

VIPA SPEED7 Studio

SW | SPEED7 Studio | Manual

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www.vipa.com/en/service-support/manuals

VIPA CONTROLS

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Structure and contents of the documentation

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1.2 Purpose of the documentation

This documentation describes the VIPA SPEED7 Studio software package. Please also note ♦ Chapter 1.4 'Structure and contents of the documentation' on page 12.

The manual is intended for persons who implement control functions for VIPA SPEED7 automation systems using *SPEED7 Studio*.

1.3 Validity of the documentation

This software description is valid for the *SPEED7 Studio* software package from version 1.7.

Please also note & Chapter 2.4 'Software identification' on page 16

Information on more recent versions or service packs which will be issued after the publication of this software description are provided at <u>http://www.vipa.com</u>

1.4 Structure and contents of the documentation

Chapter	Contents
Schapter 1 'General information on this documentation' on page 11 (of this chapter)	 Information on this documentation and on further documentations Form of notes and information Designation of interface elements
♦ Chapter 2 'To the SPEED7 Studio pro- gram' on page 15	 Product description and technical features of SPEED7 Studio Information on the target group and its qualifications Identification and scope of delivery
Chapter 3 'Installation and activation of SPEED7 Studio' on page 17	How to install, uninstall and activate (license) SPEED7 Studio
Schapter 4 'Working with SPEED7 Studio' on page 22	 Explanation of the user interface, menus and functions Adaptation and operation options of <i>SPEED7 Studio</i>
\Leftrightarrow Chapter 5 'Managing and editing projects' on page 61	Information and operating instructions regarding project administra- tion and processing
& Chapter 6 'Selecting and configuring devices and components' on page 72	Information and operating instructions regarding the selection and configuration of devices
& Chapter 7 'Connect devices' on page 155	Information and operating instructions regarding devices and commu- nication networks

Presentation and tags

Chapter	Contents
Chapter 8 'Creating, transferring and testing the user program' on page 192	How to create a user programInformation on the declaration of variables
Chapter 9 'Creating a visualisation' on page 288	How to create HMI visualisations
♦ Chapter 10 'Motion Control' on page 314	How to configure drivesInformation and operating instructions regarding creation of cams
Chapter 11 'Deployment SPEED7 EtherCAT Manager' on page 355	Information about configuration and diagnostics of EtherCAT systems

1.5 Presentation and tags

Notes, tips, recommendations, examples and operating instructions are presented in this documentation as follows:

Safety notes



DANGER!

This icon refers to dangers that will lead to death or serious bodily injury if the precautionary measures named are not taken.



CAUTION!

This icon refers to dangers that can lead to death or serious bodily injury if the precautionary measures named are not taken.



NOTICE!

This icon refers to important information. Any disregarding may result in system errors or data loss.

Tips	and	recommenda-
tions	;	

This icon refers to information which will facilitate the use of the system.

Example	Here you will get examples how to apply the operations or programming examples explained before.
Operating instructions	 This documentation includes operating instructions for many functions which you can follow step by step. Operating instructions include the following elements: ▲ Every operating step tells you what to do. The individual steps of any operating instruction consisting of several steps will be successively numbered. ⇒ Here, the result of the operating step is presented.

Presentation and tags

Further tags and format- The following tags are used in this documentation for highlighting certain information: **ting**

Tags/formatting	Explanation
'Menu → Menu item'	Menu command
	Example: 'File → Open project'
'Text'	Text of the programming interface, e.g. edit field in a dialogue window
	Example: <i>'User name'</i>
	- or -
	push button
	Example: <i>'Cancel'</i>
[Key]	Key or key combination of the computer keyboard
	Example: [Ctrl]+[C]
Product	Product designation (italics)
	Example: SPEED7 Studio
Program code	Program code (monospace font)
2	Icon / button of the programming interface
٩	Reference number in the illustrations (encircled consecutive number)
	Example:
	(1) Toolbar
•	List, e.g. for listing several operating options
Ŕ	Cross-reference to further information
	Example: Shapter 1.4 'Structure and contents of the documentation' on page 12

Technical features

2 To the SPEED7 Studio program

2.1 Product description

Controls based on SPEED7 technology can be used to an optimum with the *SPEED7 Studio* engineering tool.

SPEED7 Studio maps the complete automation process - from hardware configuration, communication and programming to visualisation.

Intuitive user interfaces allow for the immediate access to different modules. Thus, additional tools of third-party suppliers for hardware configuration, for linking different field buses, for programming or for the visualisation and operation of the systems are no longer necessary.

Hardware configuration SPEED7 Studio allows for the direct configuration of VIPA controls which include SPEEDBUS, PROFIBUS, EtherCAT or PROFINET, as well as 300S CPUs, communication processors or SLIO-I/Os with all VIPA-specific parameters. The corresponding variables are automatically created in the CPU. Pre-defined device templates can be added at the adequate position using Drag & Drop.

NetworkingNo specific bus system knowledge is required for the configuration of networking via
PROFIBUS, PROFINET and EtherCAT with SPEED7 Studio. SPEED7 Studio provides
various device templates which allow for the graphic networking configuration.

Programming The programming languages IL and FBD can be used in the current version for programming.

For easier textual programming, texts are structured by syntax highlighting. Moreover, it is possible to save notes in the code or define "regions" which allow for the clearly structured display of IL.

The graphic programming languages use different colours for different block groups which allows for easy functional allocation.

When entering the program code, the syntax is checked and the user is immediately informed about possible errors.

For diagnostics purposes, the current values can be displayed in the blocks or online in watch tables. A history and trend display are also available.

VisualisationWith SPEED7 Studio, it is possible to create a web-based visualisation. For this purpose,
a SVG graphic editor is available which is used for the creation of individual pages.
Ready-made elements provided in a library allow for very easy design.

The central data management in *SPEED7 Studio* allows for the access to all variables of the control.

The visualisation function is not only accessible via a conventional touch panel but also via any browser-enabled mobile end device such as a tablet PC or a smart phone. The only thing required is a Java-enabled web browser.

Further visualisation properties include loss-free scalable SVG vector graphics, pre-configured dynamic samplings and objects, object-oriented parametrising and client scripting.

2.2 Technical features

For *SPEED7 Studio* design, technologies and tools such as .net 4.0 and vector-based UI visualisation with Windows[©] Presentation Foundation are used.

Software identification

Central data management	Hardware configuration, networking, programming and visualisation use a central data- base based on a central SQL server. This allows, for example, for the direct access to control variables for visualisation creation without having to synchronise the data of the different tools.
Vector-based graphics	Any graphics used in <i>SPEED7 Studio</i> are vector-based and used, for example, for the photo-realistic illustration of components which can thus be zoomed without losses.
Multilingualism	All graphic user interfaces are available in different languages. The interface and menu language in <i>SPEED7 Studio</i> can be changed during programming.

2.3 Target group and qualification

SPEED7 Studio may be used only by qualified personnel. Due to their training and experience, the qualified personnel are capable of recognising risks and avoiding possible dangers when using *SPEED7 Studio*.

2.4 Software identification

- In order to get information on the installed SPEED7 Studio version and on the plugin modules, select 'Help → Info' in the menu bar.
 - ⇒ The dialogue window with information on *SPEED7 Studio* will open.

Please also note & Chapter 1.3 'Validity of the documentation' on page 12

3 Installation and activation of SPEED7 Studio

3.1 System requirements

The minimal system requirements for the installation of the *SPEED7 Studio* software package include:

- Processor: Intel[©] Pentium[©] 4 or AMD Athlon[©] 64
- Operating system: Microsoft[©] Windows 7[©] or Windows 8[©] or Windows 10[©]
- Working memory: At least 2 GB RAM
- Hard disk space: At least 12 GB (installation on portable flash memories not possible)
- Monitor and graphics card: Monitor resolution 1024 x 768 pixel (1920 x 1080 recommended), a colour depth of 16 Bit and 256 MB VRAM

3.2 Installation of SPEED7 Studio

You can install SPEED7 Studio with a downloaded file.

Double-click on the installation diagram. Follow the instructions on the monitor.



You must agree to the licensing agreement before you can use SPEED7 Studio. This must be confirmed during installation.

Further components are required in order to operate *SPEED7 Studio*. If the following programs are not already available on your PC, they are installed automatically:

- Microsoft .NET Framework 4.52
- Microsoft SQL Server[©] 2014 SP1
- WinPcap

3.3 Activate SPEED7 Studio

You can use a 30-day demo version or activate a licence.

In order to use *SPEED7 Studio* without restrictions, you require a licence, which you can obtain from your local VIPA GmbH customer service organisation.

Use 30-day demo version With the demo version, you can use *SPEED7 Studio* with no obligation and free of charge for 30 days. After this time has expired, you can use *SPEED7 Studio* again only when you activate a licence.

1. Start SPEED7 Studio. Schapter 4.2 Start SPEED7 Studio' on page 22

- ⇒ If no licence is activated, the dialogue window for activating the licence will open each time you start SPEED7 Studio.
- 2. Click on 'No'.
 - ⇒ SPEED7 Studio is started.

Each time you start *SPEED7 Studio*, it is shown for how many days you can still use the demo version.

Activate licence online

If the PC on which you would like to use *SPEED7 Studio* is connected to the internet, you can activate the licence online.

- 1. Start SPEED7 Studio. & Chapter 4.2 'Start SPEED7 Studio' on page 22
 - ⇒ If no licence is activated, the dialogue window for activating the licence will open each time you start *SPEED7 Studio*.
- 2. Click on 'Yes'.
 - ⇒ The 'Product activation' dialogue window will open.

🛷 Activation	×
SPE Stu	ED
Licence Key:	
VIPA-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-XXXX-X	XXXX-XXXX
Your name:	
My Name	
Email address:	
my_email@address.com	
Activate	Activate offline

- Fig. 1: "Product activation" dialogue window
- **3.** Enter the serial number that you received with your order of *SPEED7 Studio* in the *'Licence key'* input field.
- **<u>4.</u>** Enter your name in the 'Your name' input field.

- **5.** If you enter your e-mail address in the *'Email address'* input field, you receive an e-mail confirmation regarding the product activation.
- 6. Click on 'Activate'.
 - ⇒ The licence is activated and SPEED7 Studio is started.

Activate licence offline If the PC on which you would like to use *SPEED7 Studio* is not connected to the internet, you can activate the licence offline. For this, you need to obtain an activation key via another PC that is connected to the internet.

- 1. Start SPEED7 Studio. & Chapter 4.2 'Start SPEED7 Studio' on page 22
 - ⇒ If no licence is activated, the dialogue window for activating the licence will open each time you start *SPEED7 Studio*.
- 2. Click on 'Yes'.
 - ⇒ The 'Product activation' dialogue window will open.

🐗 Activation	×
SPEED	
Licence Key: VIPA-XXXX-XXXX-XXXX-XXXX-XXXX	
Your name:	
My Name	
Email address:	
my_email@address.com	
Activationkey:	
	1
Activate Activate offline	

- Fig. 2: "Product activation" dialogue window
- **3.** Enter the serial number that you received with your order of *SPEED7 Studio* in the *'Licence key'* input field.
- **4.** Enter your name in the 'Your name' input field.
- **5.** If you enter your e-mail address in the *'Email address'* input field, you receive an e-mail confirmation regarding the product activation.
- 6. Click on 'Activate offline'.
 - \Rightarrow A dialogue window with information on the subsequent steps will open.
- 7. Click on 'OK' in the dialogue window.
 - ⇒ The 'Save as' dialogue window will open.
- **8.** Save the HTML file and transfer this file (e.g. with copy and paste) to a PC that is connected to the internet.

- **9.** Double-click on the HTML file.
 - ⇒ The HTML page is opened in the browser. The activation key is accessed by the VIPA licence server and is shown in the browser.
- **10.** Enter the activation key into the 'Activation key' input field in the 'Product activation' dialogue window.
- **11.** Click on 'Activate offline' again.
 - ⇒ The licence is activated and SPEED7 Studio is started.

3.4 Uninstallation of SPEED7 Studio

You can use the system control to uninstall SPEED7 Studio. Follow the instructions on the monitor.

A dialogue window will open, where you can select whether your stored projects should be retained or deleted.



All project data are removed from the data carrier!

Make sure that the project data are no longer needed. _

Select language

4 Working with SPEED7 Studio

4.1 Overview

This chapter explains the user interface of SPEED7 Studio. & Chapter 4.7 'User interface' on page 24

Moreover, it contains a description of various operating options with mouse and keyboard. Schapter 4.17 'Mouse and keyboard operation' on page 48

4.2 Start SPEED7 Studio



- Click on the program button. You can find SPEED7 Studio in Windows Start under 'VIPA GmbH'.
 - \Rightarrow SPEED7 Studio is started. The start page appears.



It is possible to run SPEED7 Studio simultaneously several times on one PC if you want to use it for various projects. It is not possible to open the same project in different instances of SPEED7 Studio.

4.3 End SPEED7 Studio 😈

- Select one of the following options if you want to end the program:
 - Main window: Click on the Close button of the SPEED7 Studio program window.
 - Menu bar: Select 'File → Exit'.
 - **Keyboard:** Press [Alt]+[F4].

After you have made changes to the project, a dialogue window will open, where you can select whether to save or ignore the changes.

⇒ SPEED7 Studio is ended.

4.4 Select language

You can select the language in which the user interface is to be displayed.

Select the menu command 'Language' and click on the desired language.

 \Rightarrow The user interface is displayed in the selected language.



If you change to another language while a project is open, not all elements can be changed to the selected language. Close the project and open it again to change all elements into the selected language.

Select interfaces

4.5 Select syntax language (mnemonics)

You can select the language in which the language elements (mnemonics) of the user program are to be displayed.

- 1. ▶ Select the menu command 'Extras → Configurations'.
- **2.** Under *'Mnemonic configurations'*, select the desired syntax language.
 - \Rightarrow The language elements are displayed in the selected language.

Example	IL syntax in different languages:
	 German: U E0.1 (UND Eingang 0.1) International: A I0.1 (AND Input 0.1)

4.6 Select interfaces

You can choose which interfaces to use for the data exchange.

