable electronic systems (PES).

Function block diagrams (FBD) and sequential function charts (SFC) in accordance with IEC 61131-3, as well as structured text (ST) can be used to program systems in SILworX. This chapter describes some basic practices in the Function Block Diagram Editor (FBD Editor).

- Open a program.
  - In the structure tree, select the *Program* object subordinated to the resource that should be programmed and click **Edit** on the Action Bar. The FBD Editor appears.

The FBD Editor is basically divided into the following areas: drawing area, Object Panel and Navigation Panel. Refer to Chapter 3.1.5 and Chapter 3.1.6 for a short introduction.

4.9.1 Selecting Standard Functions and Function Blocks

SILworX offers numerous standard functions and standard function blocks that can be used to create programs.

You can group logic segments into user-defined function blocks and use them multiple times in the programs.

To use the functions and function blocks, proceed as follows:

- Click the **Blocks** tab located in the Object Panel.
- To expedite the search of functions and function blocks, activate the filter function. The wildcard character is implicitly located before and after the entry.

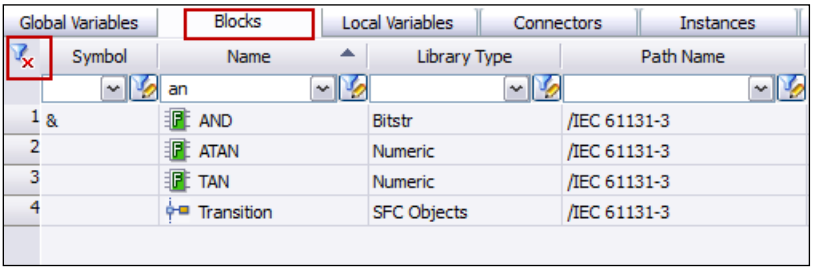


Figure 4-29: Activating the Filters

4.9.2 Dragging Objects to the Drawing Area

- To practice, drag some objects or function blocks from the Object Panel into the drawing area.

From *Bitstr*	1x AND	From *Timer*	1x TON
From *Compare*	1x GE	From *Convert*	1x AtoINT

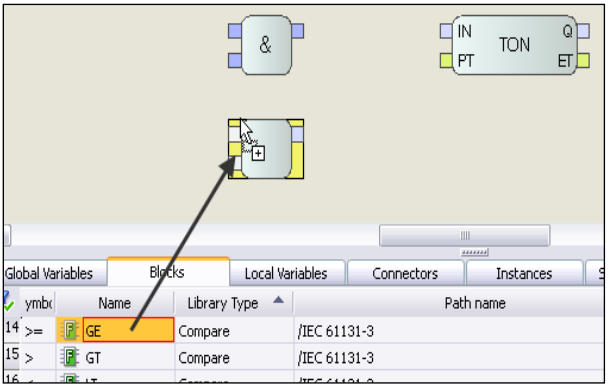


Figure 4-30: Dragging POUs to the Logic

- Click the **Global Variables** tab and drag the *Sensor_01* variable into the drawing area.

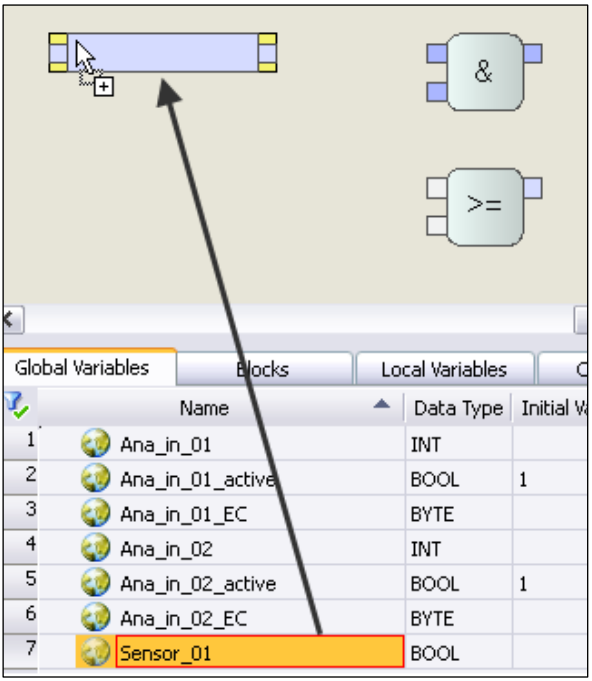


Figure 4-31: Dragging Variables to the Logic

4.9.3 Connecting Objects in the Drawing Area

- To perform the following steps more easily, zoom in the drawing area:

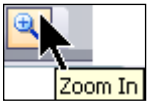


Figure 4-32: Zooming In

- Connect the output of the *Sensor_01* variable to an input of the AND function.

– Click the output 1, hold the mouse button down and draw a connection line to the input 2 of the AND function. Then, release the mouse button.

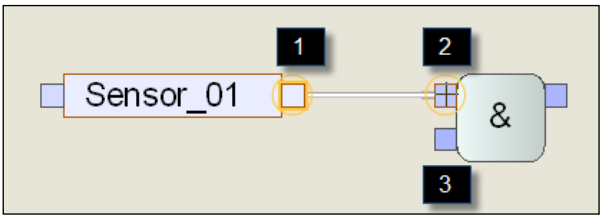


Figure 4-33: Connecting the Objects

- Drag the *Sensor_02* variable into the drawing area and connect the *Sensor_02* output to the available 3 input of the AND function.

4.9.4 Extending Function Blocks and Functions

If a function or function block with more than two inputs is required, position the mouse pointer on the lower border of the POU. When the mouse pointer becomes a double arrow, the POU can be extended.

- Press and hold the left mouse button while dragging the AND function downward. The function can be extended up to a maximum of 16 inputs.

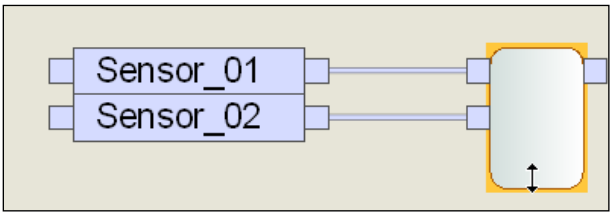


Figure 4-34: Extending Function Blocks

4.9.4.1 Creating Value Fields

Create one value field of REAL data type and one value field of TIME data type. Proceed as follows:

- Right-click anywhere in the drawing area and select **Create Value Field** from the context menu.

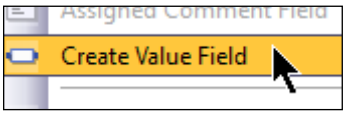


Figure 4-35: Creating Value Fields

- Left-click to position the value field at the required location. The new value field is of BOOL data type.

> The color of the value field corresponds to the assigned data type (see the online help).

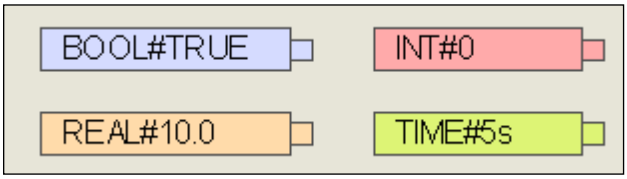


Figure 4-36: Various Data Types

- Double-click the value field and enter the REAL value `800.0`. SILworX recognizes the data type and changes the color of the value field.
- Connect the value field to the required input.
- If a conflict is still reported, proceed as described in Chapter 4.9.5.

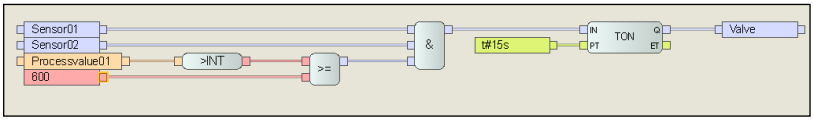


Figure 4-37: Logic Completed

- Create another value field and enter the value `t#15s`. The data type of the value field is automatically adjusted.
- Position the value field as shown above.
- Drag the *Process Value01* and *Valve* variables from the *Global Variables* tab to the drawing area and complete the network.
- Assign a page name in **Page List**.

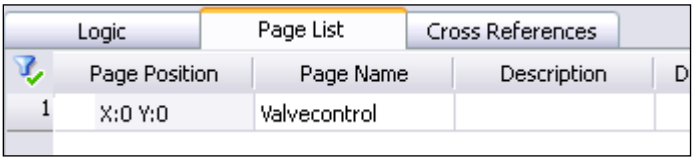


Figure 4-38: Entering the Page Name

- Save the program.

4.9.5 Updating Conflicts

Value fields with conflicts or instances of function blocks where the interface has changed are marked as faulty. These conflicts can be removed as follows:

- Right-click a faulty object and select **Update Conflicts, Current Instance with Conflicts** from the context menu.

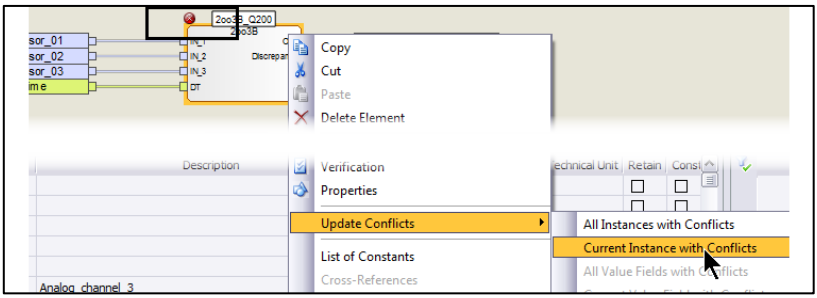


Figure 4-39: Removing Conflicts

- You may have to redraw the connection lines.

4.9.6 Selecting Lines

The following options are available for selecting lines:

Selection	Action
Individual segment	Left-click
Vertex to vertex	Double-click
Entire line segment	Shift key + double-click

Table 4-7: Selecting Lines

4.9.7 Moving Lines

The following options are available for moving lines:

Move	Action
Line end	Shift key + drag&drop with the line end
Line segment	Shift key + drag&drop with the line segment

Table 4-8: Moving Lines

4.9.8 Locking Line Segments

The positions of line segments can be locked and are thus excluded from the graphical autorouting.

- Right-click the segment and select **Lock Element** from the context menu.

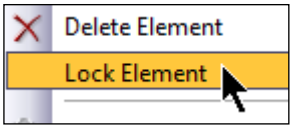


Figure 4-40: Locking an Element

- Repeat the previous step to undo the locking procedure.

4.10 Offline Simulation

During the offline simulation, SILworX simulates the execution of the user program on the PADT. The displayed information is essentially identical to that of the online test, see Chapter 6.4.

Changing variable values in the offline simulation is handled like forcing.

4.10.1 Preparing the Offline Simulation

- In the structure tree, select the program for which you want to start the offline simulation, e.g., *Program* 1.
- Click **Offline** on the Action Bar 2.

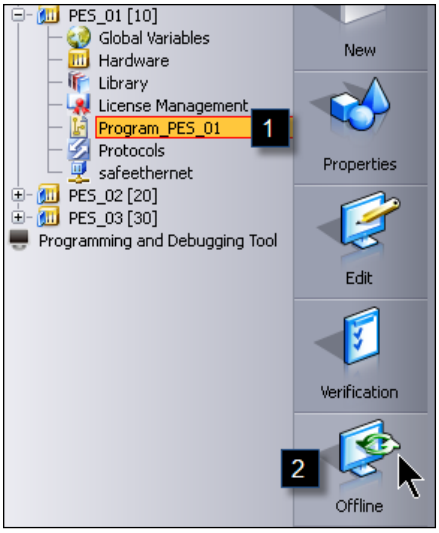


Figure 4-41: Starting the Offline Simulation

- Click **OK** to confirm the dialog box *The offline simulation is being prepared...* The code generator starts generating code for the logic of the selected program only.
- If warnings or error messages are displayed in the logbook, refer to Chapter 4.11.1 for error analysis details!

4.10.2 Starting the Offline Simulation

If code was generated without errors, the program logic is opened as offline simulation.

- Select **Online, Programs, Start Program (Cold Start with Test Mode Option)** to start processing the offline simulation. The *Start Program...* dialog box appears.

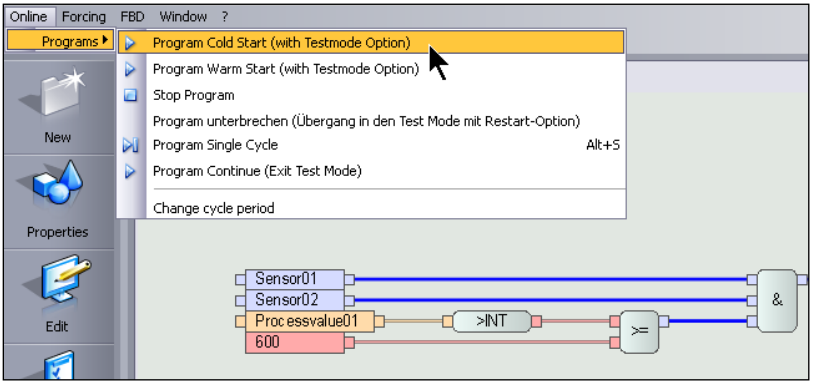


Figure 4-42: Starting the Offline Simulation

- Keep the default settings for all options and click **OK**.

4.10.3 Manipulating Variables in the Offline Simulation

If the values of variables should be manipulated, this can be done directly in the space where the logic is displayed (in the drawing area), or in the Object Panel.

4.10.3.1 Setting Values in the Drawing Area

- Right-click the variable for which the value should be modified, and select **Edit Global (Local) Force Data** from the context menu.
- To select a group of variables, press the **Ctrl** key and simultaneously click the required variables. Make sure to select either global or local variables. If both variable types are selected, the menu function is not available.

- Right-click a selected variable and select **Edit Global (Local) Force Data** from the context menu. The *Edit global (local) force data* dialog box appears.

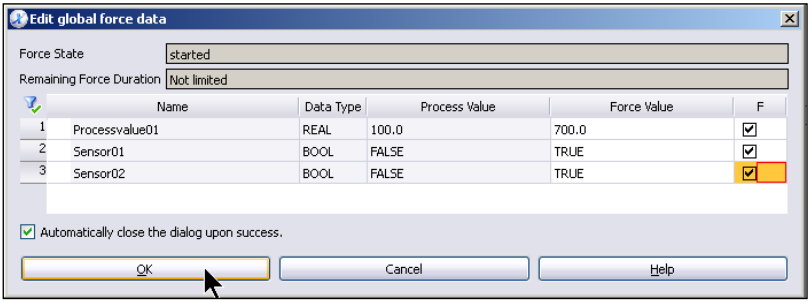


Figure 4-43: Entering Values in the Offline Simulation

- Enter the required force value in the *Force Value* column. The data format and range of values must be consistent with the data type. Instead of TRUE and FALSE, 1 and 0 can also be used.
- Activate the individual force switch in column *F*.
- Click **OK** to confirm the action: the process value is replaced by the force value.

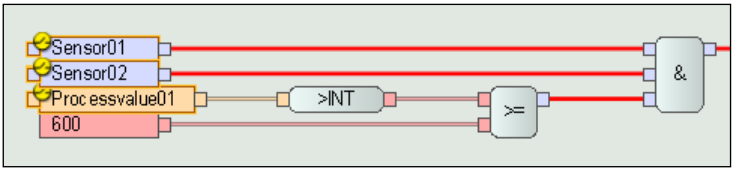


Figure 4-44: Representation of a Forced Variable

The variables with set force switches are specially marked in the logic representation:

1. A yellow switch icon is displayed on the left-hand side, above the variables.
2. The color of the OLT field created manually changes from gray to yellow.
3. Forcing starts immediately in the offline simulation. In the manually created, individual OLT field of a forced variable, the identifier F appears to the left of the value.

4.11 Code Generation

Prior to loading the program into a controller, code must be generated. The code generation verifies the configuration settings and the syntax of the logic, and converts the SILworX data into machine-readable code.

If errors are detected in the project, code generation is aborted and messages reporting potential fault causes are output. These errors must be removed manually.

To perform the code generation, proceed as follows:

- In the structure tree, right-click the resource for which code should be generated and select **Code Generation** from the context menu. The *Start Code Generation* dialog box appears.
- Activate the option **Automatically close the dialog upon success** and click **OK**.

Set the following parameters in the *Start Code Generation* dialog box:

Parameters	Description
Prepare Reload	The generated code can be loaded into the controller by performing a reload. Certain conditions must be met for reload. HIMatrix systems with enhanced performance require a license to enable the reload function. Also observe the instructions specified in the safety and system manuals.
CRC Comparison	Code is generated twice and the results are compared to ensure they are identical. For safety-related code generation, the CRC comparison must be active.
Automatically close the dialog upon success	The window is automatically closed if the action is completed successfully. This option is available for many dialog boxes.

Table 4-9: Code Generation Parameters

4.11.1 Warnings and Error Messages of the Code Generator

Detected inconsistencies and errors are logged in the code generator's logbook.

⚠ CAUTION

Warnings and Error Messages!

If warnings were reported during code generation, it is possible to load the code, but the warnings must be taken into account for industrial applications. They usually report incomplete parameter settings and tasks.

Errors must be removed!

To quickly localize error causes, right-click the logbook and select the **Go to…** function from the context menu.

- Click the (+) sign located to the left of the code generator messages to open the corresponding list.
- Right-click a text line and select **Go to...**

To find the cause of warnings, the *Target Path* column provides information where the element is used or was defined.

	Date/Time	Severity	Message	Target Path
20	31/07/2013 14:...	Warning	Code generation finished. Warnings: 2. Errors: 0. CR...	/Configuration/PES_10
21	31/07/201...	Info	Source code generation started.	/Configuration/PES_10 [10]/01_Program_PES_10
22	31/07/201...	Info	Source code generation completed.	/Configuration/PES_10 [10]/01_Program_PES_10
23	31/07/201...	Warning	Used global variable 'COM_PES_10_to_PES_20' has no ...	/Configuration/Global Variables/COM_PES_10_to_PES_20
24	31/07/201...	Warning	Used global variable 'AI_Process_value_1oo1' has no s...	/Configuration/PES_10/Global Variables/AI_Process_value_1oo1
25	31/07/201...	Info	Code generation finished. Warnings: 2. Errors: 0.	/Configuration/PES_10

Figure 4-45: Localizing Warnings

4.11.2 After a Successful Code Generation

The code generation result is a configuration file containing all programs and resource settings.

This file is called resource configuration.

The detailed code generation report is located in the logbook. Click the + sign on the left-hand side of the row to open the detail view.

One of the most important bits of information is the code version generated by the code generator; in the figure below: `CRC: 0x4f8598e6`.

Another important piece of information in this context is the extension located after the CRC value, here `V6`. This extension indicates that an operating system version compatible with SILworX V6 or higher must be loaded in the controller, see also Table 4-2.

15/04/2014 17:09:30.497	Info	Code generation finished. Warnings: 0. Errors: 0. CRC: 16#4f8598e6-V6.
15/04/2014 17:09:14.776	Info	Source code generation started.
15/04/2014 17:09:16.984	Info	Source code generation completed.
15/04/2014 17:09:28.602	Info	Code generation finished. Warnings: 0. Errors: 0.
15/04/2014 17:09:30.497	Info	Code generation finished with CRC: 16#4f8598e6.
15/04/2014 17:09:30.509	Info	The CRC comparison from the dual code generation was successful. The generated code is valid.

Figure 4-46: Messages of the Code Generator

If dual code generation was successful and the CRC comparison was requested, a message appears reporting that the action has succeeded.

⚠ CAUTION

To ensure safety-related operation of the system, code generation must be performed twice! If the *CRC Comparison* option was not activated prior to starting the code generation, a second code generation must be started manually.

Code is only valid if both code generations result in identical CRC values (compare the entries in the logbook). This ensures detection of potential errors (bit errors) that the non-safe PC may theoretically cause during code generation.

Also observe the instructions provided in the safety manual!

5 Start-Up

This chapter starts with an explanation of some basic terms. Afterwards it describes the start-up procedure in accordance with the different resource types.

5.1 Basic Knowledge

The following section explains certain basic parameters and behaviors, which are important for start-up.

5.1.1 SRS

An important setting for controllers is the SRS. It is composed of system ID, rack ID and slot ID.

5.1.1.1 System ID

The system ID is a resource property and identifies the system, e.g., when resources are communicating via safe**ethernet**.

5.1.1.2 Rack ID

Each rack is assigned an own ID, in accordance with the specifications made in the Hardware Editor. The automatically generated racks of the HIMax and HIQuad X systems always contain one or more CPU modules. Usually, the extension racks only contain I/O modules, as well as COM modules in HIMax systems.

All racks are interconnected via system bus modules (HIMax) or F-IOP modules (HIQuad X), with all rack IDs being unique.