- **1.** ▶ Select the menu command '*Extras* → Configurations'.
- 2. Under 'Standard interfaces', select the desired network adapter or port:
 - 'Standard adapter Ethernet' Data exchange via an Ethernet interface between the programming device and the connected devices
 - 'Standard adapter simulation' To test (simulate) the user program on the programming device
 - 'Standard port serial' Data exchange via a serial interface between the programming device and the connected devices

Under "communication settings", you can change further configurations. *Chapter 6.18.2 'Communication settings (PLC)' on page 109* User interface

4.7 User interface

In the second se	ional - MyProject		- 🗆 🗙	
File View Language Theme Simulation E	ixtra Project AG Window Help	9		
💷 🔎 🗖 🖶 🔍 🔒 💥 🖥 🚱 🗷 •	🏟 🖪 🏹 😂 🔥 🐁 🐌 👔 🧭 🙀 👔 🕼 🗱 🕼	• 🐌		
🔒 Project tree 🗸 🖣 🗙	🔝 General	🔀 Catalog	→ 中 >	×
1 = 1 =				1
Title: Project solution MyProject	Start page 📲 Devices and networking	Device templat	es 📕 Cr 🔹 🕨	
Author: System administrator		注::==::==::=::::::::::::::::::::::::::		
 MyProject 	PLC_01 315-2AG13	A SearchText	×	ŧ.
Project overview		Filter Active		
翌 Devices and networking 🔨	4	🔺 👔 CPUs	/	^
Add new device		VIPA MICRO)	
Documentation	DP-Mastersystem (1)	VIPA SLIO		
PLC_01 [CPU 315-2AG13 315SB/DI			6	
⑦ Device overview	053-1DP00	P Pecentralised n	erinhen	
bevice properties		 Decentralised p VIPA SLIQ 	enpirely	
Device configuration		SLIO 053	3-1DP00	
Address overview	A ¥	🖁 SLIO 053	3-1EC00	
🔺 🗐 PLC program	Device: PLC_01	📱 SLIO 053	3-1PN00	
🖗 Cross-Reference list		VIPA 200V		
🕅 Assignment list	Connections Slot Component Order number I-Address O-Address	🔺 🔜 нмі	+	~
Program blocks	1	Catalog information		
PLC variables	2 CPU 315-2AG13 315SB/DPM 315-2AG13	Name:	SLIO 053-1DP00	^
Watch tables	100%	Vendor:	VIPA GmbH	
A Local components	10076	Version of device	2.51	
CPU 315-2AG13 315SB/DPM	🖹 Output 👻 🕂 🗙	description:		
DI16xDC24V [Slot4: 321-1BH0		Order info:	SLIO 053-1DP00	
DO16xDC24V/1A [Slot5: 322-				
Decentralised periphery	intersage source lype line scamp v			
	Consistency check has been started VPS/ProjectConsistencyEngine:StartEngine 100 Info 08.05.2017 15:51:08		. 7	
	Consistency check has been startec VPS7ProjectSymbolsConsistencyEngine:StartEngine ⑰ Info 08.05.2017 15:51:08			
	Project open [MyProject] (1) Info 08.05.2017 15:51:07	Catalog Prope	rties	V
SDEED7 Studio 16 25049 BC Pour 25049 Destantia		Drainet		
SPEED7 Studio - 1.6.35048 RC Rev.35048 Professio	Project open [MyProject] (7) Info 08.05.2017 15:51:07 (7) Dutput 🏠 Programming 📆 Consistency 🏫 Communicati 📭 Project logbo 🏊 EtherCAT mess Donal	Catalog Proper	rties	~

Fig. 3: SPEED7 Studio user interface (example)

- (1) Menu bar
- (2) Toolbar
- (3) Project tree
- (4) Area of operations

- (5) Output range
- (6) Catalog/properties
- (7) Status line

You can show and hide further windows and adjust the arrangement and size of the windows. \bigcirc Chapter 4.17.1 'Adjusting the user interface' on page 48

Information on the general use of SPEED7 Studio: Schapter 4.17 'Mouse and keyboard operation' on page 48

(1) Menu bar Most of the commands you need for working with SPEED7 Studio are provided in the menu bar. Further commands can be accessed via the context menus using the right mouse button, e.g. functions of a device in the project tree. Schapter 4.17.2 Mouse operation – context menu' on page 49

The menu commands 'Project' and 'Device' are only shown if a project is open.

You can use the menus with the mouse or the keyboard. \Leftrightarrow Chapter 4.19 'Menu and keyboard commands' on page 57

User interface

(2) Toolbar	Important commands you need for working with SPEED7 Studio are provided in the toolbar. More commands can be accessed via the toolbars and push buttons of different editors.
	Some of the commands in the toolbar are only shown if a project is open.
(3) Project tree	Any project device and project data can be accessed via the project tree. The project tree includes any object which you have created in the project, e.g. devices, components, pro- gram blocks, HMI images. Here you can add or remove devices and components. Fur- thermore, you can open editors in order to edit settings, configurations, the control pro- gram and visualisation.
	🖏 Chapter 4.8 'Project tree 📴' on page 26
(6) Area of operations	Devices and project data can be edited in the area of operations. You can open different editors for this purpose. The register in the area of operations is divided into two register levels. You can switch through the editors in the area of operations via the tabs.
	Chapter 4.11 'Area of operations' on page 35
(5) Output range	Information on executed activities and background operations are displayed on the output range.
	Chapter 4.13 'Output range' on page 39
(6) Catalog/properties	Devices and components which you want to add to the project can be selected in the cat- alog. You can also select objects which you want to add to the PLC program or to HMI images.
	🌣 Chapter 4.9 'Catalog 💸' on page 30
	🌣 Chapter 4.10 'Properties 📄' on page 33
(7) Status line	The version of <i>SPEED7 Studio</i> is displayed at the left edge of the status line. The pro- gress bar for background operations and status messages is shown at the right edge. As long as there are no background operations, the status message created at last is shown.

Project tree

4.8 Project tree 📃

Any project device and project data can be accessed via the project tree. The project tree includes any object which you have created in the project, e.g. devices, components, program blocks or HMI images.

Roject tree	•	д	×
Title: Project solution My Project Author: System administrator			
🔺 🔄 My Project 2			
🕖 Project overview			
函 Devices and networking			
Add new device			
Documentation 3			
PLC_01 [CPU 015-CEFNR00] 4			
🕖 Device overview			
📷 Device properties			
 Device configuration 			
Address overview			
Motion Control 5			
PLC program 6			
Cross-References			
Assignment list			
Cam profiles			
Program blocks			
PLC variables			
Monitoring tables			
Iccal components			
Field periphery 8			
▷ 🖃 HMI_01 [TP 62M-JID0-CB] 🧐			

Fig. 4: Project tree, example

- (1) Title and author
- (2) Project
- (3) Documentation
- (4) PLC
- (5) Motion Control
- (6) PLC program

```
Project tree
```

	 (7) Local components (= local modules) (8) Decentralised periphery (9) HMI 		
	In the project tree, you can access commands in order to add or delete objects, e.g. add/ delete devices or add/delete blocks.		
	You can open editors via the project tree if you want to edit settings, configurations, the control program and visualisation.		
	Moreover, you can retrieve information, e.g. project overview, device properties or bus system properties.		
Show project tree	If the project tree is not displayed, select 'View → Project tree' or press [Ctrl]+[Shift]+[P].		
Show projects in the project tree	In order to display the project in the project tree, you must create a new project		
	It is not possible to edit several projects at the same time. It is possible to run <i>SPEED7 Studio</i> simultaneously several times on one PC if you want to use it for various projects.		
Show/hide objects	The objects in the project tree are arranged in a tree structure. You can show or hide objects:		
i≡	Hide all objects (<i>'Project</i> → <i>Collapse project tree'</i>)		
ŧ	Show all objects (<i>'Project</i> → <i>Expand project tree'</i>)		
•	Hide slave objects / close folder		
-	Show slave objects / open folder		
Recognise object state	Symbols behind an object in the project tree provide indications of the object state. <i>Chapter 4.18.3 'Markings of changes and states' on page 52</i>		
(1) Title and author			
Title and author	Here, project name and user are displayed \Leftrightarrow Chapter 5.2 'Create a new project [] on page 61		
	Right mouse button: Context menu with commands and functions regarding the project		
(2) Project			
🔰 Project name	Here, the project name is displayed.		
	Right mouse button: Context menu with commands and functions regarding the project		

Project tree

Devices and networking	•	Single click: Open "Devices and networking" <i>Chapter 6.2 "Devices and networking" editor</i> : <i>on page 73</i>
Magazina Add new device	•	Single click: Open "Add new device" dialogue window \Leftrightarrow Chapter 6.3 'Add new device (PLC)' on page 77

(3) Documentation

Documentation	Contains text documents and further sub-folders & Chapter 5.15 "Documentation" folder ? on page 69
	🛠 Chapter 5.17 'Text editor (text document) 📄' on page 70
Text document	Name of the text document
	Right mouse button: Context menu with commands and functions regarding the text document
	 Double-click: Open text document in the editor & Chapter 5.17 'Text editor (text document) i on page 70 [F2]: Rename text document

(4) PLC

III Device name	Here, the device name of the PLC is displayed.	
	 Right mouse button: Context menu with commands and functions regarding the PLC Double-click: Open the "Device configuration" of the PLC <i>Chapter</i> 6.12 "Device configuration" editor (PLC) <i>on page</i> 97 	
⑦ Device overview	Single click: Open the "Device overview" of the PLC "Device overview" editor (PLC) on page 192	
bevice properties	Single click: Open the "Device properties" of the PLC "Device properties" editor (PLC) on page 108	
bevice configuration	Single click: Open the "Device configuration" of the PLC 6.12 "Device configuration" editor (PLC) on page 97	
R Address overview	■ Single click: Open the "Address overview" of the PLC ♦ Chapter 8.14 "Address overview" editor 🛒 on page 233	

(5) Motion Control

Motion Control Overview	 Single click: Open configurations for the Motion Control functions Chapter 10.4 'Editor "Motion Control Overview" 3.' on page 317
🛐 Motion Control axes	
🌯 Add new axis	Single click: Open dialogue window "Add new axis" & Chapter 10.5 'Add new axis and 'on page 321
🖏 Axis	Name of the Motion Control axis
	 Right mouse button: Context menu with commands and functions regarding the Motion Control axis
	Double-click: Open the editor of the Motion Control axis 10.6 'Editor "Motion Control axis" ' on page 322

(6) PLC program

Project tree

🔀 Cams	Includes cams for controls with Motion Control functionality
🗊 PLC program	 Right mouse button: Context menu with commands and functions regarding the user program (PLC program)
🔁 Program blocks	 Contains all blocks of the user program Right mouse button: Context menu with commands and functions regarding the blocks, e.g. add, open, rename, delete, transfer block, or add rename, delete folder [F2]: Rename directory
🔄 Add new block	Single click: Open "Add new block" dialogue window
 Organisation block [OB] Function block [FB] Function [FC] Data block [DB] Structure block [UDT] 	 Name of the block Right mouse button: Context menu with commands and functions regarding the block Double-click: Open block in the editor [F2]: Rename program block Chapter 8.5 'Block editor for program blocks (OB, FB, FC) . Son page 196 Chapter 8.8 'Block editor for data blocks (DB) 'on page 218 Chapter 8.10 'Block editor for structure blocks (UDT) '' on page 223
PLC variables	
Add variable table	Single click: Open "Add variable table" dialogue window & Chapter 8.11 'Add variable table and edit it a on page 228
System hardware configuration	Double-click: Open variable table Chapter 8.13 "System hardware configuration" editor 232
Standard project configuration	 Right mouse button: Context menu with commands and functions regarding the variable table Double-click: Open variable table Schapter 8.12 "Variable table" and "Standard project configuration" editor of mail: 0 page 229 [F2]: Rename variable table
Watch tables	
Add watch table	Single click: Open "Add watch table" dialogue window S Chapter 8.25 'Add watch table R' on page 261
Watch table	 Right mouse button: Context menu with commands and functions regarding the watch table Double-click: Open watch table & <i>Chapter 8.26 "Watch table" editor</i> if on page 262 [F2]: Rename watch table

(7) Local components

Local components	Chapter 6.14 'Adding components' on page 102
(8) Decentralised periphery	
Decentralised periphery	& Chapter 6.5 'Adding a new device (slave)' on page 83

Catalog

(9) HMI

I HMI	 Right mouse button: Context menu with commands and functions regarding visualisation (HMI)
⑦ Device overview	 Single click: Open the "Device overview" of the HMI device <i>& Chapter 9.2 "Device overview" editor (HMI device)</i> (1) on page 288
The properties	Single click: Open the "Device properties" of the HMI device Chapter 9.3 "Device properties" editor (HMI device) on page 289
🔃 HMI project	
Variables	
🔛 Standard variables table	Double-click: Open variable table & Chapter 9.4 "Standard variables table" editor a' on page 292
Images	
🛃 Add new image	Single click: Open "Add new image" dialogue window
🚮 Image	Name of the HMI image
	Right mouse button: Context menu with commands and functions regarding the HMI image
	 Double-click: Open HMI image in the editor Chapter 9.9 "Image" editor '' on page 297 [F2]: Rename HMI image
🚰 Resources	
😤 Add resource	Single click: Open "Add resource" dialogue window 🤄 Chapter 9.6 'HMI library 🌆' on page 295
Resource	Name of the resource
	 Right mouse button: Context menu with commands and functions regarding the resource [F2]: Rename resource

4.9 Catalog 💥

Devices and components which you want to add to the project can be selected in the catalog. You can also select objects which you want to add to the PLC program or to HMI images.

Catalog



Fig. 5: Catalog, "Device templates" example

- (1) Switching to another view
- (2) Register
- (3) Show/hide objects
- (4) Search
- (5) Filter
- (6) Objects (7) Catalog infor
- (7) Catalog information

Catalog

Show catalog	If the catalog is not displayed, select 'View \rightarrow Catalog' or press [Ctrl]+[Shift]+[C].
(1) Switch to another view	If the properties are displayed instead of the catalog, you must click on 'Catalog' at the lower screen edge.
(2) Register	Certain tabs are displayed in the catalog, depending on which editor window is opened in the foreground.
Example	In the area of operations, the 1 <i>'Devices and networking'</i> editor is opened and visible in the foreground. The 1 <i>'Device templates'</i> and 1 <i>'Components'</i> tabs are available in the catalog.

Editor in the area of operations	Tabs in the catalog
E Devices and networking	III Device templates
	Components
Sevice configuration	Provide the second seco
Organisation block [OB]	Graphics library (IL, LD, FBD)
Punction block [FB]	Ode library
멸 Function [FC]	
HMI image	I HMI elements

(3) Show/hide objects

The objects in the catalog are arranged in a tree structure. You can show or hide objects:

- ∃ Hide all objects ('Project → Collapse catalog tree')
- Show all objects ('Project → Expand catalog tree')
- Hide slave objects / close folder
- Show slave objects / open folder

(4) Search

You can search for certain objects in the catalog.



(5) Filter

(6) Add object

1. \blacktriangleright Enter a search text in the input field.

- \Rightarrow Only those objects are displayed in the catalog which contain the search text.
- **2.** \blacktriangleright Click on $\boxed{\mathbb{X}}$ to delete the search text.
 - \Rightarrow All objects are displayed in the catalog.

- ▶ Drag the desired object from the catalog to a suitable position. ♦ Chapter 4.17.3 ♦ Mouse operation – drag & drop' on page 50
 - \Rightarrow The object is added.

Properties



4.10 Properties 🗎

Element properties can be displayed and edited in HMI images in the "Properties" window.

Properties

Properties		₹ Ū ×
Property	Value	
▲ SVG		
atv:refpx	133	
atv:refpy	295.5	
fill	#000000	
font-family	Arial	
font-size	12	
id	id_1	
x	101	
У	300	
P Event	f	Action

Fig. 6: Properties

Show "Properties" window	If the properties are not displayed, select 'View \rightarrow Properties' or press [Ctrl]+[Shift]+[M].
(1) Switch to another view	If the catalog is displayed instead of the properties, you must click on <i>'Properties'</i> at the lower screen edge.
(2) Show/hide properties	The properties are arranged in a tree structure. You can show or hide the properties:
;=	Hide all properties (' <i>Project</i> → <i>Collapse property tree</i> ')
Ę	Show all properties ('Project → Expand property tree')
•	Hide slave properties
•	Show slave properties
(3) Properties of an ele- ment	
	Click on an element in the HMI image.
	\Rightarrow The properties of the element are displayed.