HIMatrix remote I/Os are organized like extension racks and are connected via safe**ethernet**. They can be used with HIMatrix resources, as well as HIMax or HIQuad X systems.

5.1.1.3 Slot ID

Slot of a module. The slot depends on the hardware configuration.

5.1.2 Responsible Attribute for SB (HIMax only)

Another important property is the *Responsible* attribute for system bus modules (SB). In each system bus (on the left: bus A, on the right: bus B), the system bus module set to *Responsible* controls processor module access to the system bus and whether a processor module may participate in system operation.

In system bus A, the *Responsible* attribute is reserved for the left system bus module in rack 0 (fixed assignment). In most standard configurations of system bus B, the *Responsible* attribute is assigned to the right system bus module in rack 0.

If processor modules are configured in rack 1, the *Responsible* attribute must be configured for system bus B in rack 1.

The SRS and the *Responsible* settings are stored in non-volatile memories on the connector boards for system bus and processor modules. Thus, this important data is preserved even when modules are replaced.

5.1.3 MAC Address

Each module with Ethernet ports has at least one hardware address specified during production. The so-called MAC address can be found on a sticker on the module. Communication with a module can be established via the MAC address, even without knowledge of the IP address and SRS.

HIMatrix F systems have several MAC addresses.

- The MAC address of the processor module is documented on a label.
- The MAC address of the communication module is the address of the processor module + 1.

5.1.4 IP Address

IP addresses should be defined for system bus, processor and communication modules.

An IP address is composed of the network ID (net ID), subnet ID and host ID. Which portion of the IP address contains the network and subnet IDs can be specified in the subnet mask.

EXAMPLE:

IP address	Decimal	192	168	0	20
	32-bit	11000000	10101000	00000000	00010100
Subnet mask	Decimal	255	255	252	0
	32-bit	11111111	11111111	11111100	00000000

Table 5-1: Relation between Subnet Mask and IP Address

All the bits of the IP address masked with 1 in the subnet mask belong to the network ID plus subnet ID.

All the bits of the IP address masked with 0 in the subnet mask belong to the node ID.

The network address of all network subscribers must be identical if no gateway or router is used. If required, contact the network administrator.

5.1.5 Strategies for Activating the IP Address

A module's IP address is stored in a non-volatile memory within the module.

The IP address is activated in accordance with the following priorities:

- If a controller contains a valid configuration, the IP addresses are adopted from this configuration.
- If no valid configuration is available, the last valid IP address of the module is used. Take this into account if modules already utilized in another application are used.
- Factory default settings for HIMax and HIQuad X:

  Brand-new modules or processor modules that are booted with *Mode* switch set to INIT, are assigned the standard IP address 192.168.0.99.
- Factory default settings for HIMatrix F:

  A brand-new HIMatrix has the default IP address 192.168.0.99 (CPU) or 192.168.0.100 (COM). The factory settings can be restored with the aid of a reset button. Refer to Chapter 5.4.4 for details.

The current IP address for a module can be read from the SILworX dialog box *Search via MAC* and used for the first login.

The IP address of the PC must match the subnet mask and be located in the same network as the IP address of the module to be connected. It is possible that the IP address of the PC needs to be adjusted.

	PC data	HIMA system data
IP address	192.168.0.215	192.168.0.xxx (not 215)
Subnet mask	255.255.252.0	255.255.252.0

Table 5-2: Example of a Functioning Connection

5.1.6 The Mode Switch on HIMax or HIQuad X Processor Modules

The mode switch setting on a processor module is only queried while booting the controller (connecting the power). Changing the mode switch position during operation has no effects on the controller.

5.1.6.1 Booting with Mode Switch set to INIT

Setting the mode switch to **INIT** and booting the controller, the following factory settings become temporarily operative on the respective CPU module:

	Booting with INIT
IP address	192.168.0.99
SRS	60000.0.X
Login	Administrator, empty password
Enable	Standard enables are active
Delete	Reset to the factory settings (factory reset) is possible.

Table 5-3: Temporarily Operative Factory Settings

5.1.6.2 Booting with Mode Switch set to STOP

Setting the mode switch to **STOP** and booting the controller prevent the user program from being executed immediately and the CPU from entering the RUN state in spite of a valid configuration and *Autostart* set to TRUE.

This must be taken into account if processor modules previously used are started up.

In the STOP state, the user program is not processed. A new user program can be loaded.

If a valid configuration is loaded into a processor module and the conditions for system operation are met, all settings from the configuration become operative.

TIP A reset to the factory settings (factory reset) should always be performed on processor modules with unknown configurations, i.e., the system should be booted with INIT.

5.1.6.3 Booting with Mode Switch set to RUN

If the mode switch is set to **RUN** and a controller with invalid configuration is booted, the controller enters the state STOP / INVALID CONFIGURATION (the yellow STOP LED is blinking). A valid configuration can be loaded by performing a download.

If the mode switch is set to **RUN** and a controller with valid configuration is booted, the controller enters the RUN state if *Autostart* is set to TRUE in the configuration. All user programs are processed cyclically or periodically.

5.1.7 LED Indicators on the HIMax X-CPU

- The INIT LED is blinking

  The CPU module is in the INIT state. In this state, only a module login can be performed (no system login). A master reset is possible.

- The STOP LED is blinking

  The CPU module is running in system operation. Communication with the system bus modules responsible for the two system buses is available. In this mode, the system login can be performed. The CPU module configuration is invalid. A configuration can be loaded by performing a download.

- The STOP LED is lit.

  The same as *STOP LED is blinking*, but the CPU module has a valid configuration that can be started.

- The RUN LED is lit.

  The CPU module is in RUN, the user programs are executed. This is the system's normal operation!

- The ERROR LED is lit.

  The mode switch is not set to RUN. A license is used in demo mode (CPU OS 4.x and higher)

This list only specifies the meaning of LEDs important for start-up. A complete description is provided in the module manuals.

5.1.8 LED Indicators on the HIQuad X F-CPU

- The RUN LED is lit green.

  The CPU module is in the RUN state, the user programs are executed. This is the system's normal operation!
- The RUN LED is lit yellow.

  The CPU module is in the STOP / VALID CONFIGURATION state, and the configuration can be started.
- The RUN LED is blinking yellow.

  The CPU module is in the STOP / INVALID CONFIGURATION state. A configuration can be loaded. Alternatively, the module is in the INIT state. In this case, no configuration can be loaded.
- The ERROR LED is lit.

  The mode switch is not set to RUN or a license is used in demo mode.

This list only specifies the meaning of LEDs important for start-up. A complete description is provided in the module manuals.

5.1.9 LED Indicators on the HIMatrix Compact Systems

- Nearly all LEDs are lit.

  The system is being initialized. No login is possible.
- The PROG LED is lit.

  A configuration is being loaded.
- The RUN LED is blinking.

  The system is in STOP or a new operating system is being loaded into the flash ROM. The user programs are not executed.
- The RUN LED is lit.

  The system is in RUN. The user programs are executed. This state is the system's normal operation.
- The BL LED is blinking.

  A communication error occurred, for instance, when the connection to a configured remote I/O is interrupted.
- The ERROR LED is lit.

  A license is used in demo mode (CPU OS 8.x and higher).

This list only specifies the meaning of LEDs important for start-up. A complete description is provided in the HIMatrix manuals.

5.1.10 HIMatrix F Remote I/Os

- The PROG LED is blinking.

  The system is being initialized or a new operating system is being loaded into the flash ROM. No login is possible.
- The PROG LED is lit.

  A configuration is being loaded.
- The RUN LED is blinking.

  The system is in the STOP state or a new operating system is being loaded into the flash ROM.
- The RUN LED is lit.

  The system is in RUN. This state is the system's normal operation.
- The BL LED is blinking.

  A communication error occurred (OS V 8.12 and higher only).

---

i This list only specifies the meaning of LEDs important for start-up. A complete description is provided in the HIMatrix manuals.

5.1.11 HIMatrix F60 CPU 03

System LEDs (1st row)

- The RUN LED is blinking.
  An operating system is being loaded.
- The RUN LED is lit.
  The CPU is operating. Refer to the program LEDs for the program status.
- The RUN LED is off.
  The system is not operating.

Program LEDs (2nd row)

- The RUN LED is lit.
  The programs are processed or are in the FREEZE state.
- The RUN LED is off.
  The programs are in STOP.
- The STOP LED is lit.
  The program is in the STOP state or a new operating system is being loaded.
- The BL LED is blinking.
  A communication error occurred. That is, for instance, when the connection to a configured remote I/O is interrupted.
- The Fault LED is lit.
  A license is used in demo mode (CPU OS 8.x and higher).

i This list only specifies the meaning of LEDs important for start-up. A complete description is provided in the HIMatrix F60 CPU manual.

5.2 Starting Up a HIMax System

This chapter describes how to start up a HIMax system with various configurations.

5.2.1 System Operation

The first objective of the start-up is to achieve system operation.

A HIMax system may include the following components:

- At least one system bus module (SB).
- At least one CPU 01 processor module (up to four modules are possible).
- I/O modules and communication modules.

The system bus modules and processor modules must be configured since the modules either contain the factory settings or settings from a previous use.

> **i** A HIMax system is in system operation when the yellow STOP LEDs on the CPU modules flash or light up permanently.

5.2.1.1 Requirements for System Operation

System operation is possible if the following requirements are met:

- The Responsible attribute for the system bus modules must be properly configure, see Chapter 5.1.2.
- The mode switches on the CPU modules must be set to STOP or RUN.

5.2.2 Starting up HIMax with X-CPU 01, Rack 0

The following section describes how to start up a HIMax system equipped with an X-CPU 01 module.

5.2.2.1 Restoring the Initial State

- The system is de-energized.
- Rack 0 is equipped with *two* system bus modules and *one* X-CPU 01 module. Optionally, it may also contain I/O and COM modules.

  Additional processor modules can be added after loading the user program and are synchronized automatically, see Chapter 5.5.
- Rack 0 is **not** connected to an extension rack.
- A SILworX project was prepared in accordance with the instructions specified in Chapter 4.
- If the Ethernet interface of the PC is not equipped with an *Autocrossing* function, a cross-over Ethernet cable has to be used.

5.2.2.2 Preparing the Start-Up Process

- Set the mode switch to INIT.
- Boot the controller by switching the operating voltage on. Booting with the mode switch set to INIT temporarily activates the factory settings.

Figure 5-1: Mode Switch in INIT Position

- Connect the PADT to the *PADT* port of the system bus module in slot 01.

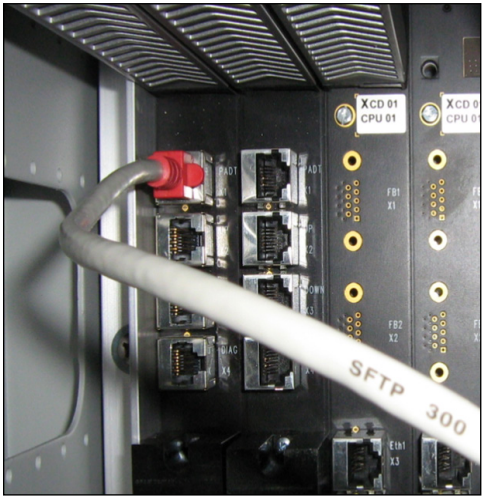


Figure 5-2: Connecting Ethernet Cables

- Start SILworX and open the project.
- In the structure tree, select the **Hardware** element and click **Online** on the Action Bar. The *System Login* dialog box appears.
- In the *Interface* group field, click **To Module Login.** At this stage, the system login is not possible.

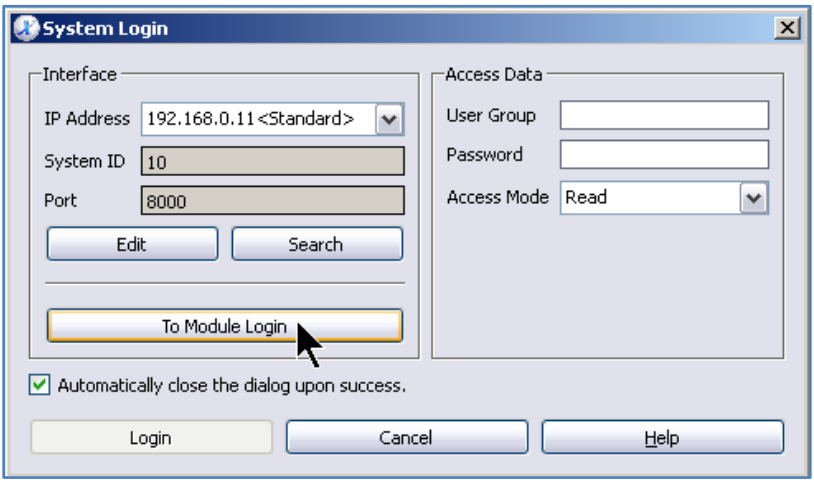


Figure 5-3: To Module Login

The steps described in the following sections are performed in the hardware online view.

5.2.2.3 Starting Up the System Bus Module in Slot 01

The following chapter explains how to start up the system bus module located in slot 01 (system bus A). The procedure to start up the system bus module in slot 02 (system bus B) is identical.

- In the online view of the Hardware Editor, double-click the icon of the system bus module in slot 01. The *Module Login* dialog box appears.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.

- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the MAC address of the system bus module. The MAC address is specified on a label on the module.
- Click **Search**.
- As soon as the PADT communicates with the system bus module, the information about connection, redundancy responsibility and system bus mode are read out and displayed in the *Settings* group field.

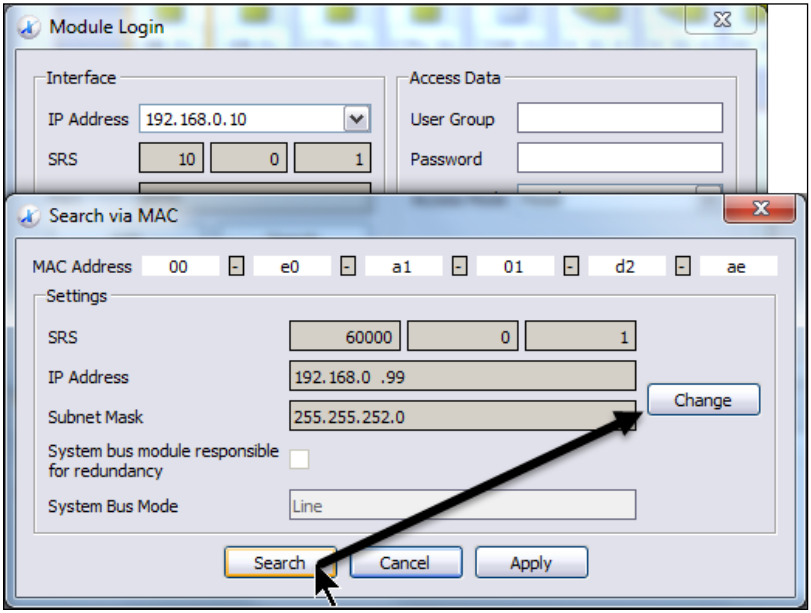


Figure 5-4: Requesting a Change in Connection Parameters

Under the following circumstances, *Search via MAC* may return no data:

1. The MAC address was not entered properly.
2. The PADT network interface card is not properly configured. A fixed IP address is required.
3. The cable used is not a cross-over cable, or the cable is not connected to the *PADT* port of the system bus module. Take the LEDs on the PADT network interface card and on the system bus module into account.
4. The PADT is equipped with multiple network interface cards.
5. A firewall is active and blocks the access.

- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.
- Copy the values for system ID and rack ID specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `10.0.`
- Copy the values for the IP address specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `192.168.0.10.`
- Activate *System bus module responsible for redundancy*.
- Select the required *System Bus Mode* (default: *Line)*.
- Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.

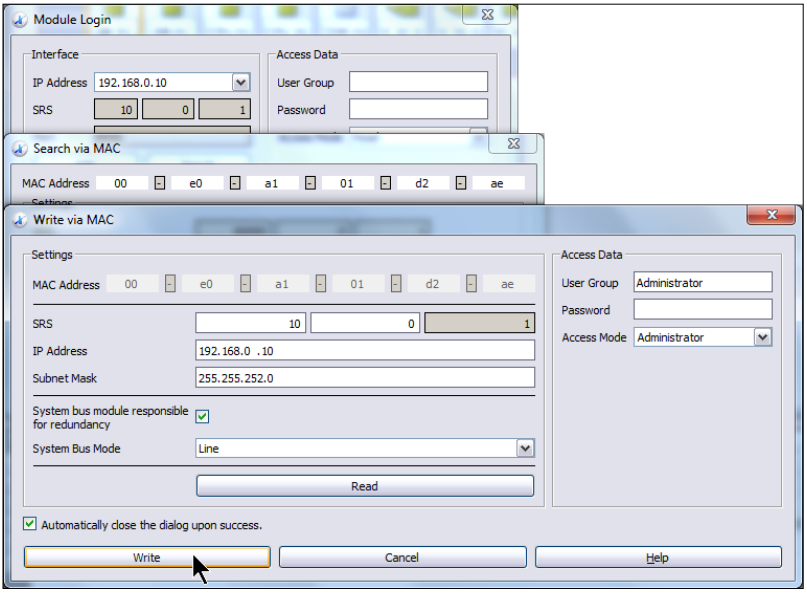


Figure 5-5: Configuring the System Bus Module in Slot 01

- Click **Write** to configure the connection data for the system bus module.
- Click **Cancel** to close the *Search via MAC* and *Module Login* dialog boxes.

5.2.2.4 Starting Up the System Bus Module in Slot 02

- Connect the PADT to the *PADT* port of the system bus module in slot 02.
- Repeat the steps described in the Chapter 5.2.2.3.
- Make sure that the *System bus module responsible for redundancy* is active (see Chapter 5.1.2), unless processor modules are also used in rack 1.
- Check the result in the logbook.

7	23/01/2019 11:28:29.568	Info	Writing settings for MAC address '00:e0:a1:01:d2:ae'.
8	23/01/2019 11:28:29...	Info	SRS: 10.0.1
9	23/01/2019 11:28:29...	Info	IP address: 192.168.0.10
10	23/01/2019 11:28:29...	Info	Subnet mask: 255.255.252.0
11	23/01/2019 11:28:29...	Info	System bus module responsible for redundancy: Yes
12	23/01/2019 11:28:29...	Info	System bus mode: Line
13	23/01/2019 11:28:29.579	Info	Settings written successfully.
14	23/01/2019 11:31:57.889	Info	Writing settings for MAC address '00:e0:a1:00:d4:a2'.
15	23/01/2019 11:31:57...	Info	SRS: 10.0.2
16	23/01/2019 11:31:57...	Info	IP address: 192.168.0.10
17	23/01/2019 11:31:57...	Info	Subnet mask: 255.255.252.0
18	23/01/2019 11:31:57...	Info	System bus module responsible for redundancy: Yes
19	23/01/2019 11:31:57...	Info	System bus mode: Line
20	23/01/2019 11:31:57.898	Info	Settings written successfully.

Figure 5-6: Logbook Message for Write via MAC

If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the system bus module read out previously.

The factory setting for the IP address of the system bus module is 192.168.0.99. The IP address of the PADT without routing must be set to 192.168.0.x (where x = 1…254, except 99).

5.2.2.5 Starting Up an X-CPU 01

The start-up according to the following description is only possible with an operating system (OS) V6.x and higher. If you have an older operating system, use version 6 of the First Steps manual.

1. Step: Setting the connection parameters

- Connect the PADT to any network port of the CPU module in slot 03.
- In the online view of the Hardware Editor, double-click the CPU icon in slot 3. The *Module Login* dialog box appears.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the MAC address of the CPU module. The MAC address is specified on a label on the module.
- Click **Search**.

  As soon as the PADT communicates with the CPU module, the connection data are read out and displayed in the *Settings* group field.

Under the following circumstances, *Search via MAC* may return no data:

1. The MAC address was not entered properly.
2. The PADT network interface card is not properly configured. The PADT requires a fixed IP address.
3. The cable used is not a cross-over cable, or the cable is not connected to the *ETHn* port of the CPU module. Take the LEDs on the PADT network interface card and on the CPU module into account.
4. The PADT is equipped with multiple network interface cards.
5. A firewall is active and blocks the access.

- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.

- Copy the values for system ID and rack ID specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, for example: `10.0.`
- Copy the values for the IP address specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, for example: `192.168.0.11.`
- For authorization purposes, enter the default user group data in the *Access Data* group field.
  - Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Click **Write** to configure the connection data for the CPU module.
- Click **Cancel** to close the *Search via MAC* dialog box.
- In the *Module Login* dialog box, click the *User Group* field and press **Ctrl+A** to enter the default user.
- Click **Login**.
- The Control Panel for the module appears.