4.11 Area of operations

Editors in the area of operations

Devices and project data can be edited in the area of operations. You can open different editors for this purpose, e.g. via the menu bar, the toolbar or the project tree.

 $\boldsymbol{\texttt{\$}}$ 'Overview of tabs and editors' on page 36

PLC_01 317-2AJ12	
Ethernet	
DP-Mastersystem (1)	
DP_Slave_001 DP_Slave_002 053-1DP00 053-1DP00 Id: 002 Id: 003	
	Ð
A V	
Device: PLC_01 Rack: UR 0	
Slot Component OrderNo. I-Adress O-Adress Comment	
1	
2 CPU 317-2AJ12 317SE/DPM 317-2AJ12	
-X1 MPI Interface 8191*	

Fig. 7: Editors in the area of operations, "Devices and networking" example

Register in the area of operations	💼 General	PLC_01 DP_Slave_001	HMI_01	-0	•
	👌 Start Page	Devices and Networking		-0	

Fig. 8: Register and tabs

- (1) Main register
- (2) Sub-register

The register is located above the editors. It is divided into two register levels and contains the following tabs:

(1) Main register

The free 'General' tab contains sub-registers of the project. Further tabs (e.g. "PLC01", "DPSIave_001", "HMI01") contain sub-registers of the devices.

(2) Sub-register

Contains tabs with editors for the project (e.g. start page, devices and networking) or for the selected device (e.g. device properties, program blocks, images).

Adjusting the area of operations You can enlarge or reduce the area of operations. Schapter 4.17.1 'Adjusting the user interface' on page 48 Area of operations

Switching to another You can switch through the editors in the area of operations via the tabs. A tab for each editor open editor is displayed. Only the selected editor is visible. If you want to switch to another editor, you must proceed as follows: 1. Click on the desired tab (Device or "General") in the main register. ⇒ The editors corresponding to the selected device or to "General" are displayed in the sub-register. 2. Click on the desired tab in the sub-register. \Rightarrow The editor is displayed in the area of operations. Example You want to access the start page. First click on for 'General' and then on Start page'. You can also switch to another editor via the project tree. Click on the desired function in the project tree.

Closing the editor

💼 General	
🔖 Start Page	🗱 Devices and Networking 🗙
	2

- **1.** Move the mouse pointer to the right edge of the tab.
 - \Rightarrow The \bigotimes icon is automatically displayed.
- 2. Click on the icon.
 - \Rightarrow The editor is closed.

Closing all editors

- ▶ Select in the menu bar 'Window → Close all documents'.
 - ⇒ All editors in the area of operations are closed. Only the start page remains open.

Overview of tabs and editors

Main register	Sub-register	Editor in the area of operations
<u> </u> General	👆 Start page	🌣 Chapter 4.12 'Start page 🔖 ' on page 37
	Devices and networking	Schapter 6.2 "Devices and networking" editor ? on page 73
	Project overview	🌣 Chapter 6.1 "'Project overview" editor 🕜' on page 72
PLC	⑦ Device overview	Schapter 8.2 "Device overview" editor (PLC) (1) on page 192
	b Device properties	Schapter 6.18 "Device properties" editor (PLC) on page 108
	bevice configuration	Schapter 6.12 "Device configuration" editor (PLC) on page 97
	Organisation block [OB]	♦ Chapter 8.5 'Block editor for program blocks (OB, FB, FC) FC) E E C an page 196
	EFunction block [FB]	
Start page

Main register	Sub-register	Editor in the area of operations
	E Function [FC]	
	Data block [DB]	Schapter 8.8 'Block editor for data blocks (DB) '' on page 218
	Structure block [UDT]	\Leftrightarrow Chapter 8.10 'Block editor for structure blocks (UDT) $\underrightarrow{\mbox{eq}}$ on page 223
	System hardware configuration	♦ Chapter 8.13 "System hardware configuration" editor i on page 232
	Standard project configuration	♦ Chapter 8.12 "Variable table" and "Standard project configuration" editor and a page 229
	Variable table	Chapter 8.12 "Variable table" and "Standard project configuration" editor and a page 229
	Watch table	🌣 Chapter 8.26 "'Watch table" editor 騷' on page 262
III Slave	bevice properties	Schapter 6.18 "Device properties" editor (PLC) on page 108
	bevice configuration	Schapter 6.13 "Device configuration" editor (slave) in page 100
💷 HMI	⑦ Device overview	♦ Chapter 9.2 "Device overview" editor (HMI device) ⑦ on page 288
	bevice properties	Schapter 6.18 "Device properties" editor (PLC) on page 108
	Standard variables table	Schapter 9.4 "Standard variables table" editor a 'on page 292
	🚮 Image	🌣 Chapter 9.9 '"Image" editor 🚮' on page 297

4.12 Start page 🔖

The major functions for project management are provided on the start page. The start page is always displayed. It cannot be closed.

SPEE

Start page

SPEED7 Studio

Start: 1	Recently used projects:	Lastaccess	2
- 	MyProject	08.05.2017 15:51:07	v
New project	MeinProjekt	08.05.2017 15:23:25	
Open project		3	
Import project			
Delete project			
Project: 2			
Project overview			
Add new device			

Fig. 9: Start page

- (1) Start
- (2) Project
- (3) Recently used projects

(1) Start

You can create a new project, open a stored project or delete projects.

- To create a new project, click on the icon <a>[3].
- To open a stored project, click on the icon

In order to import a project in VPP or VPZ file format, click on the icon S.

⇒ The 'Import project' dialogue window will open. Schapter 5.12 'Importing a project si on page 65

Output range

	■ To delete a project, click on the icon ◄. ⇒ The 'Delete project' dialogue window will open. ♦ Chapter 5.9 'Delete a project ♣. ↑ on page 64
(2) Project	If a project is open, you can open the "Project overview" or add a new device.
	Click on the icon (1) to open the project overview. S Chapter 6.1 "Project overview" editor (1) on page 72
	- or -
	Click on the icon 🗱 to add a new device. <i>Chapter 6.3 'Add new device (PLC)'</i> on page 77
(3) Recently used projects	A list of recently opened projects appears.
	<i>'Project solution'</i> – project name
	'Source' – memory location of the project
	'Last access' – date and time when the project has been opened or saved for the last time
	Double-click on the project you want to open.

4.13 Output range

Information on executed activities and background operations are displayed on the output range.

Dutput			•	ά×
Message	Source	Туре	Timestamp	Ð
New device added. [HMI_01]		🕡 Info	25.10.2013 15	44:24
Project open [MyProject]		🕜 Info	25.10.2013 15	44:09
Opening project solution [ID: 94411d79-e31f-458d-bfed-73ab7a9a6d5f]		🕜 Info	25.10.2013 15	44:08
Dutput 🔥 Programming Events 👍 Communication Events 順 Project logbook				

Fig. 10: Output range, "Output" example

(1) Switching to another view

(1) Switch to another view In order to switch between different views, you must click on the desired output window at the lower screen edge, or select the menu or keyboard command from the following table:

Ico	n and menu command	Keyboard command	Description
:::	'View → Output'	[Ctrl]+[Shift]+[O]	🌣 Chapter 4.13.1 'Output 📄' on page 40
8	'View → Programming events'	[Ctrl]+[Shift]+[E]	🌣 Chapter 4.13.2 'Programming events 属' on page 40

Output range > Programming events

Ico	n and menu command	Keyboard command	Description
4	'View → Communication events'	[Ctrl]+[Alt]+[C]	Chapter 4.13.3 'Communication events 4' on page 41
× lat.	'View → Project logbook'	[Ctrl]+[Shift]+[H]	🔄 Chapter 4.13.4 'Project logbook 🏬' on page 41
	'View → Consistency messages'	[Ctrl]+[Shift]+[K]	Schapter 4.13.5 'Consistency messages '' on page 41

4.13.1 Output 🗎

Information on executed activities and background operations are displayed in the "Output" window.

	Dutput			→ Ū ×
	-0			
_	Message	Source	Туре	Timestamp 🗢
	New device added. [HMI_01]		🕡 Info	25.10.2013 15:44:24
	Project open [MyProject]		🕡 Info	25.10.2013 15:44:09
	Opening project solution [ID: 94411d79-e31f-458d-bfed-73ab7a9a6d5f]		🕡 Info	25.10.2013 15:44:08

Fig. 11: Output

(1) Delete all messages in the output window

4.13.2 Programming events

Information on events in the PLC program are provided in the "Programming events" window.

6												
8	😢 0 Error 🕂 0 Warning 💷 20 Info —											
			Message	Message detail	Error code	Source	Row	Column	Devi	ce	Path	
•	1	i	Result of black generatio	Length: 280 Byte(s)	0	SDB0	0	0	PLC_	01	MyProject	t,
	1 Message detail				Error co	de	Row	Colur	n			
0000: 70700302070B0000000011880000000 0010: 037ED6202A8A000000000000000000000000000000000				Ŧ								

Fig. 12: Programming events

(1) Show/hide messages

Show/hide details

You can show or hide further details on a message:

- Hide message details
- Show message details

4.13.3 Communication events 👍

Information on communication events between the programming device and the connected devices are provided in the "Communication events" window.

👈 Communication Events					
		2 Error 💷 0 Info			
	Ĩ	Message 2	Source	Device	Path
1	8	Download canceled.	Projekt Download	PLC_01	MyProject/Communication
2	8	Following Blocks aren't compilied: OB1	Projekt Download	PLC_01	MyProject/Communication

Fig. 13: Communication events

- (1) Delete all messages in the output window
- (2) Show/hide messages

4.13.4 Project logbook **I**

All activities are chronologically listed in the "Project logbook" window.

Project logbook			▼ ₽	×
Timestamp 🗢	User	Message		*
10/25/2013 2:37:04 PN	1 TKTK-L530\Thomas	Compiling project is finished.		
10/25/2013 2:37:04 PN	1 TKTK-L530\Thomas	Creation hardware configuration Done!		
10/25/2013 2:37:04 PN	1 TKTK-L530\Thomas	Compiling S7 project done!		
10/25/2013 2:37:04 PN	1 TKTK-L530\Thomas	Starting hardware configuration creation		

Fig. 14: Project logbook

4.13.5 Consistency messages 🖪

If you edit blocks, inconsistencies can arise, e.g. interface conflicts between two blocks. If you transfer inconsistent blocks into the control, this can lead to processing errors in the user program. In the "Consistency messages" window you are provided with information on block consistency.

🕅 Consistency Messages					B		→ ₽ ×
D	·][😢 0 Error 🕂 1 Warning 💷 2 Info				Area filter:	All
	Ì	Message	Alessage detail	Device 🛆	Source	e 🛆	Path
1		A recompile of block instance FC1 is required.		PLC_01	FC1 (Fu	nktion_1)	MeinProjekt.PLC_01.FC1 (Funktio
2	Q,			PLC_01	OB1 (M	ain)	MeinProjekt.PLC_01.OB1 (Main)

Fig. 15: Consistency messages

- (1) Restore consistency
- (2) Show/hide messages
- (3) Filter devices

Working with SPEED7 Stud	io VIPA SPEED7 Studio
Search / Replace in block	
Restore consistency	
	Click on the button is to remove existing inconsistencies.
	A dialogue window will open. ♦ Chapter 8.17 'Check and restore consistency i on page 243
Show problem area	
	Double-click on a consistency message.
	⇒ The inconsistent block is opened in the block editor and the problem area is shown.
4.13.6 EtherCAT mess	sages
	All EtherCAT messages of the individual devices are listed chronologically in this window.
Show EtherCAT messages	To open the "EtherCAT messages" window, select 'View \rightarrow EtherCAT messages'.

4.14 Search / Replace in block 🔙 🐘

You may search for and replace text or certain character patterns in the user program using the "Search in block" window.

Search / Replace in block

	😹 Search 🔛 Replace 🛑
Se	arch for:
A	\s*8
Re	place with:
A	\s*9
9	Advanced Settings
	Search range
	All networks
	Active networks [1]
	Search direction
	Up
	Down
L	Search mode
L	normal
L	Regular expression
L	Search whole words only
	Match case
-	Find Next

Fig. 16: Search / Replace in block

- (1) "Search" and "Replace" tabs
- (2) Advanced Configurations

Show Search / Replace To open the "Search in block" window, select '*View* \rightarrow Search in block' or click the button \square or \square in the block editor.

(1) Switch to another view You can switch between "Search" and "Replace" using the two tabs.



You must open the block editor \Leftrightarrow Chapter 8.4 'Editing program blocks' on page 195 before you can search for or replace text.

Show/hide Advanced Configurations

Show/open Advanced Find options

ф

VIPA SPEED7 Studio

Search / Replace in block

Hide/close Advanced Find options

Search 屫

- **1.** Select the 'Search' tab.
 - **2.** Enter the text that you want to search for in the input field 'Search for'.
 - 3. Click on 'Find Next'.

Replace 🔛

- **1.** Select the 'Replace' tab.
- **2.** Enter the text that you want to search for and replace in the 'Search for' input field.
- **3.** Enter the new text in the '*Replace with*' input field.
- **4.** Click '*Find Next*' and carry out one of the following actions then:
 - If you want to replace the found text, click 'Replace'.
 - If you want to replace the text in the entire block, click 'Replace All'.
 - If you do not want to replace this text, but the next found text, click 'Find Next'.

(2) Search with advanced Here you can choose if only the current network or all networks of the block are to be search settings because the searched.

You may select the search direction.

Moreover, you can choose if, in the search, only entire words are to be found and if the search is to be case-sensitive.

For the option 'Regular expressions', see below.

Search by means of regular expressions

You may use wildcard characters within so-called regular expressions to automate search or replace tasks.

Select the 'Regular expressions' option under 'Advanced Configurations'.

Example of wildcards:

Wildcard	Meaning	Search example	The following is found
I	or	UJUN	U UN
\s+	at least one white- space character	U \s+ A0.0	U A0.0 U A0.0
\s*	any number of white- space characters	E\ s *0.0	E0.0 E 0.0 E 0.0
0	Subexpression	(U UN) \s+(E A) \s *0.0	UN E 0.0 U A0.0 UN A 0.0

An overview of regular expressions is available in the Microsoft Developer Network at <u>https://msdn.microsoft.com/de-de</u>. Search for "Language elements for regular expressions" there.

4.15 Typed variable display

A list of the control variables for "HMI images" is shown in the "Typed variable display" window.

🔣 Typed representation		•	џ	×
Variables name	Data type			
bReset bSignal dwCounter	Boolean Boolean Numeric			

Fig. 17: Typed variable display

The variables of all elements of the current HMI image are shown in the table. \odot Chapter 9.9 "Image" editor and a page 297

Show Typed variable dis-
playIf the window is not displayed, select 'View \rightarrow Typed variable display' or press [Ctrl]+
[Shift]+[T].