---

i If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the CPU module read out previously.

The IP address of the processor module in INIT mode is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1 … 254, except 99).

For the login after writing, the IP address of the PC must match the network of the new IP address.

---

2. Step: Performing a CPU factory reset without resetting the connection parameters

- Select **Online, Maintenance/Service, Reset Module Factory Settings** from the menu bar. The *Reset Module Factory Settings* appears.
- Untick the *IP Address* and *System ID* and click **OK**. This clears all settings and configurations on the CPU module, except for the IP address and the system ID. This step is recommended whenever the CPU module may contain unknown data.

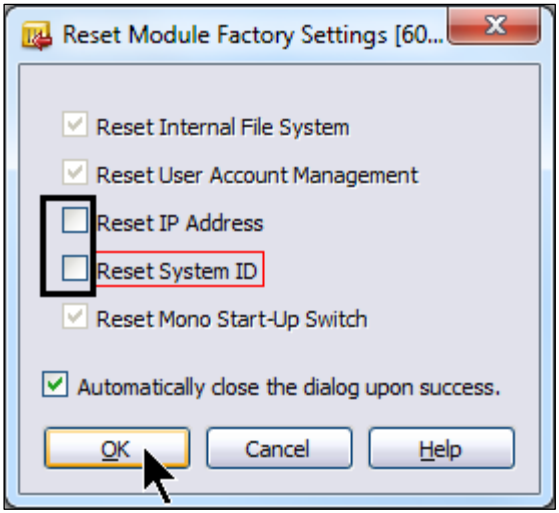


Figure 5-7: Factory Reset

3. Step: Starting mono operation

To simplify start-up with distributed CPUs (rack 0 and 1), HIMA recommends temporarily setting the system to MONO.

If a system is only equipped with one system bus and one CPU module, only mono operation is possible (in contrast to redundancy operation)! This affects the system availability.

A CPU switch must be activated to allow a system to run in mono operation. This CPU switch takes only effect if a mono project is loaded. Otherwise, the switch is automatically reset.

- Click **Online, Start-Up, Set Mono/Redundancy Operation** from the menu bar.
- In the *Redundancy* field, select `Mono` and click **OK.**

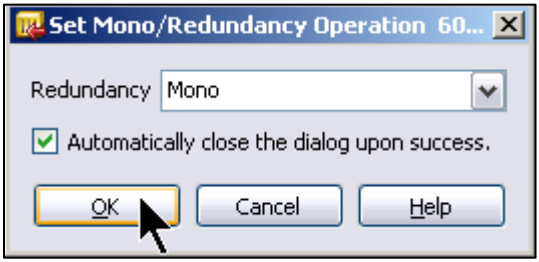


Figure 5-8: Mono Operation

- Close the Control Panel of the module.

4. Step: Checking system operation

- Turn the mode switch on the processor module from **INIT** to **RUN**. After some seconds, the yellow STOP LED starts blinking. The system is running in system operation and is in the STOP/INVALID CONFIGURATION state. In this state, the system is ready to load a new configuration.
- If you want to start up additional extension racks, do not close the Hardware Editor's online view and follow the instructions specified in Chapter 5.2.4.
- If you do not want to start up additional extension racks, close the Hardware Editor's online view and load the resource configuration to continue the start-up procedure (see Chapter 5.5).

5.2.3 Starting up HIMax with X-CPU 31, Rack 0

The X-CPU 31 includes two modules: a system bus module and a CPU module. A system may include a maximum of two X-CPU 31 modules. X-CPU 01 and X-CPU 31 modules cannot be combined. System bus modules (X-SB 01) must be used in extension racks.

5.2.3.1 Restoring the Initial State

- The system is de-energized.
- Rack 0 has been equipped with an X-CPU 31 in slot 1. Additional I/O modules and COM modules may be used. After loading the user program (see Chapter 5.5), another CPU module can be added, which synchronizes automatically (depending on the resource configuration).
- Rack 0 is not connected to an extension rack.
- A SILworX project has been prepared in accordance with the instructions specified in Chapter 4.

5.2.3.2 Preparing the Start-up Process

- Set the mode switch to INIT.

Figure 5-9: Mode Switch in INIT Position

- Boot the controller by switching the operating voltage on. Booting with the mode switch set to INIT temporarily activates the factory settings.
- Connect the PADT either to Eth1 or Eth2 of the X-CPU 31 in slot 01.

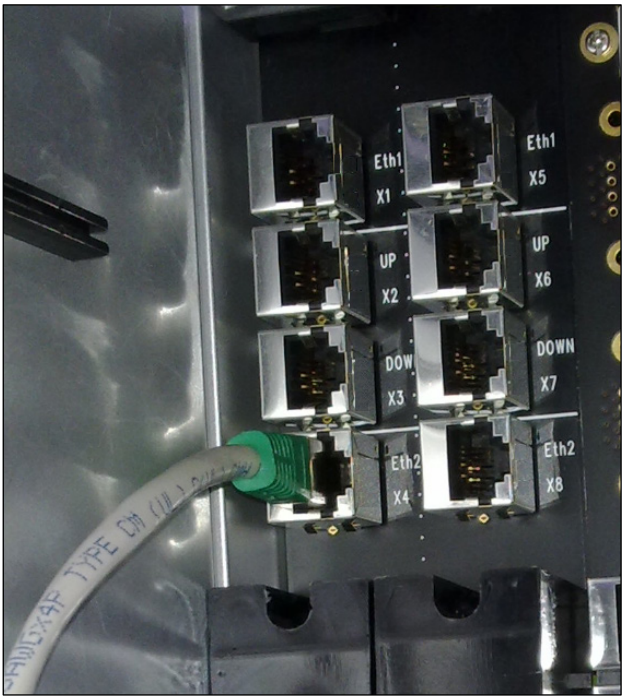


Figure 5-10: Connecting Ethernet Cables

- Start SILworX and open the project.
- In the structure tree, select the **Hardware** element and click **Online** on the Action Bar. The *System Login* dialog box appears.

- In the *Interface* group field, click **To Module Login.** At this stage, the system login is not possible.

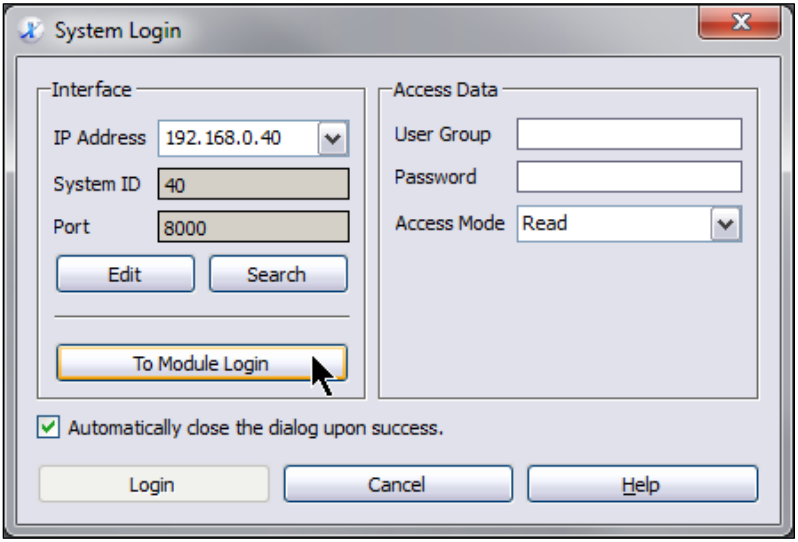


Figure 5-11: To Module Login

The steps described in the following sections are performed in the hardware online view.

5.2.3.3 Starting up the X-CPU 31 in Slot 01

The following chapter explains how to start up the CPU 31 module located in slot 01 (system bus A). A second CPU can be synchronized at a later stage.

1. Step: Setting the connection parameters

- In the online view of the Hardware Editor, double-click the icon of the left X-CPU 31 module. The *Module Login* dialog box appears.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the MAC address of the CPU module. The MAC address is specified on a label on the module.
- Click **Search**.
- As soon as the PADT communicates with the CPU module, the connection data are read out and displayed in the *Settings* group field.

Under the following circumstances, *Search via MAC* may return no data:

1. The MAC address was not entered properly.
2. The PADT network interface card is not properly configured. The PADT requires a fixed IP address.
3. The cable used is not a cross-over cable, or the cable is not connected to the *ETHn* port of the CPU module.
   Take the LEDs on the PADT network interface card and on the CPU module into account.
4. The PADT is equipped with multiple network interface cards.
5. A firewall is active and blocks the access.

- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.
- Copy the values for system ID and rack ID specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `40.0.`
- Copy the values for the IP address specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `192.168.0.41.`
- For authorization purposes, enter the default user group data in the *Access Data* group field.
  - Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Click **Write** to configure the connection data for the CPU module.

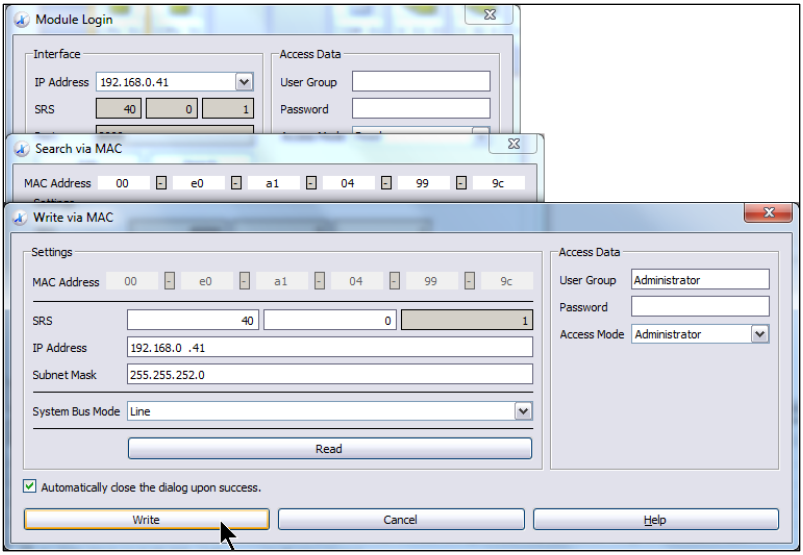


Figure 5-12: Writing the Connection Parameters via MAC

- Click **Cancel** to close the *Search via MAC* dialog box.

- In the *Module Login* dialog box, click the *User Group* field and press **Ctrl+A** to enter the default user.
- Click **Login**.
- The Control Panel for the module appears.

If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the CPU module read out previously.

The IP address of the processor module in INIT mode is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1…254, except 99).

For the login after writing, the IP address of the PC must match the network of the new IP address.

2. Step: Performing a CPU factory reset without resetting the connection parameters

- Select **Online, Maintenance/Service, Reset Module Factory Settings** from the menu bar. The *Reset Module Factory Settings* appears.
- Untick the *IP Address* and *System ID* and click **OK**. This clears all settings and configurations on the CPU module, except for the IP address and the system ID. This step is always recommended if the CPU module could contain unknown data.

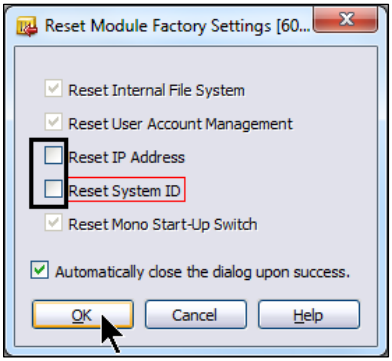


Figure 5-13: Factory Reset

3. Step: Starting mono operation

To simplify start-up, HIMA recommends temporarily setting the system to *Mono*.

If a system is only equipped with one CPU module, only mono operation is possible (in contrast to redundancy operation)! This affects the system availability.

A CPU switch must be activated to allow a system to run in mono operation. This CPU switch takes only effect if a mono project is loaded. Otherwise, the switch is automatically reset.

- Click **Online, Start-Up, Set Mono/Redundancy Operation** from the menu bar.
- In the *Redundancy* field, select `Mono` and click **OK.**

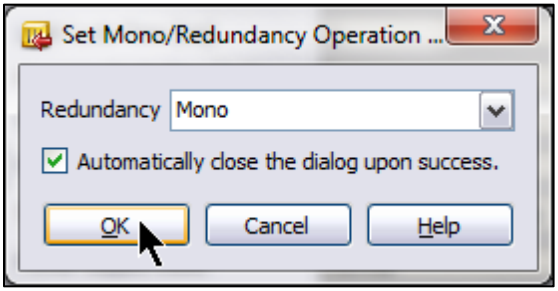


Figure 5-14: Mono Operation

- Close the Control Panel for the module.

4. Step: Checking system operation

- Turn the mode switch on the processor module from **INIT** to **RUN**. After some seconds, the yellow STOP LED starts blinking. The system is running in system operation and is in the STOP/INVALID CONFIGURATION state. The system is now ready to load a new configuration.
- If you want to start up additional extension racks, do not close the Hardware Editor's online view and follow the instructions specified in Chapter 5.2.4.

- If you do not want to start up additional extension racks, close the Hardware Editor's online view and load the resource configuration to continue the start-up procedure, see Chapter 5.5.

5.2.4 Starting up Extension Racks for HIMax

If all the instructions specified in the previous chapters have been carefully followed, the Hardware Editor's online view is open. Otherwise, open the online view as follows:

- In the structure tree, select the **Hardware** element and click **Online** on the Action Bar. The *System Login* dialog box appears.
- In the *Interface* group field, click **To Module Login.** The hardware online view appears.

5.2.4.1 Starting up the System Bus Module in Slot 01

The following chapter explains how to start up the system bus module located in slot 01 (system bus A). The procedure to start up the system bus module in slot 02 (system bus B) is identical.

⚠ NOTICE

Ensure that the extension rack is not connected to other racks during start-up!

The following steps must be performed for all extensions racks and all the system bus modules!

- Connect the PADT to the *PADT* port of the system bus module in slot 01 of the extension rack.
- In the online view of the Hardware Editor, double-click the icon of the system bus module in slot 01 of the extension rack. The *Module Login* dialog box appears.

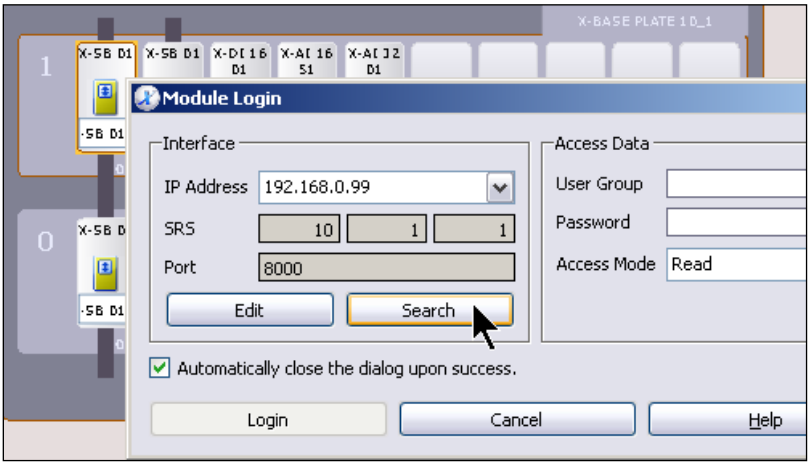


Figure 5-15: Module Login

- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the MAC address of the system bus module. The MAC address is specified on a label on the module.
- Click **Search**. If the PADT can communicate with the system bus module, the information about connection, redundancy responsibility and system bus mode are read out and displayed in the *Settings* group field.
- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.
- Copy the values for system ID and rack ID specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `10.1` (system ID = 10, rack ID = 1).

- Make sure that the *System bus module responsible for redundancy* option is not active (see Chapter 5.1.2). For system bus A, this setting may only be active for the system bus module in rack 0, slot 01.
- Make sure that the required mode has been selected for *System Bus Mode*; the usual setting is `Line`.
- For authorization purposes, enter the default user group data in the *Access Data* group field.
  - Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.

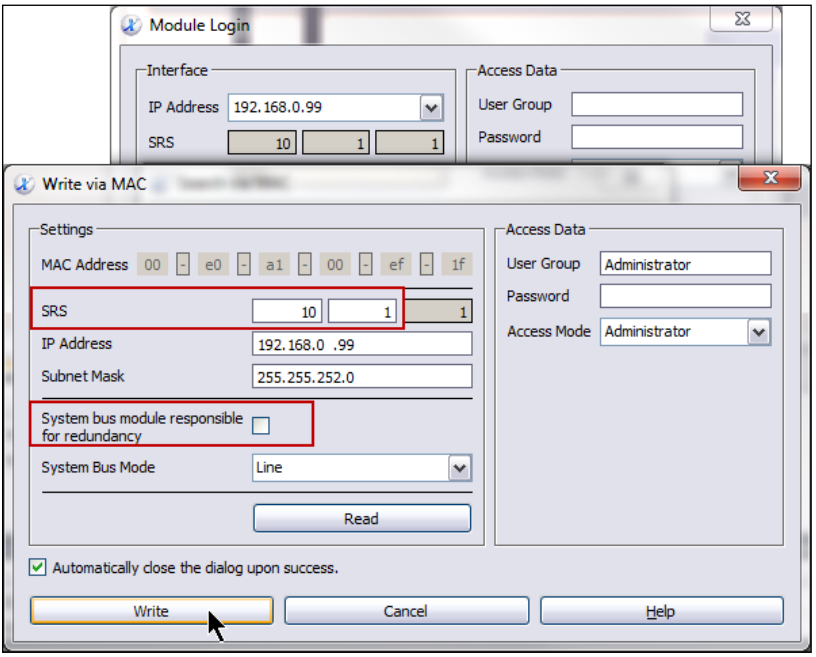


Figure 5-16: System Bus Module in Rack 1, Slot 01

- Click **Write** to configure the SRS for the system bus module.
- Click **Cancel** to close the *Search via MAC* and *Module Login* dialog boxes.

5.2.4.2 Starting up the System Bus Module in Slot 02

- Connect the PADT to the *PADT* port of the system bus module in slot 02.
- Repeat the steps described in the Chapter 5.2.4.1.
- Make sure that the *System bus module responsible for redundancy* option is not active (see Chapter 5.1.2).

  EXCEPTION: You are configuring rack 1 and it contains CPU modules.
- Check the result in the logbook.

---

i If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the system bus module read out previously.

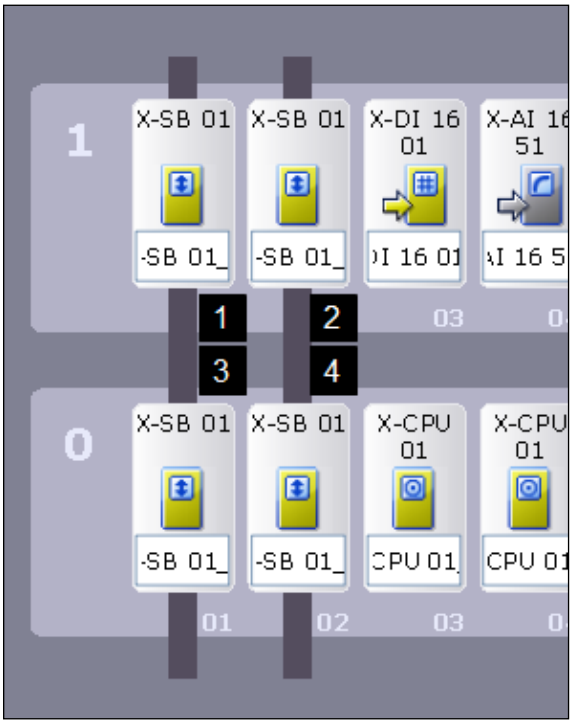
The factory setting for the IP address of the system bus module is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1 … 254, except 99).

5.2.5 Connecting Racks

The system bus is very fast. For the system bus, only use cables approved by HIMA. Only selected media converters, but no Ethernet switches are allowed in the standard line structure! In the network structure, only selected switches are allowed.

Contact HIMA technical support or sales department for further information.

- Connect the racks as configured in the Hardware Editor.



1 2 Port: **DOWN**

3 4 Port: **UP**

Figure 5-17: Connecting the System Bus

5.3 Starting Up a HIQuad X System

The F-CPU 01 contains not only the CPU, but also manages the system bus connection to the I/O processing modules (F-IOP 01). A maximum of 2 CPUs may be used. The CPUs can only be positioned in rack 0 (H51X) or in rack 1 (H41X).

5.3.1 Restoring the Initial State

- The system is de-energized.
- Rack 0 or rack 1 has been equipped with an F-CPU 01 in the left position.
- For all F-IOP 01 modules, the correct rack numbers were set in accordance with the data sheet using the DIP switches and the racks are connected via Ethernet.
- A SILworX project has been prepared in accordance with the instructions specified in Chapter 4.

5.3.2 Preparing the Start-Up Process

- Move the mode switch to INIT. The mode switch is located on the back of the front plate.

Figure 5-18: HIQuad X Mode Switch in INIT Position

- Boot the controller by switching the operating voltage on. Booting with the mode switch set to INIT temporarily activates the factory settings.
- Connect the PADT either to *Eth1* or *Eth2* of the F-CPU 01.
- Start SILworX and open the project.
- In the structure tree, select the **Hardware** element and click **Online** on the Action Bar. The *System Login* dialog box appears.
- In the *Interface* group field, click **To Module Login.** At this stage, the system login is not possible.

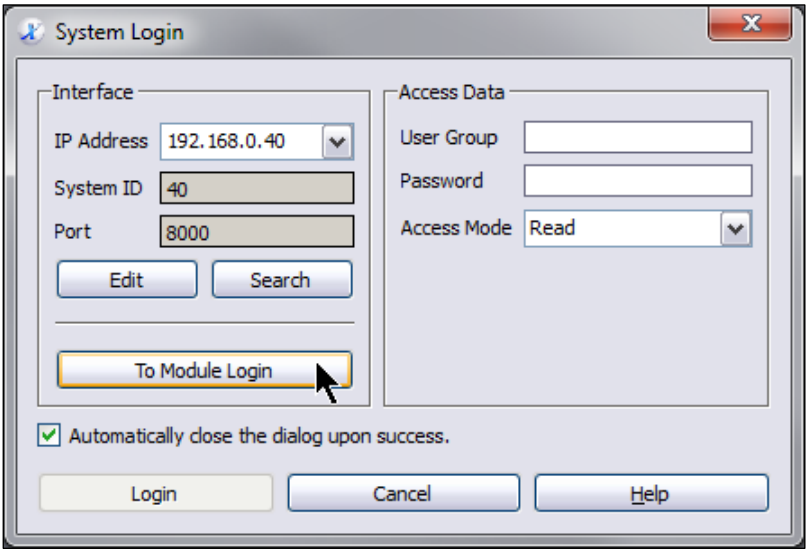


Figure 5-19: To Module Login

The steps described in the following sections are performed in the hardware online view.

5.3.3 Starting Up the F-CPU 01

The following chapter explains how to start up an F-CPU 01. A second F-CPU 01 can be synchronized at a later stage.

1. Step: Setting the connection parameters

- In the online view of the Hardware Editor, double-click the icon of the left F-CPU 01 module. The *Module Login* dialog box appears.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the MAC address of the CPU module. The MAC address is specified on a label on the module.
- Click **Search**.
- As soon as the PADT communicates with the CPU module, the connection data are read out and displayed in the *Settings* group field.

Under the following circumstances, *Search via MAC* may return no data:

1. The MAC address was not entered properly.
2. The PADT network interface card is not properly configured. The PADT requires a fixed IP address.
3. The cable used is not a cross-over cable, or the cable is not connected to the *ETHn* port of the CPU module.
   Take the LEDs on the PADT network interface card and on the CPU module into account.
4. The PADT is equipped with multiple network interface cards.
5. A firewall is active and blocks the access.

- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.
- Copy the values for system ID and rack ID specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `30.0`.
- Copy the values for the IP address specified in the *Module Login* dialog box and enter them in the *Write via MAC* dialog box, in the example: `192.168.0.31`.
- For authorization purposes, enter the default user group data in the *Access Data* group field.
  - Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Click **Write** to configure the connection data for the CPU module.

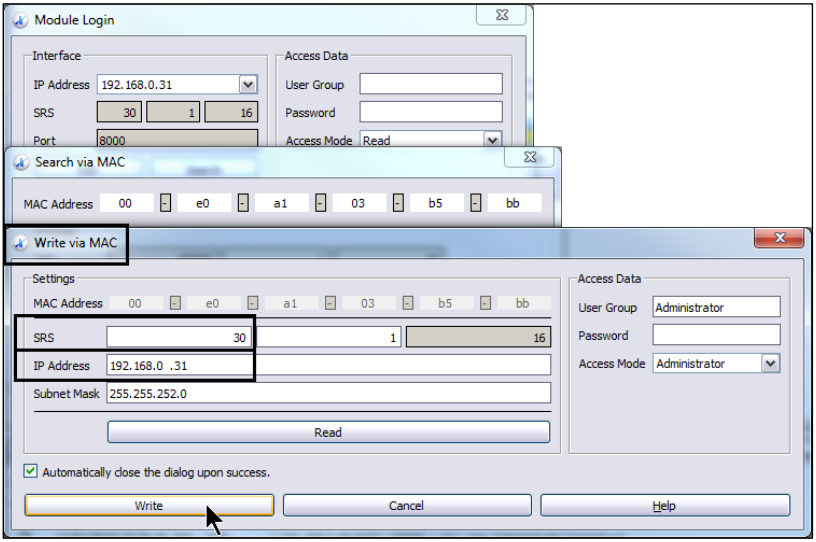


Figure 5-20: Writing the Connection Parameters via MAC

- Click **Cancel** to close the *Search via MAC* dialog box.
- In the *Module Login* dialog box, click the *User Group* field and press **Ctrl+A** to enter the default user.
- Click **Login**. The Control Panel for the module appears.

If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the CPU module read out previously.

The IP address of the processor module in INIT mode is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1…254, except 99).

For the login after writing, the IP address of the PC must match the network of the new IP address.

2. Step: Performing a CPU factory reset without resetting the connection parameters

- Select **Online, Maintenance/Service, Reset Module Factory Settings** from the menu bar. The *Reset Module Factory Settings* appears.
- Untick the **IP Address** and **System ID** and click **OK**. This clears all settings and configurations on the CPU module, except for the IP address and the system ID. This step is recommended whenever the CPU module may contain unknown data.

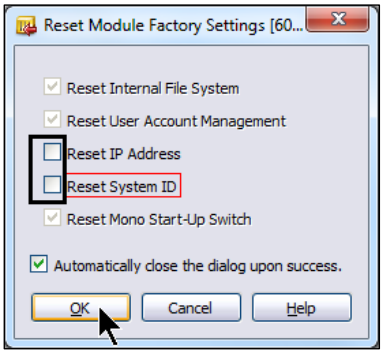


Figure 5-21: Factory Reset

3. Step: Starting mono operation

To simplify start-up, HIMA recommends temporarily setting the system to *Mono*.

If a system is only equipped with one CPU module, only mono operation is possible (in contrast to redundancy operation)! This affects the system availability.

A CPU switch must be activated to allow a system to run in mono operation. This CPU switch takes only effect if a mono project is loaded. Otherwise, the switch is automatically reset.

- Click **Online, Start-Up, Set Mono/Redundancy Operation** from the menu bar.
- In the *Redundancy* field, select `Mono` and click **OK.**

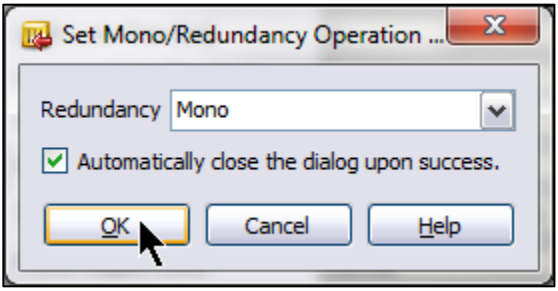


Figure 5-22: Mono Operation

- Close the Control Panel for the module.

4. Step: Checking system operation

- Set the mode switch to RUN. If this is done while the module is installed, the voltage must be switched off and on again.

  After rebooting, the RUN LED blinks yellow and the ESS LED is permanently on. The system is running in system operation and is in the STOP/INVALID CONFIGURATION state.
- Load the configuration as described in Chapter 5.5.

5.4 Starting Up a HIMatrix Controller

This chapter describes how to start up a HIMatrix controller in various applications.

5.4.1 Starting Up a Brand-New HIMatrix F or a System with Invalid Configuration

After booting, a brand-new HIMatrix F is always in the INVALID CONFIGURATION state. In this state, all connection parameters can be written directly at once. This makes it easier to load the resource configuration for the first time.

To prepare for starting up a HIMatrix controller, proceed as follows:

- The device is de-energized.
- Physically disconnect all connections to outputs and communication.
- Switch on the power supply and wait for the initialization process to be completed.
  - F3x: The RUN LED is blinking or lit.
  - F60: The STOP or RUN LED (program, 2nd row) is lit.

  The resource boots with an invalid configuration:
  - F30, F35: The RUN and Fault LEDs are blinking.
  - F60: The RUN LED is off, the STOP and Fault LEDs are blinking.

If the situation is as described above, continue with the following steps. If the Fault LED is off, a valid configuration has already been loaded. In this case, continue with Chapter 5.4.2.

- Connect the programming and debugging tool (PADT) to the controller using an Ethernet cable.
- Start SILworX and open the project.

To set the connection parameters for a HIMatrix controller, proceed as follows:

- Open the context menu of the resource whose parameters should be set.
- Click **Online**. The *System Login* dialog box appears.
- Make sure to select the IP address of the CPU via the pull-down menu.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the dialog box such that the connection data in the login dialog box is visible.
- In the *MAC Address* field, enter the MAC address of the device. The MAC address is specified on a label on the housing.
- Click **Search**. The current IP address, subnet mask and SRS are read out and displayed in the *Settings* group field.
- Click **Change**.
- Move the *Write via MAC* dialog box such that the *System Login* dialog box is visible.
- Change the values for IP address, subnet mask and system ID in accordance with the CPU settings configured in the project.
- For authorization purposes, enter the default user group data in the *Access Data* group field.
  - Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.

- Click **Write** to configure the Ethernet settings for the device.

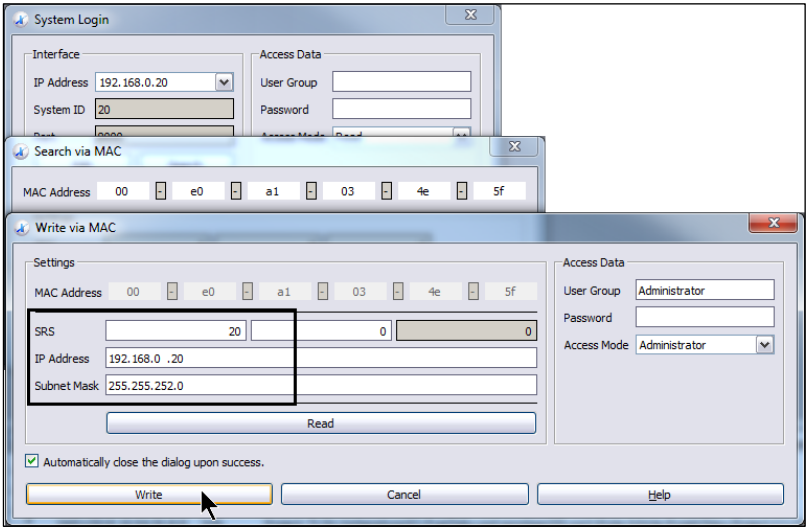


Figure 5-23: Writing the Connection Parameters

If writing via MAC fails, check whether the PADT IP address is in the same network as the IP address of the CPU module read out previously.

The factory setting for the IP address of the CPU module is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1 … 254, except 99).

For the login after writing, the IP address of the PC must match the network of the new IP address.

If the data specified for the default user group are not accepted, a user management scheme was configured in the device and administrator data specific to this scheme must be used.

If no data is known, the HIMatrix must be reset to the factory settings, see Chapter 5.4.4.

- For control purposes: In the *Search via MAC* dialog box, click once again **Search** and read back the data. Compare the data with the values in the project.
- Select **Cancel** to close the *Search via MAC* dialog box.
- To load the configuration, go to Chapter 5.5.3 and log in.

5.4.2 Starting Up a HIMatrix F with Valid Configuration

If a valid configuration has already been loaded, the Fault LED is off.

To log in to the system and change the system ID, proceed as follows:

- Select the resource name in the structure tree and click **Online** on the Action Bar. The *System Login* dialog box appears and displays the Ethernet parameters in accordance with the project settings.
- Click **Search**. The *Search via MAC* dialog box appears.
- In the *MAC Address* field, enter the HIMatrix MAC address. The MAC address is specified on a label on the controller.
- Click **Search**. The current IP address, subnet mask and SRS are read out and displayed in the *Settings* group field.

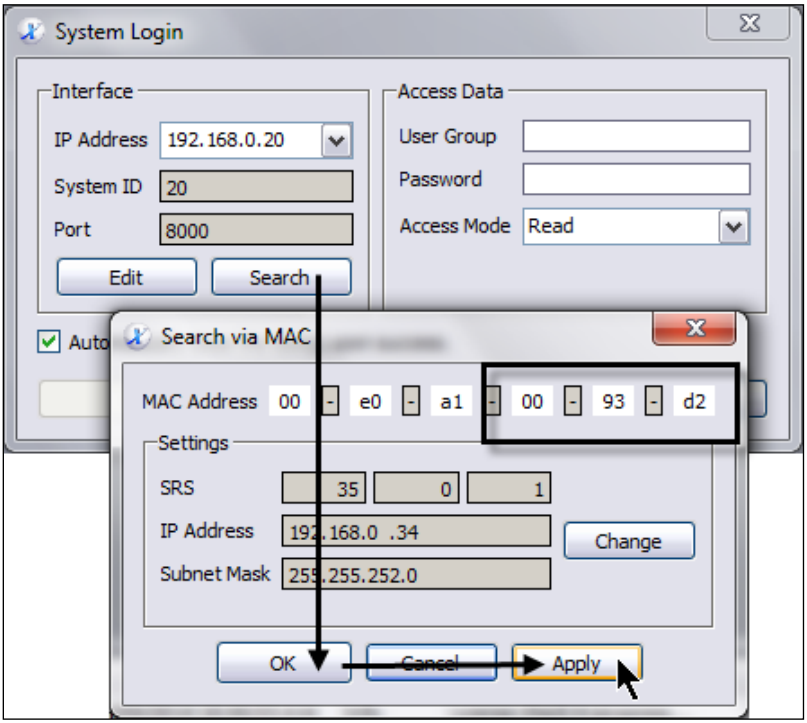


Figure 5-24: Searching the Ethernet Parameter via MAC

- Note down the IP address. This will be useful later on when loading.
- Click **Apply**. The read-out data is entered in the *System Login* dialog box.
- For authorization purposes, enter the data for the default user group in the *Access Data* group field: Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.

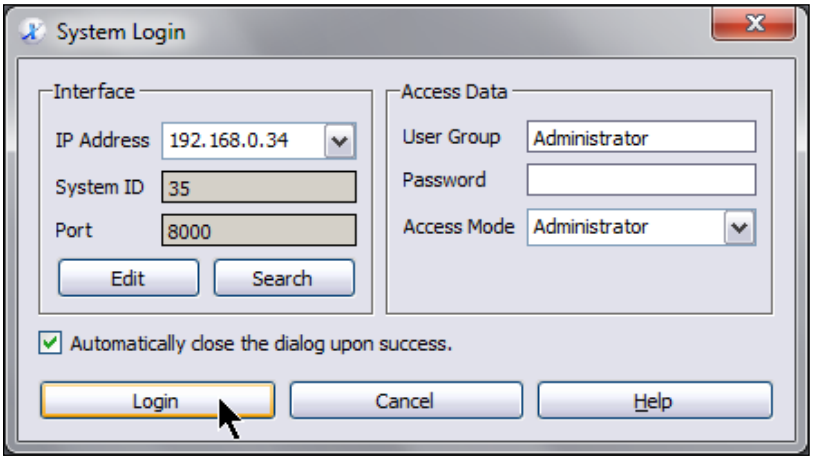


Figure 5-25: System Login

- Click **Login**.

If the data specified for the default user group is not accepted, a user management scheme has already been configured on the controller. The administrator data defined in this user management scheme must be used for the login.

If this information is unknown, the controller must be reset to the factory settings, see Chapter 5.4.4. Then continue as specified for “brand-new” systems.

To set the system ID, proceed as follows:

- Ensure that the system is in the STOP state. Otherwise, the system ID cannot be modified.
- If necessary, click the **Resource Stop** button on the Symbol Bar.

Figure 5-26: Stopping the Resource

- Open the **Online** menu, select **Start-Up** and then click **Set System ID**. The *Set System ID* dialog box appears. The current system ID is displayed in the header of the dialog box.
- Enter the required system ID (the value in the squared brackets behind the resource name) and click **OK**. Changing the system ID disrupts the communication between PADT and controller since the login was performed with another system ID (which is now overwritten).

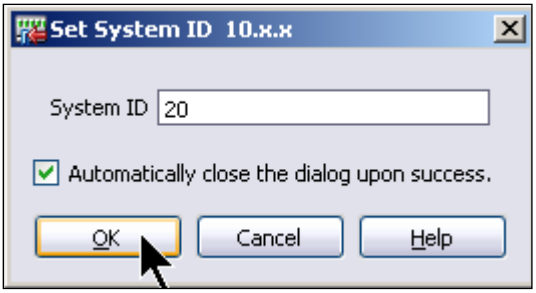


Figure 5-27: Setting the System ID

- Close the Control Panel and continue with Chapter 5.5.

5.4.3 Starting Up a HIMatrix Remote I/O

A HIMatrix remote I/O (RIO) cannot store a configuration permanently, but receives it from the parent resource whenever it is initialized.

For a remote I/O, only configure the connection parameters. Then, connect the remote I/O to the corresponding parent resource.

- The remote I/O is de-energized.
- Disconnect the communication connections.
- Switch on the power supply and wait for the initialization process to be completed (the RUN LED is blinking).
- Connect the PADT to the remote I/O using an Ethernet cable.
- Start SILworX and open the project.
- In the structure tree, open the resource directory where the remote I/O was configured.
- Right-click **Hardware** and select **Online** from the context menu. The *System Login* dialog box appears.
- In the *Interface* group field, click **To Module Login.** The hardware online view appears.
- Right-click the CPU module icon and select **Detail View** from the context menu. The *Module Login* dialog box appears.
- In the *Interface* group field, select **Search.** The *Search via MAC* dialog box appears.
- Move the *Search via MAC* dialog box such that the connection data in the login dialog box is still visible.
- In the *MAC Address* field, enter the remote I/O MAC address. The MAC address is specified on a label on the housing.

- Click **Search**. The current IP address, subnet mask and SRS are read out and displayed in the *Settings* group field.
- Click **Change**.
- Move the *Write via MAC* dialog box such that the *Module Login* dialog box is visible.
- Change the values for IP address, subnet mask, system ID and rack ID in accordance with the settings configured in the project.

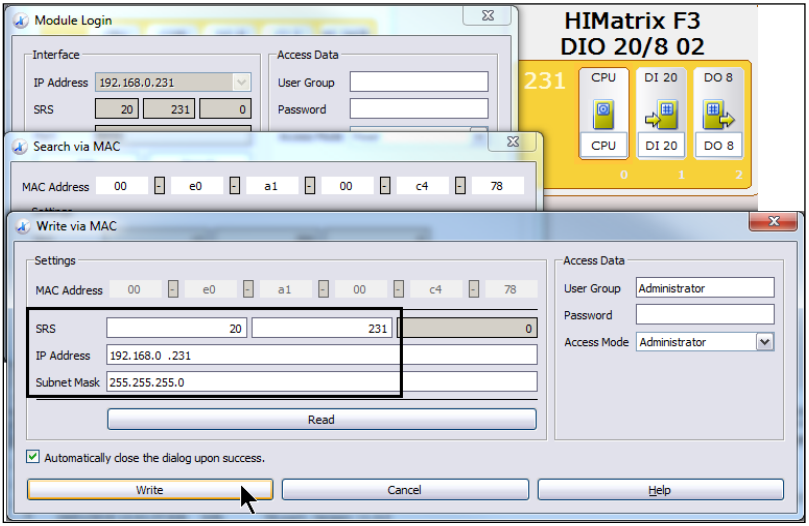


Figure 5-28: Writing the Connection Parameters

- For authorization purposes, enter the data for the default user group in the *Access Data* group field: Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Click **Write** to configure the connection parameters for the remote I/O.

If the data specified for the default user group are not accepted, a user management scheme was configured on the remote I/O and administrator data specific to this scheme must be used.

If no data is known, the remote I/O must be reset to the factory settings, see Chapter 5.4.4.

If writing via MAC fails, check whether the PADT IP address is located in the same network as the IP address of the CPU module read out previously.

The factory setting for the IP address of the CPU module is 192.168.0.99. The IP address of the PADT without routing must be set to `192.168.0.x` (where x = 1…254, except 99).

For the login after writing, the IP address of the PC must match the network of the new IP address.

- For control purposes: In the *Search via MAC* dialog box, click once again **Search** and read back the data. Compare the data with the values in the project.
- Connect the remote I/O to the parent resource using an Ethernet cable.