You can use the mouse to drag control variables to the HMI image, thereby inserting a new element.

- Drag one variable from the "Typed variable display" window to the desired position in the HMI image (drag & drop).
 - A new element is inserted in the HMI image. The control variable is entered in the element's input field.

4.16 CPU control centre b

In the CPU control centre, the current operating mode and other control data are shown. You can also control the CPU here.

CPU control centre

Run Stop Stop SF Bus1 Bus2 Run PLC01 Order No: Firmware: V2.6.0 Active interface: Ethernet interface Address: 192.168.10.100	CPU control centre	→ ₽ ×	
Run Stop SF Bus1 Bus2 Run PLC01 Order No: Firmware: V2.6.0 Active interface: Ethernet interface Address: 192.168.10.100	10 10 10 10 10 10 10 10 10 10 10 10 10 1	-0	
Device name: PLC01 Order No: Firmware: V2.6.0 Active interface: Ethernet interface Address: 192.168.10.100	Run Stop SF Bus1 Bus2 Run		
Order No:Firmware:V2.6.0Active interface:Ethernet interfaceAddress:192.168.10.100	Device name:	PLC01	
Firmware:V2.6.0Active interface:Ethernet interfaceAddress:192.168.10.100	Order No:		
Active interface:Ethernet interfaceAddress:192.168.10.100	Firmware:	V2.6.0	
Address: 192.168.10.100	Active interface:	Ethernet interface	
	Address:	192.168.10.100	
😑 Cyclic data	Cyclic data		
Shortest cycle time: 92 ms	Shortest cycle time:	92 ms	
Current cycle time: 92 ms	Current cycle time:	92 ms	
Longest cycle time: 100 ms	Longest cycle time:	100 ms	

Fig. 18: CPU control centre

- (1) Communication status
- (2) Control CPU
- (3) Operating mode
- (4) CPU data

Show CPU control centre If the CPU control centre is not displayed, select '*View* \rightarrow CPU control centre' or press [Ctrl]+[Shift]+[U].

Select CPU If, in the project, a control is configured and a communication connection has been created with this control, you receive the current information from the CPU and can control the CPU.

If several controls are configured in the project, highlight the control that is to be shown and controlled in the CPU control centre.

(1) Communication status

Here you are provided with information on the communication connection between the programming device and the connected control:



Devices are connected – The current information from the CPU is shown.

CPU control centre

- Information is updated
- Communication error There is no current information from the CPU.

(2) Control CPU

- You can control the connected control:
- Start CPU The CPU is switched to operating mode RUN.
- Stop CPU The CPU is switched to operating mode STOP.
- Memory reset of CPU The CPU is returned to its initial state. S Chapter 6.31 Memory reset on page 150
- Open component state Here you are provided with further information on the connected control. S *Chapter 6.29 "Component state" editor* on page 138
- Refresh view The information is read again from the connected control, e.g. after removal of a communication error.

(3) Show operating mode Here, the LEDs and the switch setting of the connected CPU are shown. The display is constantly updated. If there is no communication connection or there is a communication error, no modes are shown.

LED/switch	Operating mode of the CPU
'Run'	RUN
'Stop'	STOP
'SF'	Collection error
'Bus1'	Bus error interface 1
'Bus2'	Bus error interface 2
'Run/Stop/MRES'	Current setting of the operating mode switch: RUN, STOP or memory reset

(4) CPU data

Here, further data concerning the connected control are shown:

'Device name' – Device name of the control \mathcal{G} *Chapter* 6 *'Selecting and configuring devices and components' on page* 72

'Order number' – Order number of the control (CPU)

'Firmware' - Firmware version of the control (CPU)

'Active interface' – communication connection with the control & Chapter 6.18.2 'Communication settings (PLC)' on page 109

'Address' – IP address (Ethernet connection) or MPI-address (serial connection) of the control

'Cyclic data'

- Show/open cyclic data
- Hide/close cyclic data

'Shortest cycle time – Shortest measured program processing cycle since the last transition from STOP to RUN (time base': milliseconds)

'Current cycle time' – Duration of the most recently run program processing cycle (time base: milliseconds)

Mouse and keyboard operation > Adjusting the user interface

'Longest cycle time' – Longest measured program processing cycle since the last transition from STOP to RUN (time base: milliseconds)



4.17 Mouse and keyboard operation

SPEED7 Studio offers various operating options with mouse and keyboard.

- Objects can be added to the project using the mouse:
 § Chapter 4.17.3 'Mouse operation drag & drop' on page 50

4.17.1 Adjusting the user interface

There are various options of adjusting the user interface.

Closing windows which are not required

If you want to enlarge a certain window of the user interface, you can close another window, see the following table. The closed windows can be opened at any time.

Icon an	d menu command	Keyboard command
	'View → Project tree'	[Ctrl]+[Shift]+[P]
×	'View ➔ Catalog'	[Ctrl]+[Shift]+[C]
	'View → Properties'	[Ctrl]+[Shift]+[M]
	'View → Typed variable display'	[Ctrl]+[Shift]+[T]
	'View ➔ Output'	[Ctrl]+[Shift]+[O]
-6	'View → Programming events'	[Ctrl]+[Shift]+[E]
	'View → Consistency messages'	[Ctrl]+[Shift]+[K]
40	'View → Communication events'	[Ctrl]+[Alt]+[C]
	'View → Project logbook'	[Ctrl]+[Shift]+[H]
Ь	'View → CPU control centre'	[Ctrl]+[Shift]+[U]
2	'View → EtherCAT messages'	-
×	'View ➔ Logic analysis'	-

Mouse and keyboard operation > Mouse operation – context menu

Enlarging / reducing the area of operations



Fig. 19: Changing the size of the area of operations

If you want to change the size of the area of operations, you must drag the left, right or lower frame of the area of operations.

Adjusting divided edit windows

There are edit windows which are divided into two sections e.g. the Device topology (top) section and Device details (bottom) section in the *'Devices and networking'* editor.



Fig. 20: Adjusting the edit window

Draw a line between both sections so that you can shift them.

```
- or -
```

Click on the souther to show or hide a section.

Changing the zoom factor

Many edit windows have a slider which is used to change the zoom factor.



- ▶ Move the slider or click on '+' or '-' to change the zoom factor.
 - ⇒ The current zoom factor is displayed as percentage value at the bottom right of the area of operations.

4.17.2 Mouse operation – context menu

Functions and commands for many objects and elements of the *SPEED7 Studio* user interface are provided via the context menu. A right-click with the mouse button on an object or element will open the corresponding context menu.

Mouse and keyboard operation > Mouse operation - drag & drop



Fig. 21: Example of a context menu for a device

⊳	E.	PLC program			
⊳		local compo	_8	Transfer software	
Þ		Field periph	8	import Simatic Project	
				Export ASCII Sources	
				Import ASCII Sources	
			80	Cross-References	
				Program blocks	•
				PLC variables	•
				Monitoring tables	•

Fig. 22: Example of a context menu in the project tree

4.17.3 Mouse operation – drag & drop

If you want to add objects to the project using the mouse, you can drag objects from the catalog to a suitable place in the area of operations and drop them there. This approach is referred to as "drag & drop".

- This mouse pointer is displayed while you drag the object.
- The object can be dropped at any position in the area of operations where the mouse pointer changes.

Help and support during editing > Messages



- Points where objects can be added are highlighted.
- In many input fields, the admissible value range is monitored.
- When entering an symbol name, it will be checked whether it has been allocated already.
- Information on interface elements and input fields is displayed (tool tips).
- Context help can be accessed, e.g. regarding the current editor or regarding menu functions.

4.18.2 Messages

Messages regarding accomplished activities and background operations are displayed. Different colours differentiate between status messages and error messages.

Messages in the output range

Message The connection test was successful.

Fig. 23: Example of a status message

Help and support during editing > Markings of changes and states

Message

Download cancelled.





Fig. 27: Example of different successive messages

4.18.3 Markings of changes and states

Objects in the project tree

🖳 Main [OB1] 🥖 🥼

Symbols behind an object in the project tree provide indications of the object state.

Fig. 28: Example

lcon	Meaning	Example
٨	A new object was added	A new device was added. This icon is no longer shown once the project has been saved.
l	Object was changed	A block was processed. This icon is no longer shown once the project has been saved.
	Object must be compiled	A block was changed and has not yet been compiled. The user program is not consistent.
0	Error in the object	During compilation, a syntax error was rec- ognised in a block.
	Consistency message: Warning	When checking the consistency, a problem was recognised in a block. The block needs to be recompiled.
	Consistency message: Error	When checking the consistency, an error was recognised in a block. The error needs to be resolved and the block needs to be recompiled.

Help and support during editing > Input fields

lcon	Meaning	Example
•	Comparison is error free	The comparison of an object in the project with the control is error free.
•	Comparison is not error free	The comparison of an object in the project with the control is not error free.
<u>.e.</u>	Watch object is active	The "Watch block" function is switched on.

Changes in an input field	🖔 🔆 Chapter 4.18.5 'Input fields' on page 53
---------------------------	--

4.18.4 Points where objects can be added

Colours or highlights show the positions where elements can be added.

Points where components can be added

If you select a component in the catalog, the admitted positions where you can add the component are marked in green in the device configuration.



Fig. 29: Example of positions where components can be added (green marking)

4.18.5 Input fields	
Admissible value range	Many input fields check already during input whether the admitted value range is com- plied with. Incorrect values are automatically corrected to the next possible value which is admitted.
Changing default values	If you overwrite the standard value (also: presetting, default value) with another value in the input or selection field, the frame of the input field changes.

Help and support during editing > Tool tips

MPI-Data		
Address	Max Address	
2	63	2 -

Fig. 30: Example of default value and changed value

(1) Default value: grey frame

(2) Changed value: green double frame

4.18.6 Tool tips

Tool tips are brief descriptive texts with information on the operating and input elements. _____ If you rest the mouse pointer on an element, the tool tip is displayed.

R	
Transfer	
F9	

Fig. 31: Example of a push button tool tip

Numbe	er of memory byte	s starting with MB0	
16	2		
Numb	Number of me	mory bytes starting with MB	0: counters starting
0	Default value:	16	
Areas	Min. value:	0	
nicus	Max. value:	1024	Byte address
Reten			

Fig. 32: Example of an input field tool tip

Help and support during editing > Automatic completion



Fig. 33: Example of an operand field tool tip

4.18.7 Automatic completion

When you enter declarations or instructions, a selection list with input suggestions and other information will be shown as a tool tip. With each additional letter you enter, the suggestions are narrowed down.

Examples of input and selection fields	Data type	
	BLOCK_DB	-
		DB Block DB
	BLOCK_F	-B Block FB
	BLOCK_F	C Block FC
	BLOCK_S	SDB Block SDB
	SOOL	Bit (0 / 1)
	I BYTE	8 Bit unsigned

Fig. 34: Input suggestions in the selection field 'Data type' (input: B)

Help and support during editing > Calling up and using help

Examples for the input of instructions	1 1 # Image: Big State Measure Image: Decision of the state Image: Measure Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state Image: Decision of the state	
	1 1 Image: Count_3 Image: Type image: Symbol variable Image: Funktionsbaustein_1_1 Image: Operand image: Count_3 Image: Funktionsbaustein_1_2 Image: Operand image: Count_3 Image: Funktionsbaustein_2_4 Image: Operand image: Count_3 Image: Funktionsbaustein_2_4 Image: Count_3 Image: Fig. 36: Input suggestions for symbol names in the block editor (input: ")	

4.18.8 Check symbol name

When entering a symbol name which has been allocated already, an error message is displayed.

4.18.9 Calling up and using help ?

	SPEED7 Studio help contains the complete software description. Help is context-sensi- tive, i.e. it refers to a certain interface element or a certain section.
Calling up help with [F1]	1. Click in the section (e.g. project tree, editor) for which you need information.
	2. Press [F1] to call up help.
	⇒ The help window will open.
Structure of the help window	The navigation frame is located at the left side of the help window. It contains three regis- ters:
	 Contents: Table of contents Index: Searching keywords in the index directory Search: Full-text search

The help topic is displayed at the right side of the help window.

Menu and keyboard commands

4.19 Menu and keyboard commands

Icon and menu command		Keyboard com- mand	Description		
File	File				
J	'File ➔ New project'	[Ctrl]+[N]	Chapter 5.2 'Create a new project []' on page 61		
\geqslant	'File ➔ Open project'	[Ctrl]+[O]	🌣 Chapter 5.3 'Opening a project 🔊 ' on page 62		
	'File ➔ Close project'	[Ctrl]+[W]	🌣 Chapter 5.4 'Closing a project 🞣' on page 63		
	'Saving ➔ file'	[Ctrl]+[S]	🌣 Chapter 5.6 'Saving a project 📊' on page 63		
F	'File ➔ Save as'	[Ctrl]+[Alt]+[S]	Chapter 5.7 'Saving a project as		
4	'File → Delete project'	[Ctrl]+[D]	🌣 Chapter 5.9 'Delete a project 🚄' on page 64		
6	'File → Import project'	[Ctrl]+[F12]	Chapter 5.12 'Importing a project ; on page 65		
	'File → Print'	—	🌣 Chapter 5.13 'Print 🚍 ' on page 66		
	'File ➔ Print preview'	—	🌣 Chapter 5.14 'Print Preview 🚉' on page 69		
—	'File → Recently opened projects'	—			
٢	'File → Exit'	[Alt]+[F4]	♦ Chapter 4.3 'End SPEED7 Studio [™] on page 22		
Vie	w				
	'View → Project tree'	[Ctrl]+[Shift]+[P]	🌣 Chapter 4.8 'Project tree 🛃' on page 26		
*	'View → Catalog'	[Ctrl]+[Shift]+[C]	🌣 Chapter 4.9 'Catalog 💸' on page 30		
æ	'View → Search in block'		Schapter 4.14 'Search / Replace in block 🔜 🐏' on page 42		
	'View → Properties'	[Ctrl]+[Shift]+[M]	🌣 Chapter 4.10 'Properties 📄' on page 33		
	'View → Typed variable display'	[Ctrl]+[Shift]+[T]	Schapter 4.15 'Typed variable display' on page 45		
:::	'View ➔ Output'	[Ctrl]+[Shift]+[O]	🌣 Chapter 4.13.1 'Output 📄' on page 40		
8	'View → Programming events'	[Ctrl]+[Shift]+[E]	Schapter 4.13.2 'Programming events : on page 40		
(<u>7</u>	'View → Consistency messages'	[Ctrl]+[Shift]+[K]	Schapter 4.13.5 'Consistency messages '' on page 41		
4	'View → Communication events'	[Ctrl]+[Alt]+[C]	Chapter 4.13.3 'Communication events d' on page 41		
N.	'View → Project logbook'	[Ctrl]+[Shift]+[H]	🗞 Chapter 4.13.4 'Project logbook 📭' on page 41		
	'View → EtherCAT messages'	_	Schapter 4.13.6 'EtherCAT messages' on page 42		
≌	'View ➔ Logic analysis'	—	🌣 Chapter 8.27 'Logic analysis 😒' on page 267		
Ь	'View → CPU control centre'	[Ctrl]+[Shift]+[U]	♦ Chapter 4.16 'CPU control centre on page 45		
Lar	nguage				
	'Language → German'	—	♦ Chapter 4.4 'Select language' on page 22		