As soon as the parent resource has recognized the remote I/O, the PROG LED for the remote I/O is lit briefly and the remote I/O enters the same state as the parent resource.

5.4.4 Resetting the HIMatrix to the Factory Settings

The reset to the factory settings is only required if a user management scheme is loaded in the controller and its administrator accounts are unknown.

A reset temporarily activates the following factory settings.

Parameters	Value
Standard IP	192.168.0.99
Standard SRS	60000.0.X (60000.200.x for remote I/O)
Standard login	Administrator, empty password

Table 5-4: HIMatrix Settings after a Factory Reset

The reset key for compact controllers and remote I/Os is located on the controller's upper side and can be accessed through a small opening next to the Ethernet ports.

For the F60, the reset key is located behind the front plate.

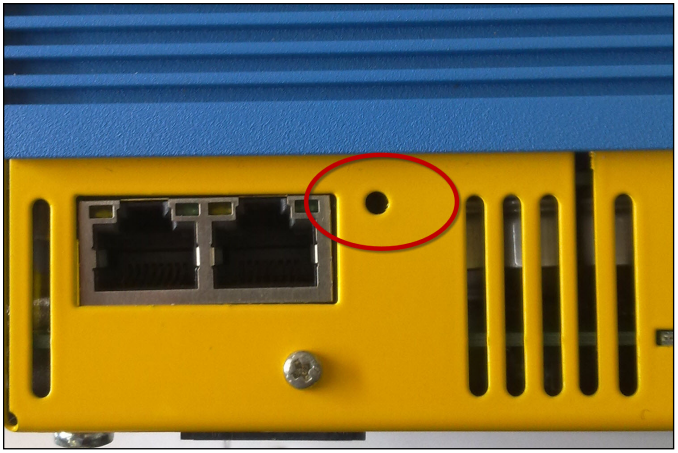


Figure 5-29: Reset Key on HIMatrix F

To perform a system reset, proceed as follows:

- Switch off the power supply of the controller.
- Press and hold the reset key. Use a non-conductive pin and apply just a little pressure. Excessive pressure may damage the reset key!
- Press and hold the reset key while switching on the power supply.
- Press and hold the reset key until the initialization process is completed (compact devices: RUN LED is blinking, F60: STOP LED is ON).

> **i** Since the factory settings do not match the loaded configuration, the system enters the STOP state and the FAULT LED is lit or blinking.
>
> The factory settings are only active until the next booting (without pressing the reset key). After that, the parameters of the last valid configuration apply again.

- Now proceed as described in Chapter 5.4.1.

5.5 Loading and Commissioning a Resource (PES)

This chapter describes the loading procedure during commissioning. Chapter 6.7 (Download/Reload) describes how to load a changed configuration.

5.5.1 Requirements

To load and start a resource, the controller must be started up as described in Chapter 5.2 (HIMax), Chapter 5.3 (HIQuad X) or Chapter 5.4 (HIMatrix). The following requirements must be met:

1. HIMax: The controller must run in system operation and the system ID used in the project must be configured. For initial loading, connect the configured CPU module to the PADT. Later, preferably log in via a COM module.
2. HIQuad X: The controller must run in system operation and the system ID used in the project must be configured. For initial loading, connect the configured CPU module to the PADT. Later, preferably log in via a COM module.
3. HIMatrix: The system ID used in the project must be configured in the controller. For initial loading, connect the CPU module to the PADT. Later, preferably log in via the COM module.
4. SILworX: A project with a resource configuration compiled without errors must be opened in SILworX.

5.5.2 Preparing the System Login

When the resource is loaded for the first time, the configured IP address is not always consistent with the IP address actually active in the system. If necessary, the IP address has to be adjusted in the login dialog box to comply with the IP address active in the controller. Only after this step, a login is possible. The system ID was already configured.

- In the structure tree, select the **Resource** that should be loaded and click **Online** on the Action Bar. The *System Login* dialog box appears.

TO LOG IN WITH THE STANDARD IP ADDRESS, OR A KNOWN IP ADDRESS

- If the IP address has always been set in the previous steps, select the IP address from the drop-down menu.

Or:

- In the *System Login* dialog box, click the **Edit** button. The *IP/SRS* dialog box appears.
- For standard IP address: In the *IP/SRS* dialog box, click the **Default Value** button located on the right, next to the *IP Address* field. The standard IP address is activated for the login.
- For a known IP address: Type the IP address in the data field.
- Click **OK** to adopt the setting.

TO LOG IN WITH AN UNKNOWN IP ADDRESS

If the IP address active in the module is not known, use the MAC address to determine the IP address.

- In the *System Login* dialog box, select **Search** in the *Interface* group field. The *Search via MAC* dialog box appears.
- In the *MAC Address* field, enter the MAC address for the controller. The MAC address is specified on a label on the controller.
- Click **Search**. The connection parameters are read and displayed.
- Click **Apply** to apply the connection parameters in the *System Login* dialog box.

5.5.3 Logging in to the System

To log in to the system, proceed as follows:

- Ensure that a valid IP address is specified in the *Interface* group field.
- For authorization purposes, enter the default user group data in the *Access Data* group field.

  Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Click **Login**. The Control Panel for the resource appears.

5.5.4 Performing the First Download

Due to the previous settings of the connection data, the system is typically in the STOP system state. This state is a requirement for a download and is displayed in the *System Information* group field contained in the Control Panel.

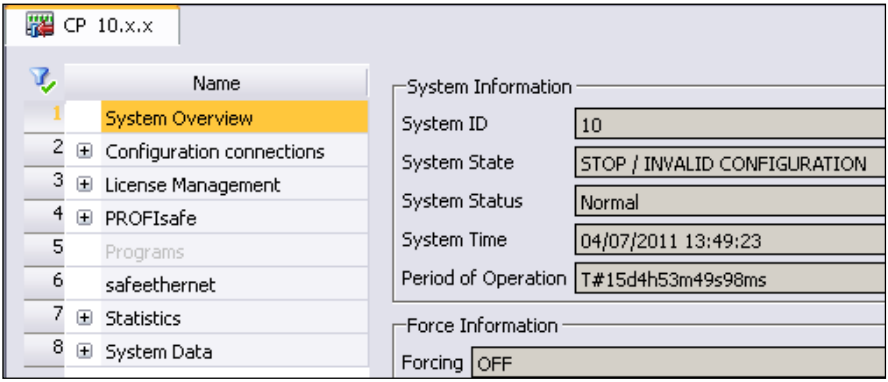


Figure 5-30: Control Panel

- If necessary, click **Resource Stop** on the Symbol Bar.
- Click **Resource Reload/Download** on the Symbol Bar. The *Resource Reload/Download* dialog box appears.

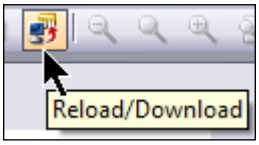


Figure 5-31: Resource Download

- Activate the option *Create Project Archive after Loading*
- Click **Download** to start the loading process.

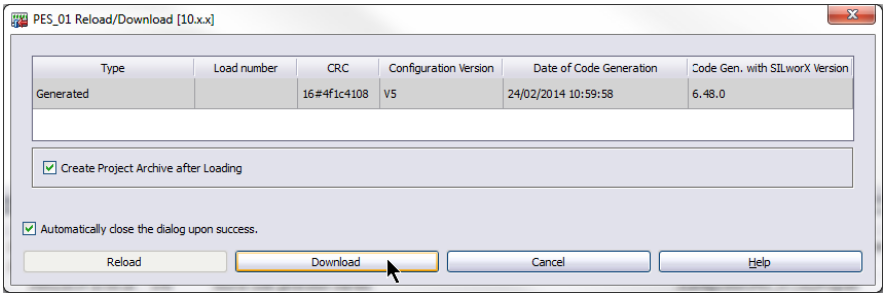


Figure 5-32: Starting the Download

- If there is no loss of connection after the download, the project can be archived immediately. For further details, refer to Chapter 8.1.
- Perform a cold start by selecting **Online** in the menu and then clicking **Resource Cold Start**. The CPU enters the RUN state. Also refer to the System Information specified on the Control Panel.

5.5.5 Connection Loss after a Download

The IP addresses configured in the project are active after a successful download. If the new IP address of the resource and the IP address used during the login are not identical (quite normal for the first load procedure), the communication between PADT and resource is interrupted.

The connection loss is also displayed in the logbook.

No project archive has been created due to communication loss. The archive will be created at a later point in time. For further details on *Archiving*, refer to Chapter 8.

5.5.6 Resource Cold Start

- If the connection is lost after performing a download, log in again. To this end, click **Connect** on the Symbol Bar. The *System Login* dialog box appears.

Figure 5-33: Establishing the Connection

- In the *Interface* group field, select the required IP address from the drop-down list.
- Click **Login**.
- Click **Resource Cold Start** on the Symbol Bar. The CPU enters the RUN state. Also refer to the *System Information* specified on the Control Panel.

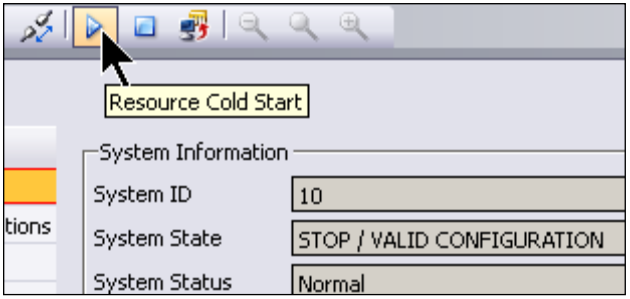


Figure 5-34: Starting the Resource

5.5.7 Important Final Actions

After loading for the first time, it is useful to carry out some important final actions.

5.5.7.1 Synchronizing the Redundant CPU

If the HIMax or HIQuad X system was configured for more than one CPU, insert the redundant CPU module now. This module is then automatically synchronized and enters the RUN state.

5.5.7.2 Creating the Project Archive

Create a project archive in a separate directory after every load procedure if the archive has not been created automatically. Refer to Chapter 8 for detailed instructions.

5.5.7.3 Setting the Date and Time

As long as no time synchronization over SNTP is used, configure the date and time for the resource after the download.

- Log in to the resource as described in Chapter 5.5.3.
- Select **Online, Start-Up, Set Date/Time** from the menu bar. The *Set Date/Time* dialog box appears.
- The dialog box displays the date and time of the PADT. If required, change these settings in accordance with the specific requirements.
- Click **OK** to send the data to the resource.

The time is calculated in UTC based on the PADT time and time zone configured in the Windows operating system.

In the resource, the time is stored as UTC.

6 Online Functions

A large number of functions can be performed in SILworX after a configuration was loaded into a resource.

The following elements from the resource structure tree can be displayed online:

Resource	Control Panel for system overview, diagnosis or resource load procedure.
Program	Logic of the user program.
Hardware	Hardware configuration with diagnosis, module handling.
Force Editor	List of all global and local variables with their current values.

6.1 Opening a Project

To open a project, it must be available in an editable form. Archives have to be opened using *Restore*. This is described in Chapter 8.4.

To open a project, proceed as follows:

- Click the **Project, Open** menu functions. The *Open Project* dialog box appears.

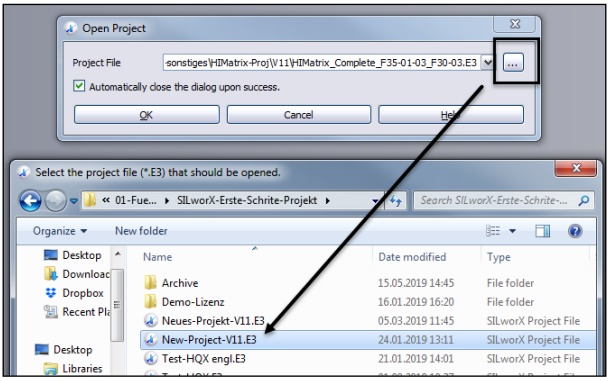


Figure 6-1: Selecting the Project File

- Select the *project file* that should be opened and click **Open**.
- Click **OK**.

6.2 Logging in to the System

- Select the resource name in the structure tree and click **Online** on the Action Bar. The *System Login* dialog box appears.
- In the *Interface* group field, select the IP address of the module used to physically connect the PADT to the resource from the drop-down list. If the *Standard Interface* option is selected for the resource (see Chapter 4.6.5.1), the IP address is marked as *Standard*.
- For authorization purposes, enter the user group data in the *Access Data* group field.
  - If a user management scheme was configured, the user group, password and access mode specific to this scheme must be used.
  - For authorization purposes if no user management scheme was configured, enter the data for the default user group in the *Access Data* group field:

    Click the *User Group* field and press **Ctrl+A**. The user group and access type are filled in automatically.
- Then click **Login**. The Control Panel appears after a successful system login.

6.2.1 Analysis of a Failed System Login

If the login procedure was not successful, proceed as follows:

1. Logbook: Check the messages in the logbook.
2. IP address: Make sure that the IP address of the PADT is in the same network as the IP address of the connected module. The PADT requires a fixed IP address.
3. Active firewall: If a firewall is active, verify the settings and configure the firewall in accordance with the application.
4. Several network interface cards: If there are several network interface cards in the PADT, the network interface cards must be configured for different subnets. Make sure that the IP addresses are on different networks or use routing.
5. Cable: If required, use a cross-over cable to directly connect the PADT to the system bus module.

6.3 System Overview

After a successful system login, the Control Panel appears with the *System Overview*. The system overview provides a summary of the most important data and settings for a resource.

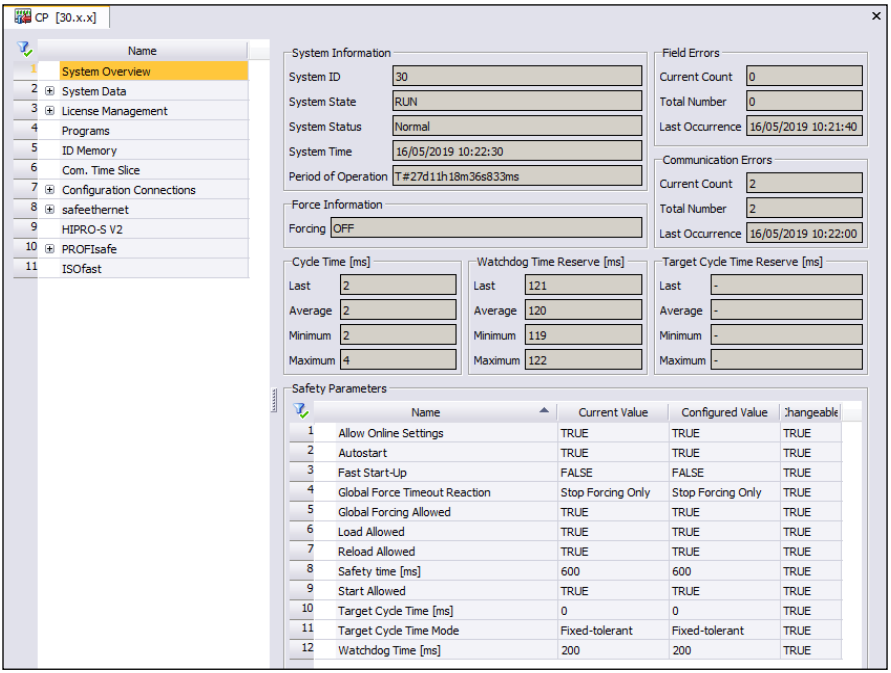


Figure 6-2: Control Panel

For instance, the Control Panel provides the following information:

System state and status	Safety parameters
Force status	State of the programs
Field faults and communication errors	State of the existing safe**ethernet** connections
Cycle time	Activated or required licenses

6.4 Programs in the Online View

After a system login (see Chapter 6.2), a program can be opened in the online view, e.g., to visualize the logic and the current values.

6.4.1 Opening the Online View

To display the online view of the program running in a resource, proceed as follows:

- In the structure tree, open the resource required (in the example: *PES_01*).
- Select the required program name located under the resource and click **Online** on the Action Bar. The program's online view appears.

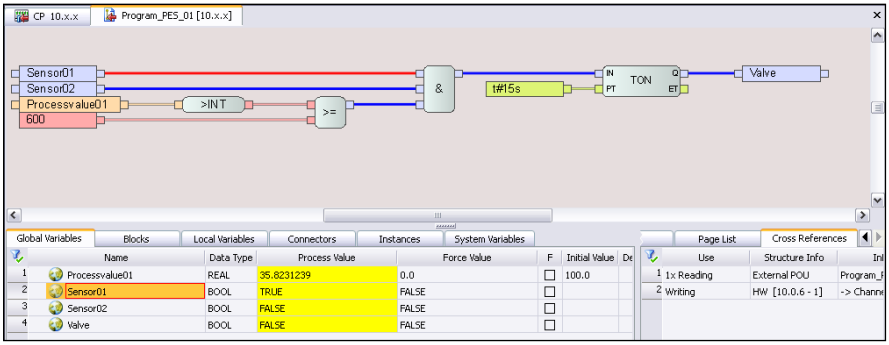


Figure 6-3: Online View of the Program

The online view provides an overview of the current process and force values.

- The states of binary variables appear with colored connection lines: FALSE = blue, TRUE = red.
- The values of variables are displayed in the tables of the Object Panel.
- Right-click the drawing area and select *Activate Automatic OLT Field* from the context menu to visualize the automatic online test fields next to the variables and POU outputs.

6.4.2 Using Free OLT Fields

Free online test fields can be created in the logic's online view to summarize multiple variables within one worksheet.

This allows variables used at a different position in the logic to be displayed.

- Click a variable in the Object Panel and drag it onto a free space in the logic. The name of the variable and the value are displayed in a free OLT field.
- If necessary, repeat the previous step to create an overview of multiple variables.
- Save the changes if the OLT fields should be kept after closing the online view. This action does not affect the online capability or the CRC value.

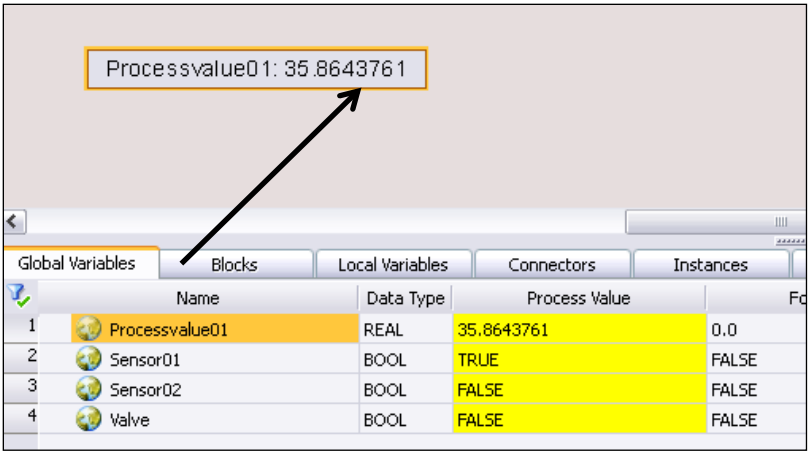


Figure 6-4: Free OLT Field

6.4.3 Navigation in the Logic

In order to facilitate orientation within the logic of extensive user programs, SILworX provides three tabs with different functions in the navigation window:

1. Logic (Overview).
2. Page list.
3. Cross-references.

6.4.3.1 The Logic Tab

You can use the mouse wheel to change the zoom factor of the overview while holding down the **Ctrl** key. The red frame marks the portion of the logic represented in the drawing area. Click on the part of a worksheet on which you want to center the frame.

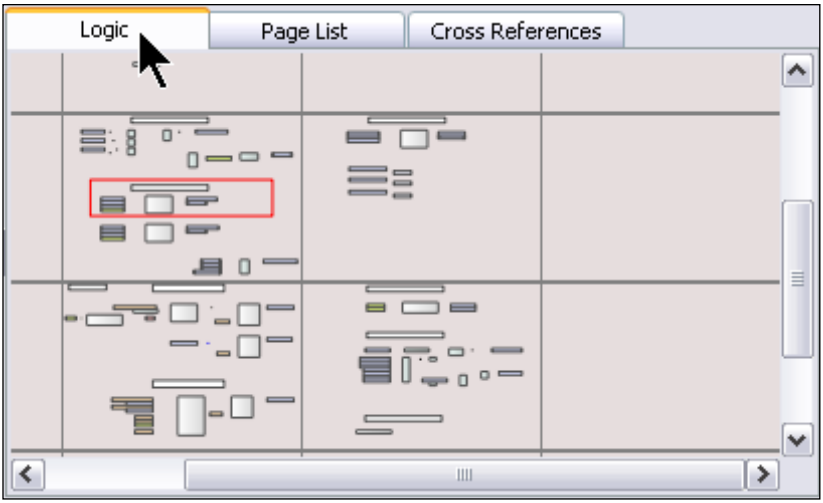


Figure 6-5: Overview of the Logic

6.4.3.2 The Page List Tab

The **Page List** tab lists all worksheets contained in the logic. If page name and description were specified when editing the logic, they are displayed next to the page position.

A worksheet can be selected and aligned in the drawing area at its upper left edge.

- Double-click a page position or select **Go to…** from the context menu.

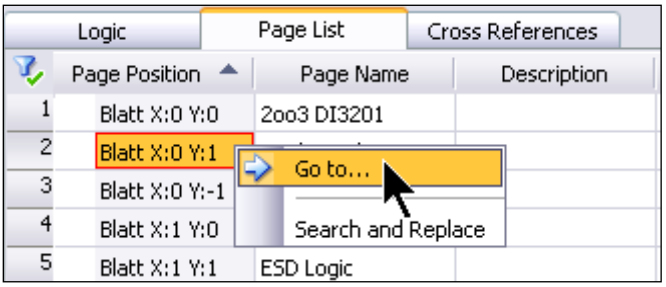


Figure 6-6: Page List

6.4.3.3 The Cross-References Tab

The **Cross-References** tab displays all uses of the global and local variables. The element selected in the Object Panel determines which use applies to the variable.

Cross-references for local variables:

The **Local Variables** tab of the Object Panel contains all variables used in the current logic block (POU).

- Select the required variable from the list. Long lists can be filtered and sorted, see Chapter 3.2.5 and Chapter 3.2.6.
- In the *Cross-References* tab, double-click a *Use* in the local POU or select **Go to…** from the context menu. The location in which the variable is used is centered in the drawing area.

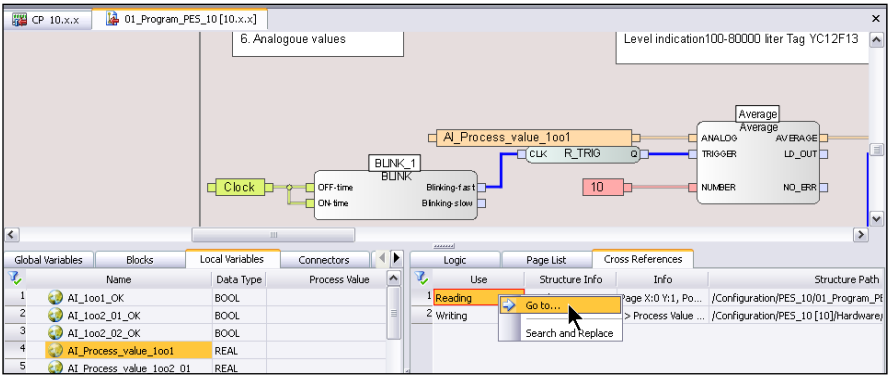


Figure 6-7: Cross-References for Local Variables

Cross-references for global variables:

Since global variables are used in various locations within a project, the cross-references associated with them are not only displayed in the program, but also in the following editors:

- Global Variable Editor.
- Protocol Editor.
- Hardware Editor.
- FBD Editor.

The cross-references are available wherever the list of global variables is displayed. They are always handled in the same manner.

- Select the required variable from the list. Long lists can be filtered and sorted, see Chapter 3.2.5 and Chapter 3.2.6.
- In the *Cross-Reference* tab, double-click a *Use* of the global variable or select **Go to…** from the context menu. The corresponding POU appears either online or offline.
- Double-click the local use. The location in which the variable is used is centered in the drawing area. Depending on the use of the currently open editor, the POU is displayed online or offline.

6.5 Forcing

SILworX distinguishes between two types of forcing:

1. Global forcing.
2. Local forcing.

Individual enable procedures are defined in SILworX for both types of forcing, and the information is displayed in separate tables.

The following chapters describe how to use global forcing. The procedure for local forcing is identical. However, only variables of type *VAR* can be forced locally.

⚠ WARNING

Personal injury possible!

Forcing is always a safety-relevant intervention in the operation of a safety controller.

Observe the relevant notices specified in the safety manual!

6.5.1 Global Forcing Allowed (Force Enable)

Global Forcing allowed is a resource property. If this parameter is not active, global forcing is not possible.

Global forcing allowed is loaded into the controller as part of the resource configuration. If you change this setting afterwards, you have to perform a new code generation, which results in a change of the CRC! Then you have to load the resource again.

The resource properties can be displayed and configured as follows:

- In the structure tree, click the **Resource** element and select **Properties** on the Action Bar. The *Resource Properties* dialog box appears.

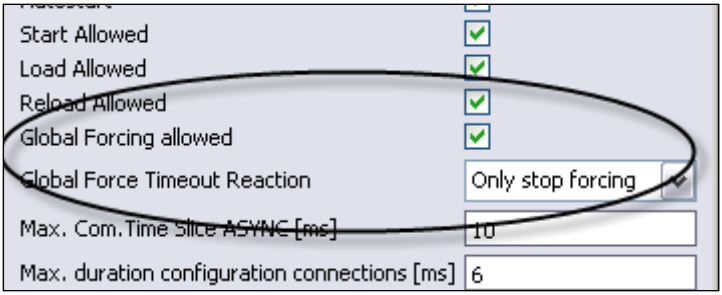


Figure 6-8: Global Forcing Allowed

6.5.2 Local Forcing Allowed (Force Enable)

Local Forcing Allowed is a program property. If this parameter is not active, local forcing is not possible.

The *Local Forcing Allowed* property is loaded into the controller as component part of the resource configuration. If this setting is changed subsequently, a new code generation must be performed, which results in a change in the CRC! Afterwards, the resource must once again be loaded.

The program properties can be displayed and configured as follows:

- In the structure tree, click the **Program** underneath the resource and then select **Properties** on the Action Bar. The dialog box for the program properties appears.

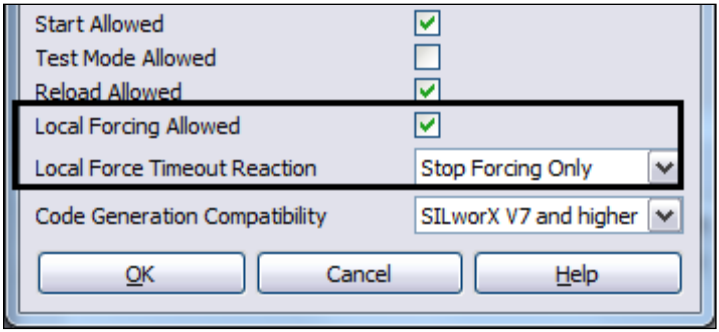


Figure 6-9: Local Forcing Allowed

6.5.3 System Variable Force Deactivation

In addition to the *Global Forcing Allowed* and *Local Forcing Allowed* parameters, (global and local) forcing can also be locked using the *Force Deactivation* system variable. Forcing can then be deactivated using, e.g., a key switch.

In the Hardware Editor, double-click the *HIMatrix* system name or, for HIMax and HIQuad X, the gray rack area (see Chapter 4.6.2) to connect the *Force Deactivation* system variable to a global variable.

The *Force Enables* and *Force Deactivation* states are displayed in the Force Editor.

6.5.4 Force Editor

Select the **Forcing, Force Editor** menu functions to open the Force Editor. The menu is only available after a system login. If required, a system login has to be performed via **Resource - Online**, **Hardware - Online** or **Program - Online**.

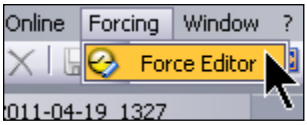


Figure 6-10: Opening the Force Editor

The Force Editor provides an overview of the most important force information:

Force state (stopped, started)	Force timeout reaction
Individual force switch set (yes, no)	Forcing allowed (resource property)
Remaining force duration	Force deactivation (system variable)

Table 6-1: Important Force Information

6.5.4.1 Checking the Force Status

Prior to changing the force settings, ensure that the system is not influenced by unintentional changes. Check the following points:

<table>
<tr><th colspan="4">What is the force state?</th></tr>
<tr><td colspan="2">Started</td><td colspan="2">Stopped</td></tr>
<tr><td colspan="2">Have individual force switches been set? (Field F)</td><td colspan="2">Have individual force switches been set?</td></tr>
<tr><td>Yes</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="2" rowspan="2">For details on how to proceed to force an already forced system, refer to Chapter 6.5.9.</td><td>Reset the force data as follows:
▪ In the Forcing menu, click Stop Global Forcing. The Stop Global Forcing dialog box appears.
▪ Select the Reset Force Data option and click OK to confirm.
Configured force switches and force values are reset in the system.</td><td>No action</td></tr>
<tr><td colspan="2">No action</td></tr>
</table>

Table 6-2: Determining the Force Status

6.5.5 Editing Force Data

Force data can be edited in SILworX using various functions:

1. From within the Force Editor.
2. From within the logic.
3. From within watchpages.

6.5.5.1 Editing the Force Data in the Force Editor

- Log in to the system, see Chapter 6.2.
- Select the **Forcing, Force Editor** menu functions to open the Force Editor.
- To edit the force data of a single variable, double-click the variable in the table. The *Edit Global Force Data* dialog box appears.

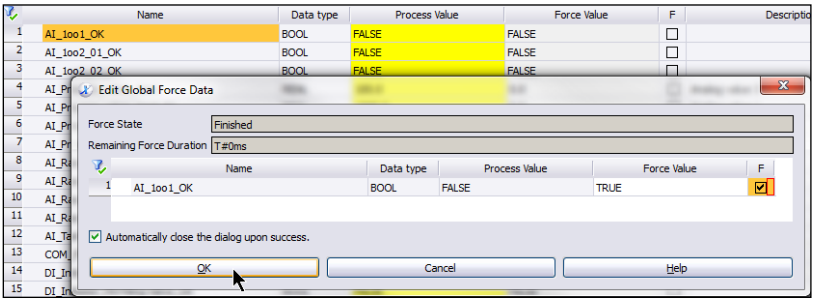


Figure 6-11: Editing the Force Data of Individual Variables

- To edit the force data associated with multiple variables, press and hold the **Ctrl** key while clicking the variables listed in the table. Right-click one of the selected variables and select **Edit Global Force Data**. The *Edit Global Force Data* dialog box appears.

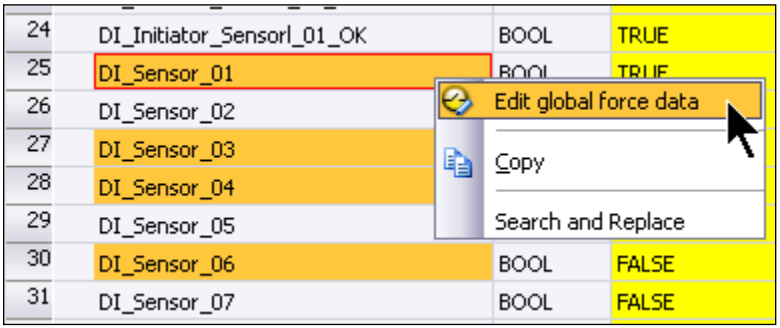


Figure 6-12: The Edit Global Force Data Menu Function

- Enter the force value in the *Force Value* column. If BOOL variables are used, 1 can also be entered for TRUE and 0 for FALSE.
- Activate the individual force switch in column F.
- Click **OK**.

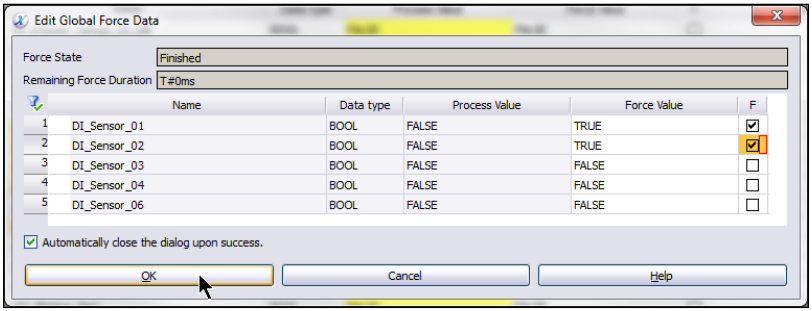


Figure 6-13: Editing Force Data for Multiple Variables

6.5.5.2 Editing the Force Data in the Logic

- Log in to the system (see Chapter 6.2).
- In the structure tree, open the resource required.
- Select the required program name located under the resource and click **Online** on the Action Bar. The program's online view appears.
- Double-click a variable in the logic. The *Edit Global Force Data* dialog box appears.

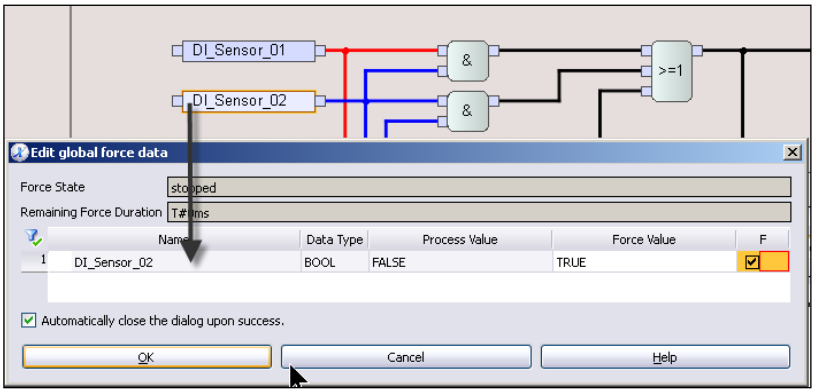


Figure 6-14: Editing Force Data

Note that forcing cannot be performed in OLT fields.

- Activate the individual F force switch for the selected variable and click **OK**. In a variable prepared to be forced, a yellow switch symbol appears on the upper left-hand side of the variable symbol. As soon as forcing begins, this variable uses the force value instead of the process value.

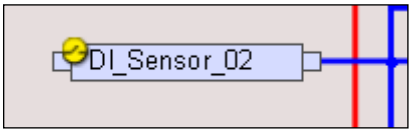


Figure 6-15: Variable with Activated Force Switch

6.5.6 Starting and Stopping Forcing

The menu for starting and stopping forcing is only active if the Force Editor has the focus, i.e., it is the active window.

6.5.6.1 Starting Forcing

As soon as forcing has started, all variables with activated force switch adopt the configured force value!

⚠ CAUTION

Only start forcing after ensuring that the force values and F force switches were properly set.

Check the setting as follows:

- In the Force Editor, click the filter symbol on the upper left-hand side of the table. An additional row with filter options appears below the column title.
- Filter the F column based on the active checkboxes. Only the variables with set force switches are displayed.

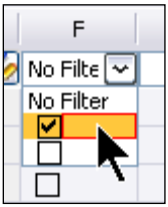


Figure 6-16: Filtering for Activated Force Switches

- Check the variables.
- Select the **Forcing, Start Global Forcing** menu functions.

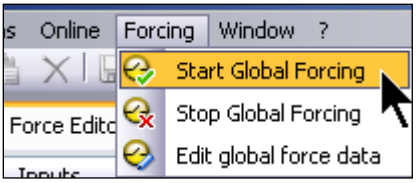


Figure 6-17: The Start Global Forcing Menu Function

- If required, define a force duration in the *Force Duration* field and click **OK**.

Figure 6-18: Starting Forcing

After starting forcing, the *Force State* setting in the Force Editor changes from *Stopped* to *Started*. The values used in the user program are displayed in yellow in the Force Editor.

Force values are only used for variables with active force switches.

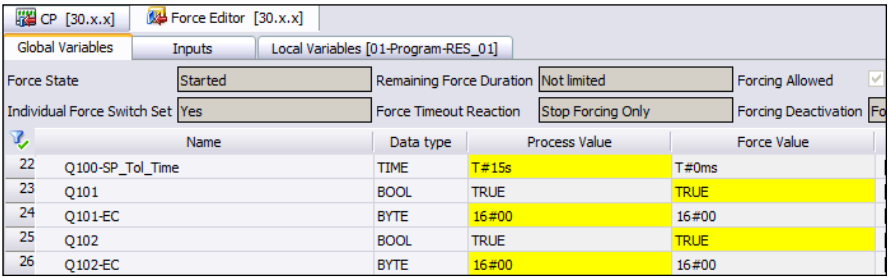


Figure 6-19: Forced Variables

6.5.6.2 Stopping Forcing Manually

If no force duration is configured when forcing is started, forcing must be stopped manually.

- In the **Forcing** menu, click **Stop Global Forcing.** The *Stop Global Forcing* dialog box appears.

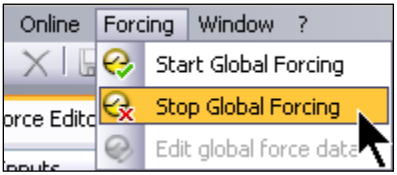


Figure 6-20: The Stop Global Forcing Menu Function

- Activate the **Reset Force Data** option to reset all force values and force switches after stopping forcing. After clicking **OK**, the force state changes to *Finished*.

  If the force data are not reset, the force state remains set to *Prepared*.
- Click **OK** to stop forcing.

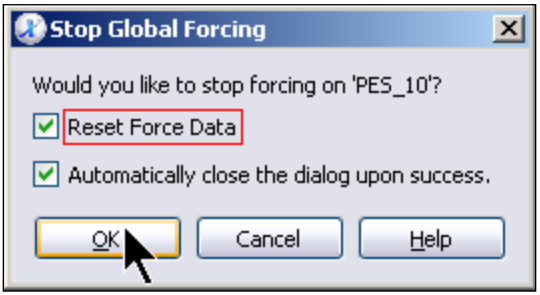


Figure 6-21: Stopping Forcing and Resetting the Force Data

6.5.7 Saving Force Selections and Settings in Watchpages

For repeated tests, it can be useful to predefine certain force settings and use them as needed. This is done using watchpages. First, a *Watchpages* subfolder has to be created in the structure tree. Proceed as follows:

- In the structure tree, select the resource for which watchpages should be created.
- Click **New** on the Action Bar. The *New Object* dialog box appears.
- In the *New Object* dialog box, select the *Watchpages* element and click **OK**.

To create individual watchpages, proceed as follows:

- In the structure tree, select the *Watchpages* element and click **New**.
- For global forcing, select **Watchpages (Global Forcing**). Assign a useful name for the watchpage and click **OK.**

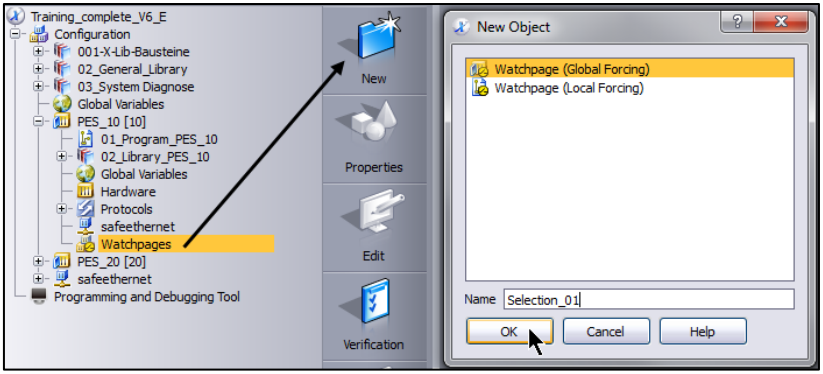


Figure 6-22: Selecting the Watchpage Type

- In the structure tree, select the new watchpage element and click **Online** on the Action Bar.
- Drag the required variables from the Object Panel onto the watchpage.

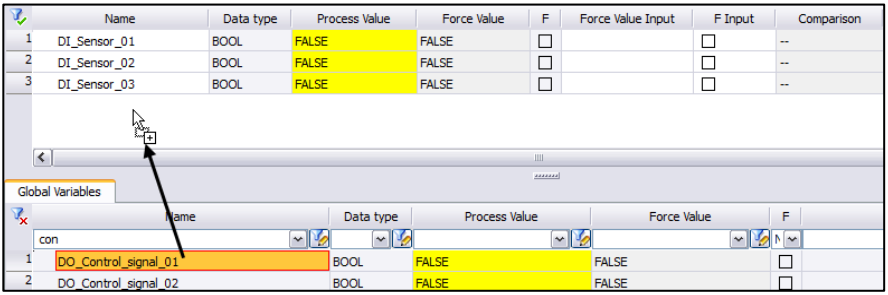


Figure 6-23: Defining a Watchpage

- Check the current values and settings in the gray columns.
- The required settings are configured in the *Force Value Input* and *F Input* columns.
- Click the **Save** button on the Symbol Bar to save the watchpage and all the configured settings. You can create as many watchpages as required.

TIP Sometimes, it can be useful to save a watchpage with set and one with reset force values.