Menu and keyboard commands

Icon and menu command		Keyboard com- mand	Description
— 'Language ➔ English'		—	
The	eme		
—	'Theme ➔ Small font size'	—	
—	'Theme ➔ Normal font size'	—	
—	'Theme 🗲 Large font size'	—	
Sin	nulation		
Ь	'Simulation → Start PLC simulation'	—	🏷 Chapter 8.19 'Simulate user program 🌇'
Ь	'Simulation → End PLC simulation'	—	on page 246
0	'Simulation → PLC simulation configurations'	[Alt]+[l]	Schapter 8.19.1 'PLC simulation configurations on page 247
Ext	ra		
GSD	'Extras → Install device description file (PROFIBUS – GSD)'	_	♦ Chapter 6.9 'PROFIBUS – GSD on page 90
<u>GML</u>	'Extras → Install device description file (PROFIBUS – GSDML)'	-	
ESI	'Extras → Install device description file (EtherCAT – ESI)'	-	ଓ Chapter 6.11 'EtherCAT – ESI ≝i' on page 95 €
	'Extras ➔ Install block library'	—	Schapter 8.31 'Install block library ""' on page 286
	'Extras → Edit Ethernet partners'	—	Schapter 6.19 'Search for accessible partners' on page 112
۲	'Extras ➔ Configurations'	_	Schapter 4.5 'Select syntax language (mne- monics)' on page 23 Schapter 4.6 'Select inter- faces' on page 23
Pro	ject (is shown only if a project is open)		
:=	'Project ➔ Collapse project tree'	—	🌣 Chapter 4.8 'Project tree 📑' on page 26
:=	'Project ➔ Expand project tree'	—	
:=	'Project ➔ Collapse catalog tree'	—	🌣 Chapter 4.9 'Catalog 汰' on page 30
:=	'Project ➔ Expand catalog tree'	—	
:=	'Project ➔ Collapse property tree'	—	🌣 Chapter 4.10 'Properties 📄' on page 33
:=	'Project → Expand property tree'	—	
	'Project → Project overview'	_	Schapter 6.1 "'Project overview'' editor (1) on page 72
N.	'Project → Devices and networking'	_	Schapter 6.2 "Devices and networking" editor : on page 73
-	'Project → Add new device'	[Ctrl]+[Shift]+[N]	Schapter 6.3 'Add new device (PLC)' on page 77
Ø	'Project → Consistency test/restoration'	[Ctrl]+[Alt]+[K]	Schapter 8.17 'Check and restore consistency 'on page 243

Menu and keyboard commands

Icon and menu command		Keyboard com- mand	Description
	'Project → Compile'	[F6]	🌣 Chapter 8.18.1 'Compile 🌄' on page 246
4	'Project ➔ Compile all'	[Shift]+[F6]	🌣 Chapter 8.18.2 'Compile all 🌄' on page 246
	'Transfer → project'	[F9]	Schapter 5.10 'Transferring a project ? on page 64
	'Export → project'	[F12]	♦ Chapter 5.11 'Exporting a project ♣' on page 65
	'File → Print'	—	🌣 Chapter 5.13 'Print 🚍 ' on page 66
<u>_</u>	'File ➔ Print preview'	—	🌣 Chapter 5.14 'Print Preview 🚉' on page 69
Dev	vice (is shown only if a control is present in the	ne project)	
٢	'Device → Device overview'		Schapter 8.2 "Device overview" editor (PLC) () on page 192
			Schapter 9.2 "Device overview" editor (HMI device) (1) on page 288
	'Device → Device properties'	-	Schapter 6.18 "Device properties" editor (PLC) **********************************
-@	'Device → Device configuration'	-	Chapter 6.12 "Device configuration" editor (PLC) on page 97
	'Device → Address overview'	-	♦ Chapter 8.14 "Address overview" editor ■ on page 233
	'Device → Transfer all'	—	🌣 Chapter 8.20.3 'Transfer all 🌇' on page 250
_8	'Device → Transfer user program'	-	Chapter 8.20.2 'Transfer user program 'a' on page 249
	'Device → Transfer hardware configuration'	-	Schapter 8.20.1 'Transfer hardware configuration "" on page 248
	'Device → Export all (WLD)'	—	♦ Chapter 6.25 'Export all (WLD) ♣' on page 136
8	'Device → Export user program (WLD)'	-	♦ Chapter 6.26 'Export user program (WLD) 's' on page 137
8	'Device → Export hardware configuration (WLD)'	-	♦ Chapter 6.27 'Export hardware configuration (WLD) € on page 137
ß	'Device → Copy RAM to ROM'	—	♦ Chapter 6.28 'Copy RAM to ROM' on page 137
ď	'Device → Component state'	-	Chapter 6.29 "Component state" editor ? on page 138
\odot	'Device → Set time'	—	\Leftrightarrow Chapter 6.30 'Setting the time $\textcircled{3}$ ' on page 148
-	'Device → Memory reset'	—	🌣 Chapter 6.31 'Memory reset 💳' on page 150
	'Device → Load blocks from device'	-	$\scriptstyle{(\!$
P	'Device → Compare blocks'	-	$\scriptstyle{(\!$
Wir	ndow		
	'Window → Switch all ToolWindows'	—	
E.	'Window → Close all documents'	_	

Menu and keyboard commands

Icon and menu command		Keyboard com- mand	Description
He	lp		
?	'Help → View help'	_	$\stackrel{\scriptstyle{(5)}}{\scriptstyle{(5)}}$ Chapter 4.18.9 'Calling up and using help $\stackrel{\scriptstyle{(2)}}{\scriptstyle{(2)}}$ ' on page 56
	'Help → Info'	—	♦ Chapter 2.4 'Software identification' on page 16

5 Managing and editing projects

5.1 Project

Projects contain the configuration data of the devices which are required for the operation of a machine or system, e.g. control and components, visualisation devices, I/O components. Projects also contain the configurations of the communication connections as well as the control program.

- New projects can be created and existing projects can be edited.
- Projects can be renamed or deleted.
- Projects can be exported and imported so that they can be used on different computers.
- Transfer the completed project to the control together with the user program and activate it there.

5.2 Create a new project 🔊

Start page	
SPEED7 Studio	
Start:	
New project	
Open project	

Make sure that no other project is open.

1. Select one of the following options if you want to create a new project:

- Menu bar: Select 'File → New project'.
- Toolbar: Click on 3.
- Keyboard: Press [Ctrl]+[P].
- Start page": Click on 'New project'.
- ⇒ The dialogue window *'Create new project'* will open.

Fig. 37: New project via the "Start page"

Opening a project

Vew project				×
Create new pro	ject			
	Project name:	MyProject		
	Project data:	.\SPEED7StudioDB14		
	Catalogue data:	.\SPEED7StudioDB14		
			🖌 ОК	🔀 Cancel

Fig. 38: Dialogue window "Create new project"

- **2.** *Project name'* Enter the name under which the project data are to be saved.
- 3. Click on 'OK'.
 - ⇒ The project is created and displayed in the project tree. The 'Devices and networking' editor will open. Device templates and components are now available in the 'Catalog'.

5.3 Opening a project 🔊

It is not possible to edit several projects at the same time. It is possible to run *SPEED7 Studio* simultaneously several times on one PC if you want to use it for various projects.

- **1.** Select one of the following options if you want to open a project:
 - Menu bar: Select 'File → Open project'.
 - Toolbar: Click on
 - Keyboard: Press [Ctrl]+[O].
 - "Start page" &: Click on 'Open project' or double-click on the desired project in 'Recently used projects'.
 - ⇒ The 'Open project' dialogue window will open.
- 2. You can choose whether all the projects or only the most recently used projects are to be shown in the dialogue window.
- **3.** Select the desired project.

- **4.** Click on 'Open'.
 - ⇒ The project is displayed in the project tree. Device templates and components are now available in the *'Catalog'*. Any other open project will be closed.

5.4 Closing a project 🚚

- Select one of the following options if you want to close an open project:
 - Menu bar: Select 'File → Close project'.
 - Keyboard: Press [Ctrl]+[F4].

After you have made changes to the project, a dialogue window will open, where you can select whether to save or ignore the changes.

 \Rightarrow The project is closed and the 'Start page' is displayed.

5.5 Editing a project

You can select devices from the catalog and add them to the project tree. Then you can access the functions available in for devices and project slave components.

 ${\ensuremath{\mathfrak{G}}}$ Chapter 6 'Selecting and configuring devices and components' on page 72

5.6 Saving a project

Save the open project in order to save all project data on the data carrier.

____ Select one of the following options if you want to save a project data:

- Menu bar: Select 'Saving → file ...'.
- Toolbar: Click on .
- Keyboard: Press [Ctrl]+[S].
- \Rightarrow Project data are saved.

5.7 Saving a project as F

- **1.** Select one of the following options if you want to save the project data under a different project name:
 - Menu bar: Select 'File → Save as'.
 - **Keyboard:** Press [*Ctrl*]+[*Alt*]+[*S*].
 - ⇒ A dialogue window for the input of the new project name will open.
- 2. Enter the new project name in the input field and click on 'Save as'.
 - ⇒ Project data are saved under a new name.

Transferring a project

5.8 Rename a project 📷

Project tree ₹ 4 × 目譜。 Title: Project solution MyProject Author: Systemadministrator MyProject 🕧 Projec 👪 Rename Project

Fig. 39: "Rename project" context menu

The project has to be open.

- 1. Right-click with the mouse button on the project name in the project tree and select 'Rename project' or press [F2].
- **2.** Enter the new project name in the input field.
- Confirm your input with [Enter].
 - The */* icon indicates that you have already changed but not yet saved the ⇒ project name.
- 4. Save the project. Schapter 5.6 Saving a project a roject a project a project a project a project a project b project.
 - The project is saved under the new name, and the 2 icon is no longer dis-⇒ played.

5.9 Delete a project 🚚

Delete any project which is no longer needed.



All data of the deleted project are removed from the data carrier!

Make sure that the project data are no longer needed.

The project to be deleted must not be open.

1. Select one of the following options if you want to delete a project:

- Menu bar: Select 'File → Delete project'.
- Keyboard: Press [Ctrl]+[D].
- "Start page" b: Click on 'Delete projects'.
- ⇒ The 'Delete project' dialogue window will open.

2. Select the desired project from the list.

- 3. Click on 'Delete'.
 - ⇒ The project is deleted. All project data are removed from the data carrier.

Transferring a project 🔢 5.10

Transfer a completely edited project together with the user program and the visualisation to the connected devices.

The project has to be open.

Importing a project

Create a communication connection to the control. & Chapter 6.18.2 'Communication settings (PLC)' on page 109

- **1.** Select one of the following options if you want to transfer a project:
 - Menu bar: Select 'Transfer → project ...'.
 - Keyboard: Press [F9].
 - "Project overview" (1): Click on]].
 - ⇒ The 'Transfer project' dialogue window will open.
- **2.** Highlight **I** the devices for which you want to transfer the project data in the first column of the list.
- 3. Click on 'Check'.
 - ⇒ The communication connection is checked. If no connection can be established to the selected devices, check if the connection cables are connected correctly. If required, check the communication settings. <a> Chapter 6.18.2 'Communication settings (PLC)' on page 109
- 4. Click on 'Transfer'.
 - ⇒ The project data for the selected devices are transferred to these devices.

The dialogue window will show if the transfer has been successful or if an error occurred.

5. Click on 'Close'.

5.11 Exporting a project 🕾

Projects can be exported and imported e.g. to use them on different computers. The open project including the user program and the visualisation can be saved in VPP format in an export file. This export file can be transferred and imported to another computer.

The project to be exported has to be open.

1. Select one of the following options if you want to export a project:

- Menu bar: Select 'Project → Export'.
- Keyboard: Press [F12].
- Project tree: Right-click with the mouse button on the project and, from the context menu, select 'Export'.
- ⇒ The 'Export project' dialogue window will open.
- **2.** Select a directory from the '*Export directory*' and enter a file name.
- 3. Click on 'Export'.
 - ⇒ The export process is started. All project data are saved in the export file (VPZ data format).

For the import of the export file: \bigcirc Chapter 5.12 'Importing a project \blacksquare 'on page 65

5.12 Importing a project ୠ

Projects can be exported and imported e.g. to use them on different computers. You can import an already created export file.

For creating an export file: \bigotimes Chapter 5.11 'Exporting a project \bigotimes ' on page 65

Print > General print configurations

If you want to import a Simatic project: 🖔 Chapter 8.28 'Import an S7 program 🛼' on page 278

- 1. Select one of the following options if you want to import a project:
 - Menu bar: Select 'File → Project import...'.
 - Keyboard: Press [Ctrl]+[F12].
 - ⇒ The 'Import project' dialogue window will open.
- 2. Select the directory and the export file (VPP or VPZ file format) from the 'Choose project file'.
- 3. Click on 'Import'.
 - ⇒ The import process is started. Project data are imported. The individual steps and results are shown in the dialogue window.
- 4. Click on 'Done'.

5.13 Print 🖴

You can print the project, parts of the project or single areas. In the print preview, you can check the layout.

Print project

Select one of the following options:

- Menu bar: Select 'File → Print' or 'Project → Print'.
- Toolbar: Click on 🚍.
- The 'Print' dialogue window will open. & Chapter 5.13.1 'General print configu-rations' on page 66

Print single area

- Program blocks
- ▶ In the project tree, click with the right mouse button onto the desired area and select 'Print'.



The following areas can be printed:

- Project
- Control
- PLC program
- Program block
- Variable table
- HMI device
- HMI image
- The 'Print' dialogue window will open. Schapter 5.13.1 'General print configu-⇒ rations' on page 66

5.13.1 General print configurations

Here, you can select a logo for the header and enter information for the footer of the document. In the print preview, you can check the layout.

Fig. 40: Print area (example:
variable table)

Managing and editing projects

Print > General print configurations

Print 🔮				×
General	Ge	neral		
Selection	Ge 2 3 4 5 6 7 8 8	neral Project Company Logo Creator Author Status Comment Comment (short) Program Layout	MyProject MyCustomer U:\SPEED7_Studio\Projects\lcon.png My Name Admin DRAFT Project 001 P001 Grouped by type *	
Save selection as	projec	t setting	🔄 Preview 📄 Print 🔀 C	ancel

Fig. 41: "General print settings" dialogue window

	Project Documentation	ť
ut a serve set	y - and the state and any	and the second
Creator: My Name	Project:	Date: 2017-03-24
Creator: My Name Author: Admin	Project: MyProject 1 Customer: MvCustomer 2	Date: 2017-03-24 Status: DRAFT

Fig. 42: Header and footer of the document

1. Program layout' -

In order to output the program blocks sorted according to block type, select 'Grouped according to type'.

In order to output the program blocks according to the order of calling, select *'Hierarchically'*.

- **2.** In order to adopt the configurations for all future print operations, select "Adopt selection as project configuration".
- **3.** Click on *'Print'* to print the document.
 - ⇒ The dialogue window "Print" will open.

Print > Select print areas

4. - or -

Click on 'Preview'.

⇒ The document will be generated and shown in the "Print preview". 5.14 'Print Preview a 'on page 69

5.13.2 Select print areas

You can select here, which parts of the project to print. In the print preview, you can check the layout.

This dialogue window is not shown if you want to print single program blocks, variable tables or HMI images.

Print Print			×
General Selection	Selection		
	Filters:	Select all	
	Selection:	Cover sheet	^
		Table of contents	
		Project	
		Hardware	
		Devices and Networks	
		Graphics overview	
		Connections overview	
		 Connections details 	
		🔲 Graphics overview <u>/</u>	
		▲ 🖉 PLCs	
		PLC01_[CPU_315-2AG13_315SB/DPM]	
		PLC01_[CPU_315-2AG13_315SB/DPM]	
		Graphics overview	
		🖉 Program	\sim
		▲ During the pre-processing of project data warning(s) occured!	
		Review 🚔 Print 🔀 Cance	el

Fig. 43: Dialogue window "Select print areas"

- **1.** Highlight **I** the areas you want to print. Deselect the areas **I** you don't want to print. The symbol **I** shows that not all parts are highlighted in one area.
- **2.** Click on '*Print*' to print the document.

⇒ The dialogue window "Print" will open.

3. or -

Click on 'Preview'.

⇒ The document will be generated and shown in the "Print preview". 5.14 'Print Preview (a) 'on page 69

5.14 Print Preview 🖳

In the print preview, you can check the layout of the document to be printed. Then, you can print the document or save in PDF or DOC format.

- ▶ In order to create and view the print preview, select one of the following options:
 - Menu bar: Select 'File → Print preview' or 'Project → Print preview'.
 - Toolbar: Click on <a>[,

You can also call up the print preview in the dialogue window of the print settings. *Chapter 5.13.1 'General print configurations' on page 66*

	Project Documentation	ť
		4
Table of Contents		
MyProject		
PLC 01 [CPU 315-20G13	315SB/DPM]	
Main [OB1]	51556/DFMJ	
Funktionsbaustein 1 (FB	1]	
Funktionsbaustein 1 1	DB1]	
Funktionsbaustein_1_1 [Hardware Variables	DB1]	
Funktionsbaustein_1_1 [Hardware Variables PLC Variables	DB1]	
Funktionsbaustein_1_1[Hardware Variables PLC Variables Assignments	DB1]	

Fig. 44: Print Preview

Toolbar

Save: Save the document in PDF or DOC format

Print: Print document

5.15 "Documentation" folder 💦

Text documents and further subfolders can be created in the 'Documentation' folder of the project tree.

____ To create a new project, click on the icon 'Create new text document ...'.

- or -

Right-click with the mouse button on the folder and select the desired command, e.g. *'Add new folder'*.

Double-click on a text document in order to open it in the text editor.

♦ Chapter 5.17 'Text editor (text document) 📄 ' on page 70

Text editor (text document)

5.16 Create a new text document 🛼

Creating a new text document

- **1.** Click on 'Create new text document' in the 'Documentation' folder in the project tree.
 - \Rightarrow A dialogue window for the input of a file name will open.
- **2.** Enter the file name in the input field and click on 'OK'.
 - ⇒ A new text document is created and displayed in the project tree.
 - If you have selected the option 'Open document after creation', the text editor is opened.

5.17 Text editor (text document)

Text documents can be edited and saved in the *'Text editor'*. In the *'Documentation'* folder, you can create a new text document or open an existing text document in the text editor. \bigcirc Chapter 5.15 "Documentation" folder $\boxed{1}$ on page 69

Segoe UI • 12 • 🕂 🗛 🐰 🚖 🖏 • ? ? F K U T • 🧮 🗮 🗐 🗄 ! 🗄 🚍 📰				
What is <u>SPEED7</u> Studio?	A			
The new intelligence of the hardware configuration, the intuitive user interface and the system openness makes SPEED7 Studio a powerful and easy to handle tool. We want to optimize automation tasks, reduce the development effort to a minimum, and avoid time and cost intensive software training. This allows the user to concentrate on his own engineering tasks. SPEED7 Studio consistently puts the emphasis on user friendliness. The new concept includes				
 Hardware configuration, Programming and networking, Parametrization of frequency converters and drives up to Visualization. 				
In the SPEED7 Studio editor design all functions, features and libraries are prepared and monitored automatically. Unique SPEED7 tools make the soft- ware attractive and efficient. High-Speed applications are compiled more ergonomically in the SPEED-Bus functions. EtherCAT and other fieldbusses are fully integrated. Applications are projected quickly and safely, loaded automatically and named with common symbolism in the EtherCAT configurator. Integrated SLIO functionalities, such as automatic current consumption calculation and integrated process image calculation makes SPEED7 Studio a highly efficient tool that holistically integrates the products of the SPEED7 world.				
	٣			
100%	5			

Fig. 45: Test editor

Editing a text document

____ Click on the desired text document in the 'Documentation' folder in the project tree.

 \Rightarrow The text editor will open.

Enter and format text

You can enter text in the editing area. You can format text with the toolbar:

- Font type and size
- Markup bold, italics or underlined
- Font colour

Text editor (text document)

- Text left-justified, centred, right-justified or fully justified
- Enlarging / reducing the indent
- Bullet points and numbering

"Project overview" editor

6 Selecting and configuring devices and components

6.1 "Project overview" editor 💿

In the *'Project overview'* editor, the devices of the open project are listed in a table. Here you can add devices. You can also translate, transfer and export the project.

If a project is open, you can open the *'Project overview'*. Select one of the following options to this end:

- Menu bar: Select 'Project → Project overview'.
- Toolbar: Click on 0.
- Project tree: Click on 'Project overview'.
- "Start page" . Click on 'Project overview'.

MyProject-Proje	ect overview	2		
Name	Туре	Comment:		
PLC_01	CPU 317-2AJ12 317SE/DPM			
DP_Slave_001				
DP_Slave_002				
HMI_01	TP 62M-JEE0			

Fig. 46: Project overview

- (1) Toolbar
- (2) List of devices

(1) Toolbar

Add new device: Add controls (PLC) or visualisation devices (HMI) & Chapter 6.3 'Add new device (PLC)' on page 77

Compile blocks: Compile (translate) all changed project blocks into error-free machine code & Chapter 8.18 'Compile user program' on page 245

Transfer project: Transfers the user program as well as all device configurations and visualisations of the project to the control

Export project: Exports all project data to the VPP file

(2) List of devices

Provides a list of projected devices.

'Name'

____ Click on the input field to change the device name.

'Type' - Device type

'Comment' - Any comment e.g. remark or explanation

Click on the input field to change the comment.
6.2 "Devices and networking" editor

In the *'Devices and networking'* editor, the devices of the open project are topologically illustrated, and the device details are listed. Here you can add or remove devices and connections. You can also access further device functions.

If a project is open, you can open the 'Devices and networking' editor. Select one of the following options to this end:

- Project tree: Click on 'Devices and networking'.
- Menu bar: Select 'Project → Devices and networking'.



Fig. 47: Devices and networking

- (1) Device topology
- (2) Device details

(1) Device topology

All devices of the project and their networking are displayed in the device topology. Here you can add or remove devices and connections. You can also access further device functions.

"Devices and networking" editor

Adding a device



Fig. 48: Adding device via "Catalog"

- (1) Select the desired object (hold left mouse button down)
- (2) Drag the object
- (3) Drop the object at a suitable place (release the mouse button)
- (4) The object is added
 - Drag the desired device from the 'Device templates' of the catalog to a suitable place.
 - \Rightarrow The device is added to the device topology.

Selecting a device

- Click on the device.
 - ⇒ The device details for the highlighted device are displayed. Fig. 47

Removing devices



Devices to which further devices are connected, e.g. via a bus system cannot be deleted. First, all connected devices must be deleted.

1. Right-click with the mouse button on the device and select 'Delete device'.

- A dialogue window will open, where you can select whether the device should be removed or not.
- 2. Click on 'Yes'.
 - \Rightarrow The device is removed from the device topology and the project.

Removing several devices	
	1. Keep the key [Ctrl] pressed down and click on the devices you want to remove.
	- or -
	If you want to remove several devices from one row, keep the key [Shift] pressed and click on the first and the last device in the row.
	2. Right-click with the mouse button on a device and select <i>Delete selected devices</i> .
	A dialogue window will open, where you can select whether the devices should be removed or not.
	3. Click on 'Yes'.
	\Rightarrow The devices are removed from the device topology and the project.
Opening device configura- tion or device overview	Double-click on a device
	PI C: The 'Device configuration' editor will open
	HMI: The 'Device eventiew' editor will open
	HMI. The <i>Device overview</i> editor will open.
Opening the bus system properties	
	Double-click on the connecting line of the bus system.
	⇒ The 'Bus system properties' dialogue window will open.
Add connection	 Right-click with the mouse button on the left connection point of the device from which the connection comes and select '<i>Insert new connection</i>'. Chapter 7.5.1 'Insert new connection' on page 187.
Accessing further func- tions	Right-click with the mouse button on the device or a connection point and select the desired command, e.g. 'Device properties' or 'Bus system properties'.
(2) Device details	The device details contain more information on a device or connections: ■
Connections Slot Componen	Chapter 6.2.2 'Connections' on page 76
Further configurations or information on a compo- nent	
	Double-click on a component.
	⇒ A dialogue window will open.

"Devices and networking" editor > Connections

6.2.1 Local components (= local modules)

Provides a list of details on the selected device, e.g. component assignment, order numbers or I/O addresses.

Local modules	Device: Pl	LC_01 *						
Local modules Device: PLC_01 Connections Slot Component Out 1 2 CPU 314-2AG13 314SB/DPM 314 -X2 MPI interface	OrderNo.	I-Address	O-Address	MPI / IP address	Cor	*		
ETE Connections	1							
	2	CPU 314-2AG13 314SB/DPM	314-2AG13					
	-X2	MPI interface		8191*		2		-
							100	%

Fig. 49: "Devices and networking" editor: Local components (= local modules)

'Device'

Here you can select the device for which you need details.

'Rack'

____ Here you can select the rack for which you need details.

'Slot' – Slot number within the rack

'Component' - Component name

'Order number' - Order number of the component

'I-Address' – Configured input address (byte address) of an input component or an input module

'O-Address' – Configured output address (byte address) of an output component or an output module

'MPI/IP address' - Address of a communication interface

'Comment' - Any comment e.g. remark or explanation

6.2.2 Connections

Show connections

To add connections: \Leftrightarrow Chapter 7.5.1 'Insert new connection' on page 187. Connections are represented by a connecting line in the *"Devices and networking"* editor.

Add new device (PLC)



Fig. 50: Connection between two controls in the "Devices and networking" editor If you mark a device in the device topology, the connections for this device are shown in the table.

👖 Local modules	odules	Filter: A	All conn	ections	*				
RTR Commission		Nar	me l	Local Id	Туре	Active Connection	Partner	Partner Id	
Connections	ions	PLC_	01-1	1	S7 connection	\checkmark	PLC_02 [CPU 315-4EC12 3155N/EC]	1	
Connections	ions	Nar PLC_	me l _01-1	Local Id 1	Type S7 connection	Active Connection	Partner PLC_02 [CPU 315-4EC12 315SN/EC]	Partner Id 1	

Fig. 51: Connections of the marked device in the "Devices and networking" editor

If you do not mark a device in the device topology, all connections are shown in the table.

Fit All connections	Filter: All connect	tions *							
	-	Connection endpoint 1 Connection endp					dpoint 2		
	Type	Endpoint	Id	Name	lame Active Connection Endpoint		Id	Name	Active Connection
	S7 connection	PLC_01 [CPU 315-4EC12 315SN/EC]	1	PLC_01-1	V	PLC_02 [CPU 315-4EC12 315SN/EC]	1	PLC_02-1	
	S7 connection	PLC_02 [CPU 315-4EC12 3155N/EC]	2	PLC_02-2		PLC_03 [CPU 315-4EC12 315SN/EC]	1	PLC_03-1	\checkmark

Fig. 52: All connections in the "Devices and networking" editor

Make connection settings

____ Double-click on a table entry.

⇒ The 'Connection settings' dialogue window will open. S Chapter 7.5.2 'Connection settings – General' on page 188

6.3 Add new device (PLC)

You can add controls (PLC) to a project. The added devices can then be configured, linked with further devices or provided with components e.g. signal module.

- Please also note Chapter 6.4 'Add new device (HMI)' on page 79 for adding HMI devices.
- Please also note Chapter 6.5 'Adding a new device (slave)' on page 83 for adding slaves.

Add new device (PLC)



Fig. 53: Add new device via "project tree"

- **1.** Select one of the following options if you want to add a new device:
 - Catalog: Drag the desired device from the 'Device templates' register of the catalog (S Chapter 4.9 'Catalog 'on page 30) to a suitable place or connecting line in the 'Devices and networking' editor. The device is directly added and displayed in the project tree. Chapter 4.17.3 'Mouse operation drag & drop' on page 50
 - Menu bar: Device 'Project → Add new device'.
 - Toolbar: Click on R.
 - Keyboard: Press [Ctrl]+[Shift]+[N].
 - Project tree: Click on 'Add new device'.
 - "Start page" . Click on 'Add new device'.
 - "Project overview" editor 1: Click on .
 - ⇒ The 'Add new device' dialogue window will open.



Fig. 54: "Add new device" dialogue window (PLC, HMI)

- 2. Select the desired device template from the list.
- **3.** *Device name*': Enter a device name, if required.
- 4. Click on 'OK'.



If you select the option 'Open device configuration' and click on 'OK', the added device is opened in the "Device configuration" editor.

 \Rightarrow The device is added and displayed in the project tree.

6.4 Add new device (HMI)

You can add HMI devices to a project. The added devices can then be configured, linked with further devices or provided with components e.g. signal module.

- Please also note S Chapter 6.3 'Add new device (PLC)' on page 77 for adding controls (PLC).
- Please also note Chapter 6.5 'Adding a new device (slave)' on page 83 for adding slaves.

To configure HMI devices and to create visualisations: *Chapter 9 'Creating a visualisation' on page 288*

Connect HMI device to an Ethernet interface



Fig. 55: Add new device via "project tree"

- **1.** Select one of the following options if you want to add a new HMI device:
 - Catalog: Drag the desired device from the 'Device templates' register of the catalog (S Chapter 4.9 'Catalog '' on page 30) to a suitable place in the 'Devices and networking' editor. The device is directly added and displayed in the project tree. Chapter 4.17.3 'Mouse operation drag & drop' on page 50
 - Menu bar: Device 'Project → Add new device'.
 - Toolbar: Click on
 - **Keyboard:** Press [*Ctrl*]+[*Shift*]+[*N*].
 - Project tree: Click on 'Add new device'.
 - "Start page" . Click on 'Add new device'.
 - "Project overview" editor 1: Click on 1:
 - ⇒ The 'Add new device' dialogue window will open.