A reset is possible if at least an entry exists in the *Force Value Input* column. No entry does not signify FALSE or 0.

6.5.8 Forcing using a Watchpage

To send the force data of a watchpage (see Chapter 6.5.7) to a controller, proceed as follows:

- In the structure tree, select a watchpage and click **Online** on the Action Bar.
- If required, edit the *Force Value Input* and *F Input* columns.
- In the watchpage, select the lines with the force data to be sent.
- Open the context menu and click **Send Selected Force Data**. Variables with no entries in the *Force Value Input* column are not sent, even if they were selected.

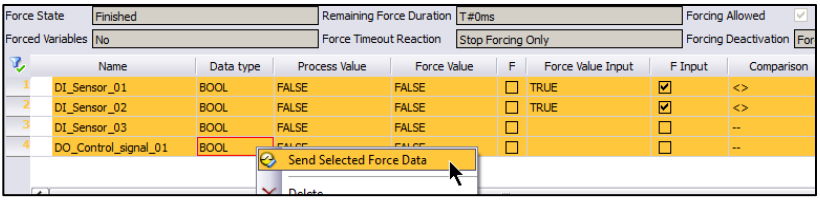


Figure 6-24: The Send Selected Force Data Menu Function

In the *Send Selected Force Data* dialog box, force data can no longer be edited. It can only be checked, or the action can be aborted.

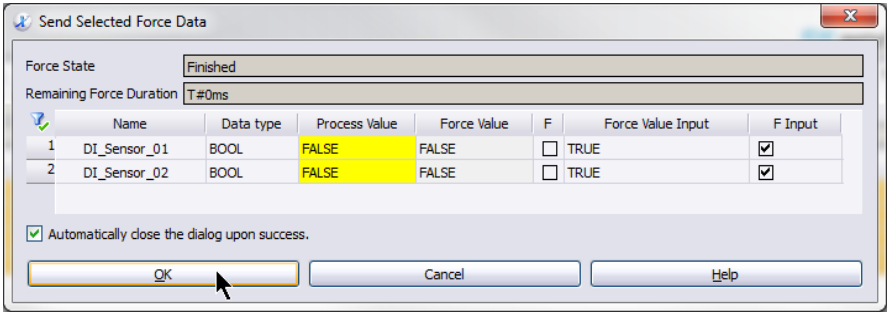


Figure 6-25: Sending Force Data

Forcing is started in the Force Editor as described in Chapter 6.5.6.

6.5.9 Forcing an Already Forced System

The displayed status helps determining whether a system has already been forced when the Force Editor is opened.

> Forcing is active when *Force State* is set to *Started* and *Individual Force Switch Set* is marked with *Yes*.

6.5.9.1 Backing up Force Data

Save the force data to restore the current force state to a later point in time. Proceed as follows:

- Create a new watchpage as described in Chapter 6.5.7 and assign a useful name.
- In the structure tree, select the new watchpage element and click **Online** on the Action Bar.
- Press **Ctrl+A** to select all the variables in the Object Panel.

- Drag all variables from the Object Panel onto the watchpage.
- Click the *F* column title. In doing so, all forced variables are sorted at the table end.

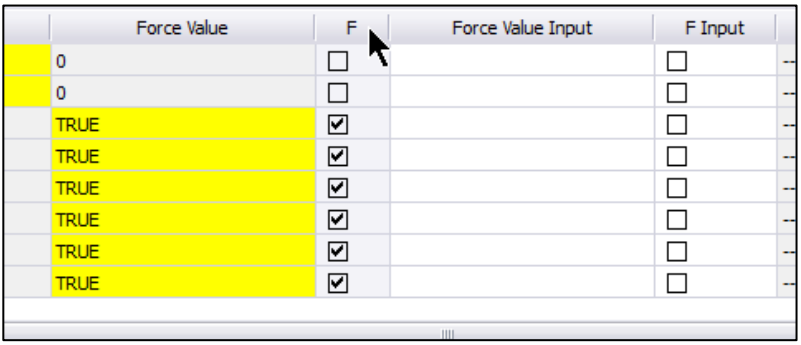


Figure 6-26: Sorting by Forced Variables

- Select the *Force Value* in the last row.
- Scroll the right scroll bar to the top.
- Press and hold the shift key while clicking the first entry in the *F* column. The *Force Value* and *F* columns are now selected.
- Right-click one of the selected lines and select **Copy** from the context menu.
- Click the first row in the cell for *Force Value Input* and select **Paste Contents**. Force values and force switches are inserted in the columns.
- Save the watchpage.

After you have saved the previous force data, you can activate the additional force data. The required steps are described in Chapter 6.5.5.1. from Section 6.5.5.1.

6.5.9.2 Restoring the Force State

To restore the original force state, proceed as follows:

- Open the watchpage with the backed up force state.
- Click twice the F column title to sort the data by ticked checkboxes.
- Select the rows that contain the character string <> in the column *Comparison*.
- Select **Send Selected Force Data** from the context menu.

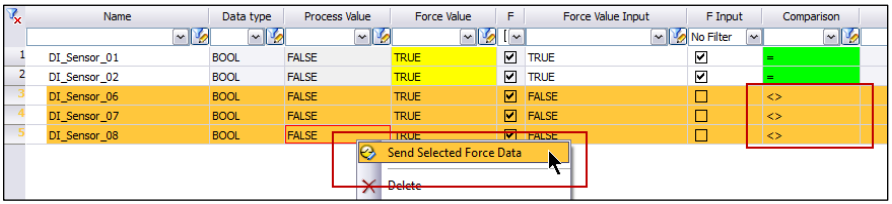


Figure 6-27: Adjusting the Force Values of a Backup

6.6 Diagnostics

The Control Panel offers a general system overview.

The various editors available in the online view can be used to perform more detailed analysis.

6.6.1 Displaying the Hardware Diagnostics

Problems in the I/O area can be analyzed in the online view of the Hardware Editor. Modules with warnings are displayed in yellow, modules with errors or faults are displayed in red.

- In the structure tree, select the **Hardware** element and click **Online** on the Action Bar. If the PADT is not yet connected to the resource, the *Login* dialog box appears.
- Enter the user group, password and access mode and click **Login**, see Chapter 6.2. The hardware online view appears.
- Double-click a module to open the detail view.

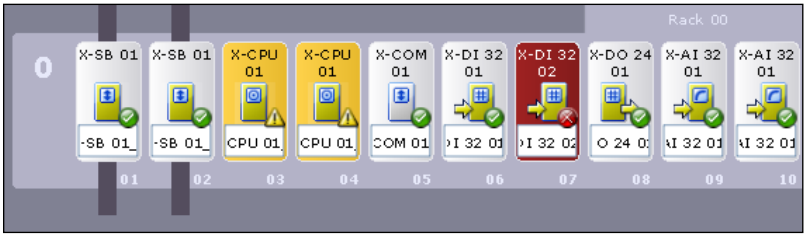


Figure 6-28: The Hardware Editor

- In the left list, select an element for which details should be displayed. By default, the *Status* of the selected module is displayed.

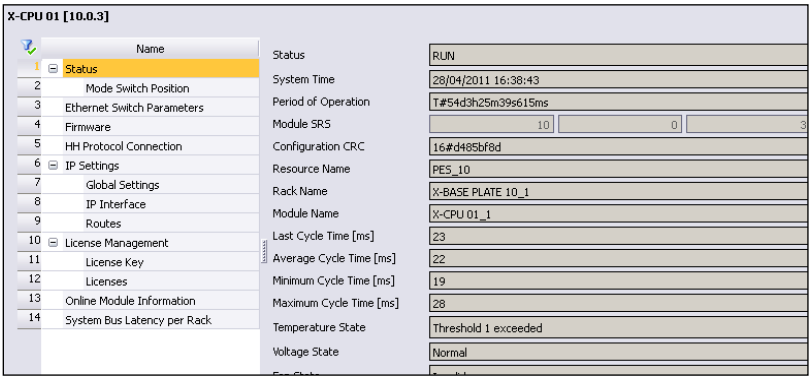


Figure 6-29: Detail View of a CPU

- Click **Firmware** to display the operating system version (see the figure, on the bottom right-hand side, *OS Version*).

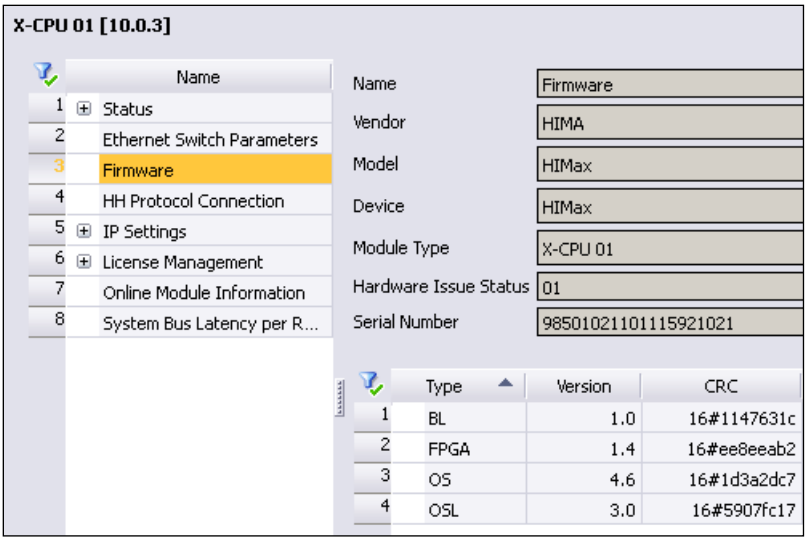


Figure 6-30: Indication of the OS Version

- Click **Close** to return to the hardware overview.

6.6.2 Displaying the Module Data Overview

- Click the **Online, Module Data Overview** menu functions.

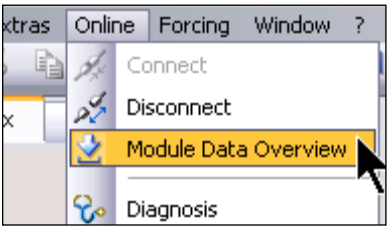


Figure 6-31: The Module Data Overview Menu Function

The module data is represented as a table. Data of remote I/Os are not listed at this level, but can be displayed using the detail view of the remote I/Os. Use the context menu for the table to save the table contents as CSV file.

The module data overview displays a table with the following information for all inserted modules:

Module SRS	OSL (OS loader)
Module type	BL (bootloader)
Module name	Hardware Revision
OS (operating system)	Serial number

Table 6-3: Module Data Overview

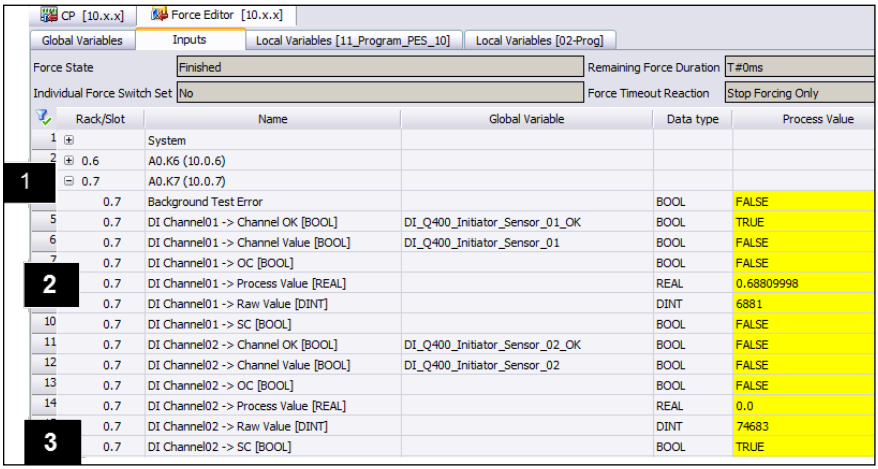
Module SRS	Module Type	Module Name	OS	OSL	BL	Hardware Issue Status	Serial Number
10.0.1	X-SB 01	X-SB A	4.6	3.0	1.0	02	98501020700115214012
10.0.2	X-SB 01	X-SB B	4.6	3.0	1.0	02	98501020700115214001
10.0.3	X-CPU 01	X-CPU 01_1	4.6	3.0	1.0	01	98501021101115921021
10.0.4	X-CPU 01	X-CPU 01_1	4.6	3.0	1.0	01	98501021101115921015
10.0.5	X-COM 01	X-COM 01_1	4.6	3.0	1.0	02	985060000000200116588002
10.0.6	X-DI 32 01	X-DI 32 01_1	4.6	3.0	1.0	02	98501020101114729010
10.0.7	X-DI 32 02	X-DI 32 02_1	4.6	3.0	1.0	02	98501020210116460008
10.0.8	X-DO 24 01	X-DO 24 01_1	4.6	3.0	1.0	02	98501020301117648005
10.0.9	X-AI 32 01	X-AI 32 01_1	4.6	3.0	1.0	02	98501021301114730015
10.0.10	X-AI 32 01	X-AI 32 01_1	4.6	3.0	1.0	02	98501021301114730020

Figure 6-32: Module Data Overview

6.6.3 Displaying the Module Values and States

The states of all system inputs can be viewed in the **Inputs** tab of the Force Editor (see Chapter 6.5.4). This does not depend on the variable assignment.

All modules are organized in a tree structure with indication of the SRS. Refer to the module-specific manual for a detailed description of the individual parameters.



1 Device in System 10, Rack 0, Slot 7

2 Process Value is 0.688 mA

3 Channel with Short-Circuit

Figure 6-33: Inputs Tab in the Force Editor

EXAMPLES:

Channel Value	State of a digital input.
Channel OK	Result of the channel internal self-test
OC	Open-circuit.
LS	Short-circuit.
Process Value	For analog input modules, scaled value in accordance with the parameter setting, otherwise the value in mA. If Channel OK=FALSE, the value is 0.0.
Raw Value	Value in mA, 1 mA = 10000 digits.

6.6.4 Displaying the Diagnostic Memory of the Modules

An experienced user with good system knowledge can evaluate the diagnostic memory using the module-specific manuals.

System	Diagnostic memory contained in
HIMax	All modules
HIQuad X	CPU, COM, F-IOP
HIMatrix	CPU, COM

- In the hardware online view, right-click a module icon and select **Diagnosis** from the context menu. The diagnostic panel appears.

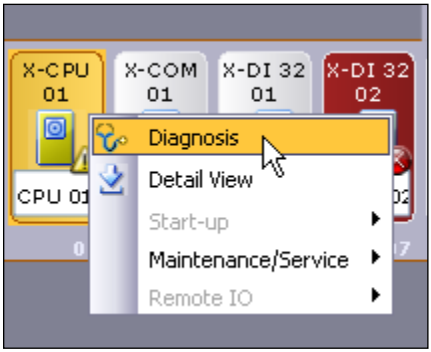


Figure 6-34: Opening the Diagnostic Panel

- Activate **All Entries** to display the entire content of the diagnostic memory.

- Activate **Entries Since** and modify the date and time to only display the entries for a more recent time period. The process for reading out the data can take some time.

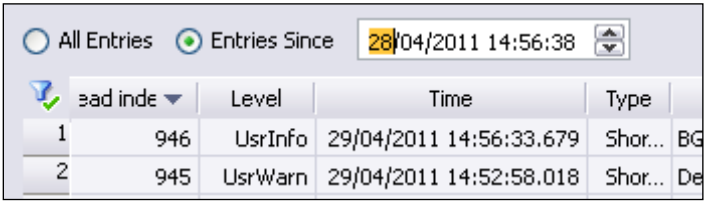


Figure 6-35: Displaying the Diagnostic Memory

6.6.4.1 Evaluating Diagnostic Data Externally

If a failure occurs and the cause cannot be identified, read the diagnostic memory of the CPU and of the module that has probably failed and send it to the HIMA hotline for analysis:

To back up the diagnostic memory in a file for evaluation purposes, proceed as follows:

- Right-click the list and select **Save** from the context menu. The data is saved as XML file and includes some basic data of the module.
- Save the diagnostic file with a unique file name and, if required, send it to the HIMA hotline support@hima.com, including its definition file (style sheet, can be found in the *Type* column in Explorer).

  To perform the analysis, HIMA needs at least the following information:
  - SILworX version.
  - LED state of all CPU modules and of the module concerned.
  - Diagnostic files of all CPU modules and of the module concerned.

6.6.5 Diagnosis of a HIMatrix Remote I/O

For HIMatrix remote I/Os the detailed view must be opened first before the **diagnosis** can be started up via the **Online** menu.

i The diagnosis of a remote I/Os is not buffered if power fails. If the diagnostic data is required, read it prior to switching off the operating voltage.

6.7 Download, Reload

Two procedures can be used to load a changed resource configuration: download and reload.

DOWNLOAD: A download is a loading process performed after a system stop. It can be performed whenever a reload is not possible. The only requirement is that the correct system ID is active in the system.

RELOAD: Reload is a loading procedure performed without stopping the system. It is possible irrespective of the number of CPU modules contained in the system. A reload can also be performed in a mono configuration with only one CPU without interrupting operation.

Reload is possible for the following systems:

System	Reload possible	License required
HIMax	Yes	No
HIQuad X	Yes	No
HIMatrix	Yes	Yes

Table 6-4: Reload Options

COLD RELOAD: A cold reload is a reload variant, during which individual modules not involved in the reload process are stopped. The stop state can last several seconds and must be considered in the context of the overall plant operation. Before a module is stopped, a message appears and the cold reload can be aborted. In this case, the system continues to operate with the previous resource configuration. Processor modules always have to be stopped manually.

6.7.1 Preconditions for a Reload

To be able to reload a resource, the following preconditions must be fulfilled:

A user program is already loaded in the resource and the resource is in RUN.

1. The last loaded user program (resource configuration) is available as SILworX project.
2. The *Reload Allowed* parameter is activated in the properties of the resource and of the program.
3. Changes to the user program were performed taking the restrictions specified in the system manual into account.
4. The user is authorized to perform a system login with Write access.
5. Reloadable code was created during the code generation, see also Chapter 4.11.
6. The system variable *Reload Deactivation* is FALSE.

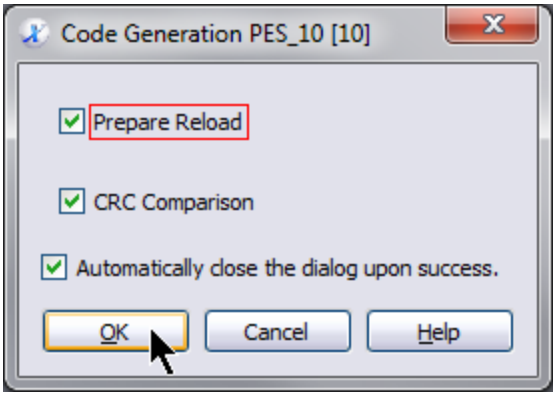


Figure 6-36: Preparing Reload

⚠ CAUTION

For the safety-related operation of a programmable electronic system, the code generation must be carried out twice! Therefore, activate the *CRC Comparison* option.

Observe the notices specified in the safety manual.

24/02/2014 12:37:16.232	Info	Code generation finished. Warnings: 0. Errors: 0. CRC: 16#31b76069-V4.
24/02/2014 12:36:57...	Info	Source code generation started.
24/02/2014 12:36:59...	Info	Source code generation completed.
24/02/2014 12:37:14...	Info	Code generation finished. Warnings: 0. Errors: 0.
24/02/2014 12:37:16...	Info	Reload code generation finished with CRC: 16#31b76069.
24/02/2014 12:37:16.241	Info	The CRC comparison from the dual code generation was successful. The generated code is valid.

Figure 6-37: Checking the Logbook

6.7.2 Performing a Reload

To perform a reload, log in to the system and connect the PADT to the resource. The reload procedure can be started by selecting the corresponding menu function in the Control Panel.

⚠ WARNING

A reload is always a safety-relevant intervention in the operation of a safety controller. For this reason, observe the relevant notices specified in the safety manual und system manual!

- Log in to the system as described in Chapter 6.2.

- Make sure that the Control Panel is the active window. Otherwise the menu function required for the next step is not available.
- Click **Reload/Download** on the Symbol Bar. The *Resource Reload/Download* dialog box appears.

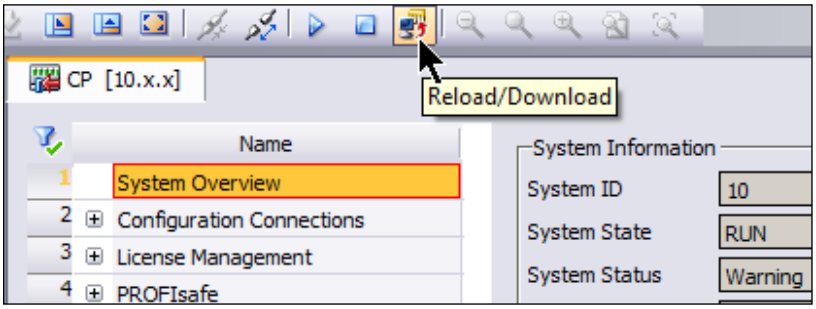


Figure 6-38: Invoking the Reload

- The *Reload/Download* dialog box shows the PES CRC version currently loaded in the resource and complying with the project data as well as the new CRC version resulting from the code generation
- Activate *Create Project Archive after Loading*

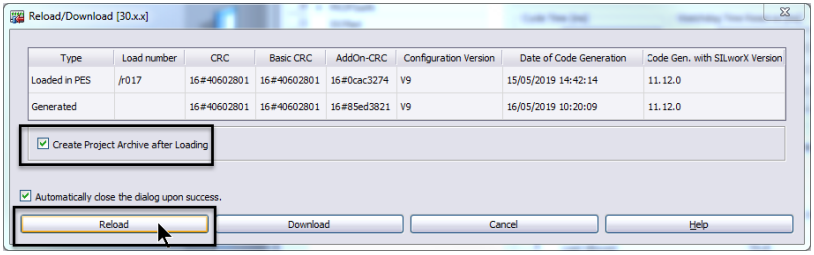


Figure 6-39: Starting the Reload

- Click **Reload** to start the reload.
- A project archive is automatically created once the loading process is completed. Only the target directory must be chosen.

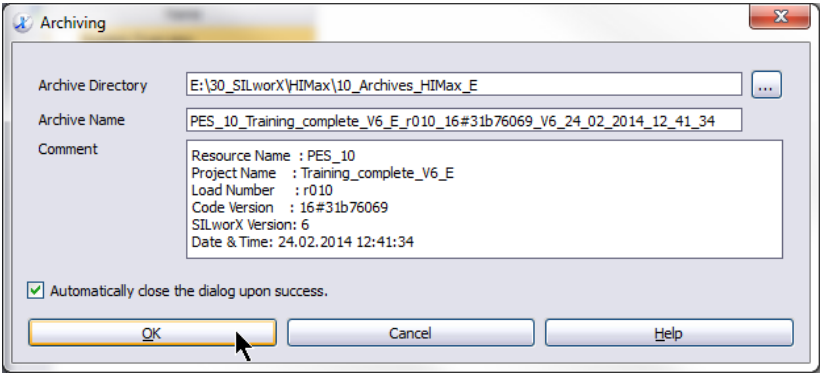


Figure 6-40: Creating Project Archive after Loading

The reload is completed when the phase RUN RELOAD CLEAN is finished.

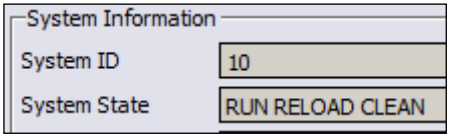


Figure 6-41: After the Reload

- Create a project archive in a separate directory after every load procedure. Create the archive manually, if it could not be created automatically. Refer to Chapter 8 for detailed instructions.

6.7.3 Repeating a Download

This chapter explains how to once again load a resource configuration after having already been loaded and subsequently changed. Refer to Chapter 5.5 for details on how to load the configuration for the first time.

The following requirements must be met:

1. A code has already been generated. Refer to Chapter 4.11 for the corresponding procedure.
2. The user must be authorized to perform a system login with Write access.

6.7.3.1 Download Procedure

- Log in to the system as described in Chapter 6.2.
- Make sure that the Control Panel is the active window. Otherwise the menu function required for the next step is not available.

  A download can only be performed if the system is in the STOP state. The system state is displayed in *System Information* group field contained in the Control Panel.
- Click **Resource Stop** on the Symbol Bar.

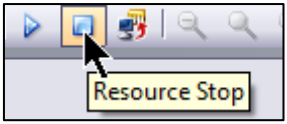


Figure 6-42: Resource Stop

- Click **Resource Reload/Download** on the Symbol Bar. The *Resource Reload/Download* dialog box appears.

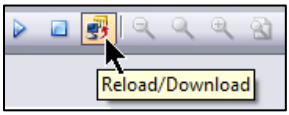


Figure 6-43: Resource Reload/Download

- Activate the option *Create Project Archive after Loading.*
- Click **Download** to start the loading process.

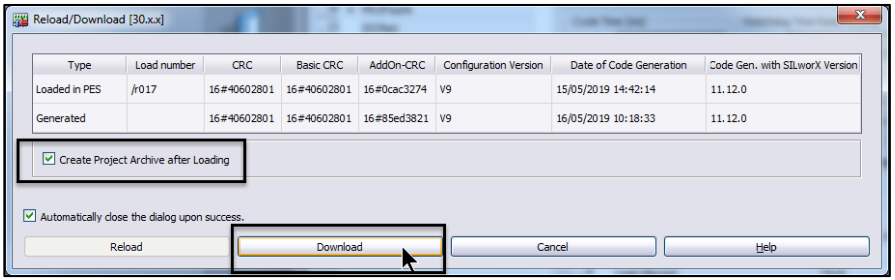


Figure 6-44: Starting the Download

- If the corresponding option has been activated, a project archive is automatically created once the loading process is completed. Only the target directory must be chosen.

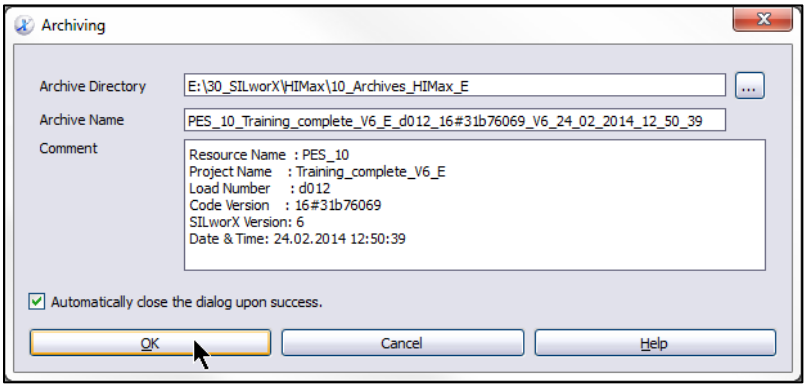


Figure 6-45: Creating the Archive

6.7.3.2 Resource Cold Start

- Click **Resource Cold Start** on the Symbol Bar. The CPU enters the RUN state. Also refer to the System Information specified on the Control Panel.

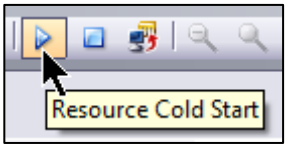


Figure 6-46: Starting the Resource

- Create a project archive in a separate directory after every load procedure. Create the archive manually, if it could not be created automatically. Refer to Chapter 8 for detailed instructions.

7 Documentation

The documentation of the project's current state is required for the acceptance test and operating license. In SILworX, the documentation can be output as a paper printout or be saved as a file in PDF format.

Prior to creating the documentation, a version comparison with the last loaded version should be performed for each resource. This ensures that the documentation contains the current CRCs (checksums) resulted from the code generations.

7.1 Performing the Version Comparison

To perform the version comparison for a resource, proceed as described in the following section. If the documentation should be created for the entire project, perform the version comparison for all the configured resources.

- In the structure tree, select a resource.
- Click the **Extras, Version Comparison** menu functions**.** The *Version Overview* dialog box appears.

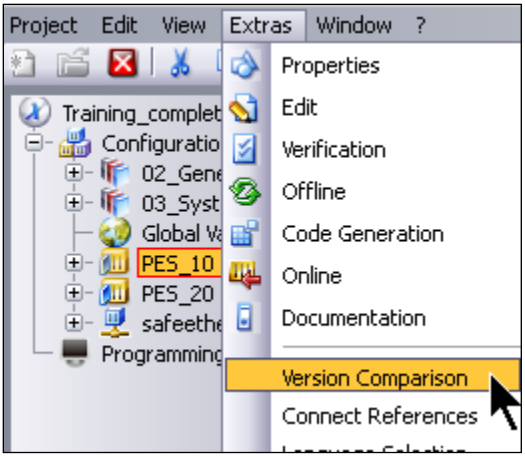


Figure 7-1: The Version Comparison Menu Function

- Check the **Last Load** option in the *Version Overview* dialog box and click **OK**. The version comparison starts.

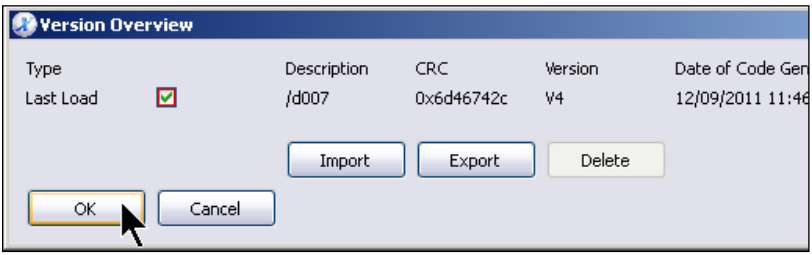


Figure 7-2: Starting the Version Comparison

- Close the version comparison window.
- If necessary, perform the steps described above for all remaining project resources.

7.2 Creating the Documentation

To document the project, HIMA recommends creating a PDF file. If required, the documentation content can thus be verified and changed in paperless form.

To create the documentation, proceed as follows:

- Click the **Documentation** button on the Action Bar. The *Creating Documentation Parameters* dialog box appears.
- If required, activate one or more of the following options. The selected options are printed in the logic diagram.
  - Show Grid.
  - Show Instance Name.
  - Show Network Number.

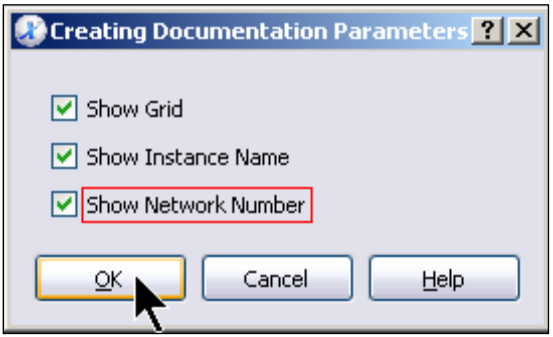


Figure 7-3: Documentation Options

- Click **OK**. The Documentation Editor appears.
- To create the documentation for the entire project, click the checkbox for the topmost project element of the list. In doing so, all the child elements are also selected.

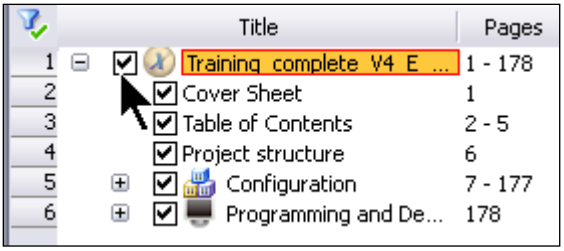


Figure 7-4: Selection of all Objects

- If required, deactivate the project elements for which no documentation should be created.

If required, you can use the **Documentation - Filter Selection** menu to save the defined filter collections with individual names. When opening the documentation at a later stage, you can re-select a filter collection via the **Filter Selection** menu.

7.2.1 Editing the Cover Sheet

Adjust the cover sheet content to meet the specific requirements prior to printing out the documentation or creating a PDF file. The entries can be checked in the print preview located on the right, next to the list of the project elements.

- Right-click anywhere within the Documentation Editor and select **Edit the Cover Sheet** from the context menu. The Cover Sheet Editor appears.

  Alternatively, use the **Documentation, Edit the Cover Sheet** menu functions.
- In the text fields on the left, enter the data to be printed on the cover sheet. The tables on the right-hand side of the Cover Sheet Editor are used to record project changes.

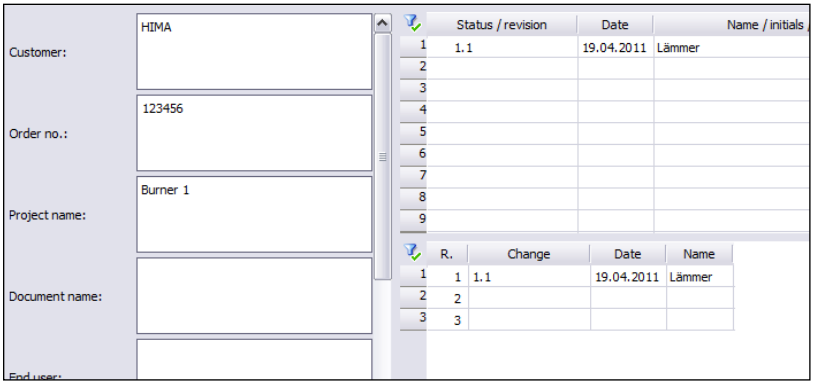


Figure 7-5: Editing the Cover Sheet

- Click **Close** to apply the actions and close the Cover Sheet Editor.

  Data entered in the Cover Sheet Editor are displayed in the print preview.

- Click the **Save** button on the Symbol Bar to save the changes to the project file.

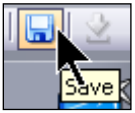


Figure 7-6: Saving

7.2.2 Printing or Saving the Documentation

The documentation for a SILworX project can either be printed out directly or saved as PDF file. Take the number of pages into account when printing out the documentation on paper. The number of pages is specified in the list of project elements.

- From the list of the project elements, select all elements that should be contained in the documentation.
- To send the documentation data to a printer, use the **Documentation, Print** menu functions.
- To save the documentation as a file, use the **Documentation, Save as PDF** menu functions. A Windows standard dialog box appears where the path and name of the PDF file can be specified.

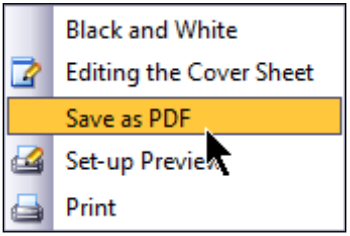


Figure 7-7: The Save as PDF Menu Function

8 SILworX Projects

Two variants of a SILworX project are possible.

1. As an archive (Project name.PA3).
2. As an editable project (Project name.E3).

Initially, an editable project is also stored in a very compact form. This file can be copied, renamed, moved, archived and further edited.

If an editable project is opened, it cannot be accessed by other users. The project data is extracted and saved in temporary files. While working in SILworX, the **Save** command affects the temporary file.

The project file is only updated with the new temporary files and recompressed once the project is closed.

---

i If the project cannot be properly closed (e.g., due to a computer crash, power outage, etc.), SILworX sends a prompt after its next start, asking to restore the project.

Confirm the action, otherwise all the changes performed since the project was last opened will be lost!

Since SILworX V5, projects can be backed up in two ways.

1. Archiving the project (recommended).
2. Duplicating the project.

As a general rule, a project should be archived in a separate directory after every download or reload process.

If only a copy is created, it should be protected from further processing. This procedure ensures that the previous project file is still accessible, should erroneous changes be performed to the working copy.

If necessary, project copies or archives can be created at any time to save the project's intermediary states.

For loaded projects, it is useful to add date, time and the note Loaded to the name of the project copy or archive.

8.1 Creating Project Archives Automatically after Loading

If the option *Create Project Archive after Loading* was active in the Loading dialog box and no connection loss occurs after successful loading of a configuration, the Archive dialog box automatically appears.

Select a suitable path and click **OK** to confirm. The suggested archive name contains the date and time and is therefore always unique.

8.2 Creating Project Archives Manually

- Save all project changes and close all editors.
- Select **Project -> Archiving** from the SILworX menu. The *Archive* dialog box appears.
- Select the *directory* in which the project archive should be created.
- Add the date and, if whished, the note *Loaded* or *Not loaded* to the proposed name.
- Click **OK**. The project archive is created.

8.3 Duplicating Projects

- Save all project changes and close all editors.
- In SILworX, select the **Project, Duplicate** menu functions. The *Copy Project* dialog box appears.
- Select the *directory* in which the project copy should be created.
- Enter a file name, date, time and the note *Loaded* or *Not loaded*.
- Click **OK**. The project copy is created.

NOTICE

HIMA recommends creating an archive as the preferred method for backing up projects.

8.4 Restoring Projects

To activate archived data, the project must be restored from the archive.

To this end, a new project is created using the archived data. The archive continues to exist.

To restore the archive, proceed as follows:

- Start SILworX. No other project may be open during this session.
- Select **Project, Restore** from the menu bar. The *Restore* dialog box appears.
- Select the required archive from the *Archive File* field.

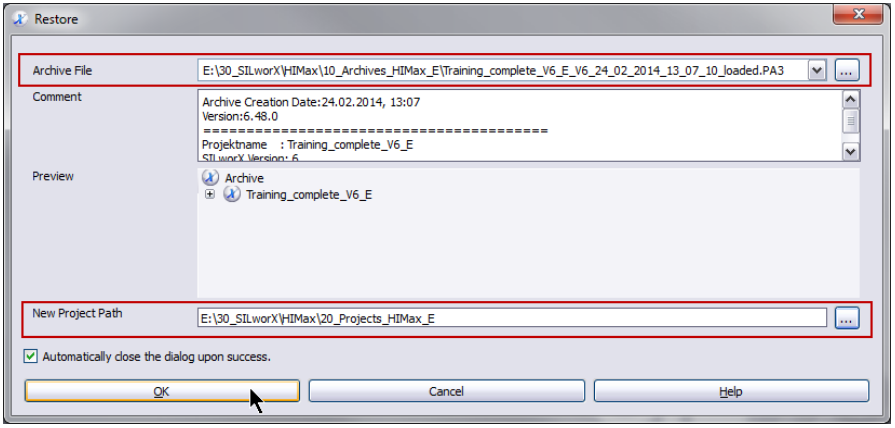


Figure 8-1: The Restore Menu Function

- In the *New Project Path* field, choose the directory for the restored project.
- Click **OK** to start the restore process.

  If the process is successful, the restored project is available.

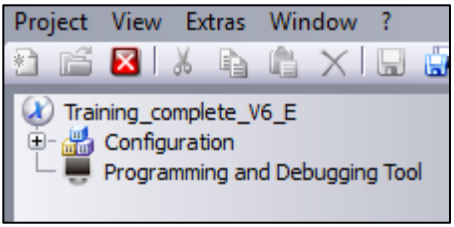


Figure 8-2: Restored Project

Appendix

Glossary

Term	Description
AI	Analog input
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses
BL	Bootloader
COM	Communication module
CRC	Cyclic redundancy check
Ctrl+A	Shortcut used to automatically enter the standard user group data Administrator during login
DI	Digital input
DO	Digital output
Drag&Drop	Procedure of dragging the chosen element and dropping it at the required position
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
FS	Full scale, in conjunction with the HIMatrix scaling range
FTA	Field termination assembly
FTT	Fault tolerance time
ICMP	Internet control message protocol, network protocol for status or error messages
IEC	International electrotechnical commission
Interference-free	Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed "interference-free" if it does not distort the signals of the other input circuit.
MAC Address	Media access control address: Hardware address of a network connection
Modules	Hardware unit to plug in to a rack

OLT	Online test
OLT Field	Online test field, i.e., field used to display the current value of a variable
OS	Operating system
OSL	Operating system loader
PADT	Programming and debugging tool (programming tool)
PE	Protective ground
PELV	Protective extra low voltage
PES	Programmable electronic system (controller)
PFD	Probability of (a safety function) failure on demand
PFH	Probability of (a dangerous) failure per hour
POU	Program organization unit (function block)
R	Read: Access mode to a system variable, it provides value, e.g., to the user program
R/W	Read/Write: Column title for the access mode to a system variable
Rack ID	Rack identifier
Resource	System configured with all necessary settings
RIO	Remote I/O, device that communicates with its parent resources via safe**ethernet**
safe**ethernet**	Safety-related bus between HIMA PES
SB	System bus or system bus module
SELV	Safety extra low voltage
SFC	Sequential function charts
SFF	Safe failure fraction, i.e., portion of faults that can be safely controlled
SIL	Safety integrity level, in accordance with IEC 61508
SILworX	Programming tool for HIMax and HIMatrix systems
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot addressing mode of a module
TMO	Timeout
W	Write, access mode to a system variable, it is assigned a value, e.g., from the user program
Watchdog (WD)	Time monitoring facility for modules or programs If the watchdog time is exceeded, the module or program enters the error stop state

WDT	Watchdog time

Table A-1: List of Abbreviations

Index

PROGRAMMING TOOL MANUAL
SILworX®

HI 801 103 E

For further information, please contact:

HIMA Paul Hildebrandt GmbH
Albert-Bassermann-Str. 28
68782 Brühl, Germany

Phone +49 6202 709-0
Fax +49 6202 709-107
E-mail info@hima.com

Learn more about HIMA solutions for SILworX® online:

www.hima.com/en/products-services/silworx/

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