Add new devic	e		×
	Add new device		
PLC	Device name: HMI_01		
	Chose a device template	Catalog informa	tion
	🔺 🖻 VIPA prof. Panels	Name:	TP 62M-JID0-CB
нмі	TP 62G-FID0-CB	Vendor:	VIPA GmbH
	TP 62I-JID0-CB	Runtime:	VIPA Web visualisation,
	TP 62K-JID0-CB		Movicon 11 CE Standard
	TP 62M-JID0-CB		
	TP 62G-FID0-CX		
	TP 62I-JID0-CX		P Parent
	TP 62K-JID0-CX		
	TP 62M-JID0-CX		
	VIPA Panel PCs		
	Web Visualisation		
	Connect with Movicon project		
	Create a Movicon project		
			🗸 OK 🛛 🔀 Cancel

Fig. 56: "Add new device" (HMI device) dialogue window **2.** Select *'HMI'*.

Add new device (HMI)

- 3. Select the desired device template from the list.
- **4.** *'Device name'*: Enter a device name, if required.
- **5.** Select one of the following options:
 - Web visualisation': Create standard HMI images
 - 'Connect Movicon project': Use existing Movicon project.
 - 'Create Movicon project': Create new Movicon project.

For more details on Movicon: Chapter 6.4.1 'Movicon project configurations' on page 82.

- 6. Click on 'OK'.
 - ⇒ The HMI device is added and displayed in the project tree.
- **7.** To connect the HMI device to an Ethernet interface of the control (CPU), you need to insert a new connection. *Chapter 7.5.1 'Insert new connection' on page 187*

Connect HMI device to the PG/OP interface

You can connect HMI devices to the Ethernet interface "PG/OP" of the control. However, you cannot then use this interface as a communication interface between the PC and the control.

Add new device (HMI)

A control with a PG/OP interface must be already available in the project. *Add new device (PLC)' on page 77*



Fig. 57: Adding HMI device via "Catalog"

- (1) Select the HMI device (hold left mouse button down)
- (2) Drag HMI device
- (3) Drop the HMI device at a suitable place (release the mouse button)
- (4) The HMI device is added

PLC_01 314-2AG13	PG_OP_Ether	rnet	
	P-Mastersystem	Interface properties	
	000	Determine accessible partner	
		Add new device	

Fig. 58: Add HMI device on the connecting line

- **1.** Select one of the following options if you want to add a new HMI device at the PG/OP interface of the control:
 - Catalog: Drag the desired HMI device from the 'Device templates' register of the catalog (Chapter 4.9 'Catalog ' on page 30) to the connecting line "PG_OP_Ethernet" in the 'Devices and networking' editor. Fig. 57 The HMI device is directly added and displayed in the project tree.
 - Editor "Devices and networking :: Right-click with the mouse button on the connecting line "PG_OP_Ethernet" and select 'Add new device'. Fig. 58
 - ⇒ The 'Add new device' dialogue window will open.
- **2.** Select the desired device template from the list. If necessary, enter a device name and click on *'OK'*.
 - ⇒ The HMI device is added and displayed in the project tree.

Add new device (HMI) > Movicon project configurations

6.4.1 Movicon project configurations

You can create an HMI device with the Movicon functionality. You can thus use the HMI device in a SCADA (Supervisory Control and Data Acquisition) system.

Add new devic	e		×
Add new devic PLC IMMI	Add new device		
PLC	Device name: HMI_01		
URM	Chose a device template	Catalog informa	tion
	VIPA Eco Panels	Name:	TP 62E-MGC0-CB
	VIPA Eco+ Panels	Vendor:	VIPA GmbH
	TP 62E-MGC0-CB	Runtime:	Movicon 11 CE Standard
	TP 62H-MGC0-CB		
	TP 62K-NHC0-CB		
	TP 62P-NHCO-CB		DOM NO.
	VIPA prof. Panels		Touch P
	VIPA Panel PCs		
	Web Visualisation		
	Connect with Movicon project		
	Create a Movicon project	s\Documents	
		, e e contente	
			🖌 OK 🛛 🔀 Cancel

Fig. 59: "Add new device" (HMI device) dialogue window

- **1.** If you add a new HMI device, you can select the Movicon functionality in the 'Add new device' dialogue window:
 - *Connect Movicon project*: Use existing Movicon project.
 Click on [] and select an already existing Movicon project.
 - 'Create Movicon project': Create new Movicon project.
 Click on [] and choose a directory in which the new Movicon project is to be saved.
- 2. Click on 'OK'.
 - ⇒ The HMI device is added and displayed in the project tree. You can recognise an HMI device with Movicon functionality by the symbol Q.

If you have selected the "Create Movicon project" option, the 'Movicon project settings' dialogue window will open.

- **3.** Enter a name for the Movicon project in the *'Movicon project settings'* dialogue window and click on *'Next'*.
- **4.** Select the control you would like to connect to the HMI device. Enter the IP address of the Ethernet interface of the control to which the HMI device is being connected.

If you want to correct the entry, click on *'Remove connection'*. The control is deleted from the input field and you can select a different control.

Click on 'Done'.

 \Rightarrow The Movicon project is created.

5. If you select the option 'Synchronise PLC variables marked for visualisation' in the 'Summary' dialogue window, the variables declared in the CPU are transferred into the standard variables table of the HMI project. Schapter 9.4 "Standard variables table" editor editor on page 292

If you select the option 'Open Movicon project', the external Movicon application is started (if available) and the project in it is opened.

To configure HMI devices and to create visualisations: *Chapter* 9 *'Creating a visualisation' on page 288*

6.5 Adding a new device (slave)

Different control systems support different bus systems e.g. PROFIBUS or EtherCAT. You can add slaves to the bus system of a control. The added slaves can then be configured or provided with components e.g. signal modules.

- To add a slave component: 🤄 'Add slave component' on page 83
- You can also connect controls (CPUs) to a DP master system as slaves. *trol (CPU) as slave' on page 85*

Add slave component

A control with the corresponding bus system must be already available in the project. & Chapter 6.3 'Add new device (PLC)' on page 77

Many device types are already pre-installed in *SPEED7 Studio* and are available in the *'catalog'*. To be able to use further device types in the project, you must install the device description file of the individual device types. *Schapter 6.8 'Installing device description files' on page 89*



Fig. 60: Adding slave via "Catalog"

- (1) Select the slave (hold left mouse button down)
- (2) Drag the slave
- (3) Drop the slave at a suitable place (release the mouse button)
- (4) The slave is added
- **1.** Select one of the following options if you want to add a new slave:
 - Catalog: Drag the desired slave from the 'Device templates' register of the catalog (Chapter 4.9 'Catalog ' on page 30) to the connecting line of the bus system in the 'Devices and networking' editor. Fig. 60 The slave is directly added and displayed in the project tree.
 - Project tree: Within the PLC under 'Decentralised periphery' and the suitable bus system (e.g. DP master system), click on 'Add new device'. Fig. 61
 - "Devices and networking" editor :: Right-click with the mouse button on the connecting line of the corresponding bus system (e.g. DP master system) and select 'Add new device'.
 - ⇒ The 'Add new device' dialogue window will open.



Fig. 61: Adding slave via "*Project tree*"

Add new devic	e				×
	Add new device				
SLIO	Device name:	DP_Slave_002			
	Number:	1	Catalog information		
	Chose a device	template			
Drives	SLIO 05	3-1DP00	Name:	SLIO 053-1DP00	
			Vendor:	VIPA GmbH	
200V			Version of device description:	2.51	
			Order info:	SLIO 053-1DP00	
GSD					
				🗸 OK 🛛 🔀 Car	icel

Fig. 62: "Add a new device" (slave) dialogue window

- **2.** Select the device type on the left, e.g. 'SLIO'.
- 3. Select the desired device template from the list.
- **4.** *'Device name'*: Enter a device name, if required.
- **5.** *DP address'* (only for PROFIBUS-DP, GSD): Select the desired station address. *DNS name'* (only for PROFINET, GSDML): Enter the bus device name, if required.
- 6. Click on 'OK'.
 - \Rightarrow The slave is added and displayed in the project tree.



If you enter a value in the 'Number' box, several slaves of the same type are added.

Add control (CPU) as slave

You can connect controls to a DP master system as slaves.

Catalog information						
Name:	CPU 215-2BP03					
Vendor:	VIPA GmbH					
Version of device description:	2.48					
Order info:	215-2BP03					
Description						
CPU, 128 KB work memory, MPI connection, PROFIBUS-DP interface module (slave) multi- tier configuration up to 32 modules						

If you want to connect a control, ensure that this control supports the PROFIBUS-DPswitching-on unit as slave (see e. g. under "Catalog information").

Note that the PROFIBUS functionality must be activated for some control types. *Chapter 6.3 'Add new device (PLC)' on page 77*

A control with DP master system which you want to add the other control to as slave must already be available in the project.

1. Add both the control with the DP master system and the control which is to be connected as slave to the project. *Chapter 6.3 'Add new device (PLC)' on page 77*



Fig. 63: Controls in the "Devices and networking" editor

- (1) Control with DP master system
- (2) Control which is to be connected as slave
- **2.** Open the 'Device configuration' of the added control. Select one of the following options to this end:
 - Project tree: Click on 'Device configuration' within the control.
 - "Devices and networking" editor :: Double-click on the control.



Fig. 64: "Device configuration" editor of the control which is to be connected as slave

3. Double-click on the line with the entry "PROFIBUS Slave" in the device details table in the bottom part.

⇒ The 'Interface properties' dialogue window will open.

Interface properties		×
General Operating Mode I/O Co	Configuration	
mode		
DP Master		
Configurations slave		
IO-system PLC_01		
Diagnostic addresses	Slave parameter addresses	
Diagnostic address: 0 🗘	Parameter telegram	
	Diagnostics data 989	
	Station data 987	
	🖌 0	K

Fig. 65: "Interface properties" dialogue window, "Operating Mode" tab

- **4.** Click on the 'Operating Mode' tab and select the control which you want to connect the device to under 'IO-system'.
- 5. Click on 'OK'.
 - A dialogue window will open, where you can select whether you want to add the device to the DP master system of the other control. Confirm this question with 'Yes'. The device is added as slave.

PLC_01 315-2AG13
PG_OP_Ethernet
DP-Mastersystem (1)
PLC_02 215-28P03

Fig. 66: Control with DP master system and connected control as slave

6.6 Removing devices

Any device which is no longer required, e.g. if you want to replace it by a new device of another type, can be removed from the project.

- Select one of the following options if you want to delete a device from the project:
 - Project tree: Right-click with the mouse button on the device and, from the context menu, select 'Delete device'.
 - "Devices and networking" editor :: Right-click with the mouse button on the device and select 'Delete device'.
 - or -

Left-click with the mouse button on the device and press [Del].

⇒ The device is removed from the project. The I/O addresses formerly assigned to the device are available.



Devices to which further devices are connected, e.g. via a bus system cannot be deleted. First, all connected devices must be deleted.

6.7 Duplicate device

You can duplicate a device, e.g. if you want to project several devices of the same type with similar configuration.

Select one of the following options if you want to duplicate a device in the project:

- Project tree: Right-click with the mouse button on the device and, from the context menu, select 'Duplicate device'.
- "Devices and networking" editor :: Right-click with the mouse button on the device and select 'Duplicate device'.
- ⇒ The device is duplicated and added to the project tree with a new device name. All configuration data and the user program is copied at the same time.

6.8 Installing device description files

In a device description file, the properties of a device type are defined. Many device types are already pre-installed in *SPEED7 Studio* and are available in the *'catalog'*. To be able to use further device types in the project, you must install the device description file of the desired device type.

A variety of device description files are used for the various communication systems:

- PROFIBUS: GSD file (General Station Description) Chapter 6.9 'PROFIBUS – GSD 'on page 90
- PROFINET: GSDML file (GSD Markup Language) GSDML and 'on page 92
- EtherCAT: ESI file (EtherCAT Slave Information) on page 95

PROFIBUS – GSD > New GSD file

6.9 PROFIBUS – GSD 🚠

Here you can install the GSD files for PROFIBUS DP slaves and have the installed device types shown to you.

- 1. ▶ Select in the menu bar 'Extra → Install device description file (PROFIBUS GSD)'
 - ⇒ The 'Install device description file' dialogue window will open.
- **2.** Click on the desired section:
 - 'New GSD file' Install device description files S Chapter 6.9.1 'New GSD file' on page 90
 - 'Installed GSD files' Show all installed device description files & Chapter 6.9.2 'Installed GSD files' on page 91

6.9.1 New GSD file

SPEED7 Studio	Developme	ent Line						
New GSD file	Install (GSD fil	e					
Installed GSD files	Sou	rce						
	So	ource pa	th: C:\Users\P \GsdFiles	C:\Users\Public\Documents\VIPA GmbH\SPEED7 Studio\Profibus \GsdFiles				
			Include :					
				🔍 Star	t reading			
	Files	s found						
			File	Info	Status	Order number	Vendor	
	1		2532dp20.gsd	VIPA_253_2DP20	installed	VIPA 253-2DP20	VIPA GmbH	-
	2		2532dp20.gse	VIPA_253_2DP20	installed	VIPA 253-2DP20	VIPA GmbH	
	3		2532dp20.gsg	VIPA_253_2DP20	installed	VIPA 253-2DP20	VIPA GmbH	
	4		speedbus.gsd	VIPA_SPEEDbus	installed	VIPA SPEEDbus	VIPA GmbH	
	5		speedbus.gse	VIPA_SPEEDbus	installed	VIPA SPEEDbus	VIPA GmbH	
	6		speedbus.gsg	VIPA_SPEEDbus	installed	VIPA SPEEDbus	VIPA GmbH	
	7		vi0008d1.qsd	VIPA 253-1DP01 (DPV0)	installed	VIPA 253-1DP01	VIPA GmbH	1
						1	Install	
							🖌 ок	

Fig. 67: Install GSD file

Source

'Source path' - Directory containing the GSD files to be installed.

____ Click on the field *'…'* to select another directory.

'Include subfolders' – Activate this option if there are GSD files in sub-directories of the source path.

Click on 'Start reading'.

⇒ In the 'Files found' table, all GSD files are shown that were found in the source path.

PROFIBUS – GSD > Installed GSD files

Files found	Provides a list of GSD files found in the source path.
	To refresh the table, click on <i>'Start reading'</i> .
Installing the device description file	
	In the second column of the table, highlight with the GSD files that you would like to install.
	- or -
	In the title row of the table, click on 📝 to select all the GSD files.
	2. Click on <i>'Install'</i> .
	The selected GSD files are installed and adopted into the catalog (S Chapter 4.9 'Catalog ' on page 30). The installed device types are shown in the 'Device templates' register.
	If the selected GSD file has been installed already, a dialogue window will open. Choose whether you want to replace the GSD file or not. Select 'Apply for all' in order to apply the process to all files.
	GSD files GSD files are composed in ASCII format.
	Each GSD file contains the device description in one language. You can recognise which language the GSD file is composed in the 'Language' column and by the last letters of the file extension:
	 gsd: Default (standard language) gse: English gsg: German
	The device description can be shown only in languages (🌣 Chapter 4.4

6.9.2 Installed GSD files

Here you can see a table with the GSD files installed in *SPEED7 Studio*. The installed device types can be used in the project. They are shown in the catalog (\Leftrightarrow *Chapter 4.9 'Catalog* \gtrsim ' *on page 30*) in the *'Device templates'* register.

'Select language' on page 22) in which a GSD file is installed.

PROFINET – GSDML

/ GSD file	Insta	alleo	d GSD files					
alled GSD files			File	Info	Order number	Vendor	Туре	Langua
		1	2532dp20.gsd	VIPA_253_2DP20	VIPA 253-2DP20	VIPA GmbH	IO	Specific
		2	2532dp20.gse	VIPA_253_2DP20	VIPA 253-2DP20	VIPA GmbH	IO	English
		3	2532dp20.gsg	VIPA_253_2DP20	VIPA 253-2DP20	VIPA GmbH	IO	Germar
		4	speedbus.gsd	VIPA_SPEEDbus	VIPA SPEEDbus	VIPA GmbH	IO	Specific
		5	speedbus.gse	VIPA_SPEEDbus	VIPA SPEEDbus	VIPA GmbH	IO	English
		6	speedbus.gsg	VIPA_SPEEDbus	VIPA SPEEDbus	VIPA GmbH	IO	Germar
		7	vi0008d1.gsd	VIPA 253-1DP01 (DPV0)	VIPA 253-1DP01	VIPA GmbH	IO	Specific
		8	vi0008d1.gse	VIPA 253-1DP01 (DPV0)	VIPA 253-1DP01	VIPA GmbH	IO	English
		9	vi0008d1.gsg	VIPA 253-1DP01 (DPV0)	VIPA 253-1DP01	VIPA GmbH	IO	Germar
		10	vi000a26.gsd	VIPA 253-1DP31 (DPV0)	VIPA 253-1DP31	VIPA GmbH	IO	Specific
		11	vi000a26.gse	VIPA 253-1DP31 (DPV0)	VIPA 253-1DP31	VIPA GmbH	IO	English
		12	vi000a26.gsg	VIPA 253-1DP31 (DPV0)	VIPA 253-1DP31	VIPA GmbH	IO	Germar
		13	vi0108d1.gsd	VIPA 253-1DP01 (DPV1)	VIPA 253-1DP01	VIPA GmbH	IO	Specific
		14	vi0108d1.gse	VIPA 253-1DP01 (DPV1)	VIPA 253-1DP01	VIPA GmbH	IO	English
		4	104.00 M	III	1001 050 40004		10	~ +

Fig. 68: Installed GSD files

6.10 PROFINET – GSDML 🚠

Here you can install the GSDML files for PROFINET partners and have the installed device types shown to you.

- **1.** Select in the menu bar *'Extra*
 - ➔ Install device description file (PROFINET GSDML)'
 - ⇒ The 'Install device description file' dialogue window will open.
- **2.** Click on the desired section:
 - 'New GSDML file' Install device description files & Chapter 6.10.1 'New GSDML file' on page 93
 - 'Installed GSDML files' Show all installed device description files & Chapter 6.10.2 'Installed GSDML files' on page 94

PROFINET – GSDML > New GSDML file

6.10.1 New GSDML file

									-
SPEED7 Studio	Develo	opme	nt Line						
New GSDML file	Inst	tall G	SDMI	. fil	e				
Installed GSDML files		Sour	ce						
		So	urce pa	th:	C:\Users\Public\Documents\VIPA Gm \GsdmlFiles	bH\SPEED7	7 Studio\Profinet	Q,	
					Include subfolders				
					🔍 Start r	eading			
		Files	found						
				Fil	e	Version	Language	Status	•
		1		gsø	dml-v2.2-yaskawa-siep3-20100726.xml	v2.2	Englisch	installed	S
		2		gso	dml-v2.3-vipa-slio-20141103.xml	V2.3	Englisch, Deutsch	installed	F
						_			
		< _			m				•
							- Inst	tall	
								🖌 ок	
				_					_

Fig. 69: Install GSDML file

Source

	Click on the field '' to select another directory.
	<i>'Include subfolders'</i> – Activate this option if there are GSDML files in sub-directories of the source path.
	Click on <i>'Start reading'</i> .
	⇒ In the 'Files found' table, all GSDML files are shown that were found in the source path.
Files found	Provides a list of GSDML files found in the source path.
	To refresh the table, click on <i>'Start reading'</i> .
Installing the device description file	
	In the second column of the table, highlight the GSDML files that you would like to install.
	- or -
	In the title row of the table, click on $\overline{\mathbf{v}}$ to select all the GSDML files.

'Source path' – Directory containing the GSDML files to be installed.

PROFINET – GSDML > Installed GSDML files

- 2. Click on 'Install'.
 - ⇒ The selected GSDML files are installed and adopted into the catalog
 (♦ Chapter 4.9 'Catalog X' on page 30). The installed device types are shown in the 'Device templates' register.

If the selected GSDML file has been installed already, a dialogue window will open. Choose whether you want to replace the GSDML file or not. Select 'Apply for all' in order to apply the process to all files.

(
	_	

GSDML files

GSDML files are composed as an XML document. The file extension is ".xml".

All the languages available for a device type (see 'Language' column) are contained in a GSDML file. The device description can be shown only in languages (& Chapter 4.4 'Select language' on page 22) contained in the GSDML file.

6.10.2 Installed GSDML files

Here you can see a table with the GSDML files installed in *SPEED7 Studio*. The installed device types can be used in the project. They are shown in the catalog (\Leftrightarrow *Chapter 4.9 'Catalog* \gtrsim ' *on page 30*) in the *'Device templates'* register.

SPEED7 Studio D	Develo	pmer	nt Line				
New GSDML file	Inst	allec	d GSDML files				
Installed GSDML files			File	Version	Info	Vendor	
		1	gsdml-v2.2-yaskawa-siep3-20100726.xml	v2.2	Drives	Yaskawa America, Inc	
		2	gsdml-v2.3-vipa-slio-20141103.xml	V2.3	I/O	VIPA GmbH	
						🗸 OF	<

Fig. 70: Installed GSDML files

6.11 EtherCAT – ESI 🚠

Here you can install the ESI files for EtherCAT slaves and have the installed device types shown to you.

- 1. ▶ Select in the menu bar 'Extra → Install device description file (EtherCAT ESI)'-
 - ⇒ The 'Install device description file' dialogue window will open.
- **2.** Click on the desired section:
 - 'New ESI file' Install device description files & Chapter 6.11.1 'New ESI file' on page 95
 - 'Installed ESI files' Show all installed device description files 6.11.2 'Installed ESI files' on page 96

6.11.1 New ESI file

	Installa	ition o	r device description file		
nstalled ESI files	Sou	irce			
	So	ource pa	th: C:\Users\Public\Documents\VIPA GmbH\SPEED7 \EsiFiles	Studio\EtherCAT	
			🔍 Start reading		
	Fou	ind			
			File	Vendor	
	1		ESI_SIES3_OPT_V_1_03_01.xml	Yaskawa Electric Corpora	əti
	2		Vipa 053-1EC00 MDP.xml	VIPA GmbH	
	3		Yaskawa SGDV-E1_CoE rev5.00.xml	Yaskawa Electric Corpora	əti
	4		Yaskawa SGDV-E1_CoE_rev5.04.xml	Yaskawa Electric Corpora	əti
	5		Yaskawa SGDV-E5_CoE rev5.00.xml	Yaskawa Electric Corpora	əti
	6		Yaskawa_SGD7S-xxxxA0xxxxF64_400V_CoE_rev7.03.xml	Yaskawa Electric Corpora	əti
	7		Yaskawa_SGD7S-xxxxA0x_CoE_rev6.01.xml	Yaskawa Electric Corpora	ati
	-	_]	Þ
				installing	

Fig. 71: Install ESI file

Source

'Source path – Directory containing the ESI files to be installed.'

____ Click on the field '...' to select another directory.

'Include subfolders' – Activate this option if there are ESI files in subdirectories of the source path.

- Click on 'Start reading'.
 - ⇒ In the 'Files found' table, all ESI files are shown that were found in the source path.

Selecting and configuring devices and components

EtherCAT – ESI > Installed ESI files

Files found

Provides a list of ESI files found in the source path.

To refresh the table, click on 'Start reading'.

Installing the device description file

1. In the second column of the table, highlight vert the ESI files that you would like to install.

- or -

In the title row of the table, click on $\overline{\mathbf{v}}$ to select all the ESI files.

- 2. Click on 'Install'.
 - ⇒ The selected ESI files are installed and adopted into the catalog (∜ Chapter 4.9 'Catalog ☆' on page 30). The installed device types are shown in the 'Device templates' register.

If the selected ESI file has been installed already, a dialogue window will open. Choose whether you want to replace the ESI file or not. Select 'Apply for all' in order to apply the process to all files.

ESI files

ESI files are composed as an XML document. The file extension is ".xml".

6.11.2 Installed ESI files

Here you can see a table with the ESI files installed in *SPEED7 Studio*. The installed device types can be used in the project. They are shown in the catalog (\Leftrightarrow *Chapter 4.9 'Catalog* \gtrsim ' *on page 30*) in the *'Device templates'* register.

"Device configuration" editor (PLC)

SPEED7 Studio De	evelopmer	nt Line		
New ESI file	Installed	ESI files		
Installed ESI files		Vendor	File	Numl
	1	VIPA GmbH	Vipa 053-1EC00 MDP.xml	3
	2	Yaskawa Electric Corporation	ESI_SIES3_OPT_V_1_03_01.xml	1
	3	Yaskawa Electric Corporation	Yaskawa SGDV-E1_CoE rev5.00.xml	6
	4	Yaskawa Electric Corporation	Yaskawa SGDV-E1_CoE_rev5.04.xml	1
	5	Yaskawa Electric Corporation	Yaskawa SGDV-E5_CoE rev5.00.xml	6
	6	Yaskawa Electric Corporation	Yaskawa_SGD7S-xxxxA0xxxxF64_400V_CoE_rev7.03.xml	1
	7	Yaskawa Electric Corporation	Yaskawa_SGD7S-xxxxA0x_CoE_rev6.01.xml	1
	8	Yaskawa Electric Corporation	Yaskawa_SGDV-E5_CoE_rev5.04.xml	1
	4		III	÷.
			√ (ЭК

Fig. 72: Installed ESI files

6.12 "Device configuration" editor (PLC)

Images of the PLC layout and a list of device details are provided in the *'Device configuration'* editor. Here you can configure the device and included components as well as add or remove components.

If a project is opened and a PLC is included, you can open the *'Device configuration'*. Select one of the following options to this end:

- **Project tree:** Click on *'Device configuration'* within the PLC.
- "Devices and networking" editor 🚉: Double-click on a PLC.

"Device configuration" editor (PLC)

F		0							
PL	C01 [0	CPU 317-2AJ12 3175E	/DPM]						
5	1	2 PLC_01	4 DI 16xDC24V 5 DI 16xD	C24V 6 DO 32	2xDC24V 7	8	9	10	11
Sneed 7			Biblickey II Biblickey DL_0_0 0 DL_0_1 0 DL_0_2 1 DL_0_2 1 DL_0_1 0 DL_0_1 0 DL_0_2 1 DL_0_4 0 DL_0_5 5 DL_0_6 0 DL_0_7 7 SM 321 0 DL_1_1 1 DL_1_2 0 DL_1_3 0 DL_1_4 0 DL_1_5 5 DL_1_6 0 DL_1_7 7 DL_1_6 0 DL_1_6 0 DL_1_6 0 DL_1_7 7 DL_1_7 7	00 33:00:34 0 0 30:00:34 0 0 30 30 30 0 0 30 0 0 30 30 0 0 0 0 0 0 0 0	0.0 0 0.1 0 0.2 0 0.3 0 0.4 0 0.4 0 0.4 0 0.4 0 0.5 0 0.6 0 0.7 7 0.8 0 0.9	2			
							0		
4					•				•
Dev	ice: PL(C01 [CPU 317-2AJ12 317	SE/DPM]	Rack:	UR 0	•			
	Slot	Component	OrderNo.	I-Adress	O-Adress	Comment			^
	- 12	Dr-Mastersystem(1)		0150		8			
	4	DI16xDC24V	6ES7 321-18H50-0AA0	0-1					_
	5	DI16xO-Adress	6ES7 321-1BH50-0AA0	4-5					
	6	D032xDC24V/0.5A	6557 322 18L00 0AA0		8 11				-

Fig. 73: Device configuration of a PLC

- (1) Toolbar
- (2) Device configuration
- (3) Device details

(1) Toolbar

Transfer hardware configuration: The current device configuration is transferred to the
control. Blocks of the user program are not transferred.

- Hardware configuration online view: The condition of the input and output signals is displayed on the components. Schapter 6.12.2 'Show output signals' on page 100
- (2) Device configuration The device configuration shows all components which are connected with the device via the rack. Here you can add or remove components. You can also access further component functions.

Showing/hiding slots For a clear presentation, you can show or hide several slots. The slots are displayed in groups e.g. "4..11", "12..19", etc.

Hiding slots/components

"Device configuration" editor (PLC)

\triangleright	Showing slots/components
	 Hidden components are not displayed in the editor. They are, however, still present in the project configuration.
Adding components	Drag the desired component from the 'Components' register of the catalog to a free
	slot. <i>♦ Chapter 6.14 'Adding components' on page 102</i> ⇒ The component is added to the device.
Removing components	
	 1. ■ Right-click with the mouse button on the component and select 'Delete component'. ⇒ A dialogue window will open, where you can select whether the component should be retained or deleted. 2. ■ Click on 'Yes'. ⇒ The component is removed from the device and the project.
Opening the properties of the component	
	Double-click on a component.
	⇒ CPU: The dialogue window of the CPU properties will open. <i>Solution Properties of the module (CPU) Solution of the properties of the module (CPU) Solution Solutio</i>
	Other components: The dialogue window of the Component properties will open. Chapter 6.24 'Component properties (MICRO modules) on page 134 Chapter 6.23 'Properties of the module (SLIO modules) on page 132 Chapter 6.22 'Component properties (300S modules) on page 129
Accessing further func- tions	
	Right-click with the mouse button on the component and select the desired command, e.g. <i>'Component properties'</i> .
(3) Device details	Provides a list of details on the device, e.g. component assignment, order numbers or I/O addresses.
	'Rack'
	▶ Here you can select the rack for which you need details.
	<i>Slot'</i> – Slot number within the rack
	<i>'Component'</i> – Component name
	'Order number' – Order number of the component
	'I-Address' – Configured input address (byte address) of an input component
	'O-Address' – Configured output address (byte address) of an output component

"Device configuration" editor (slave)

'MPI/IP address' - Address of a communication interface

'Comment' - Any comment e.g. remark or explanation

Adding components

- Drag the desired component from the 'Component' register of the catalog to a free line.
 - \Rightarrow The component is added to the device.
- 6.12.1 Display output current and add power modules (SLIO only)

Display output current

5V		245/30	Am 00		
1	2	3	4	5	6
RUN VIIRA	DOAX DCIAV 0,5A RUN MI	DOBX DC2AV 0,5A RUN No	RUN UIDA		

In the SLIO system (Slize I/O), the power consumption of the projected modules is calculated and displayed. Once approximately 70% of the maximum power consumption on the backplane bus has been reached, the colour of the arrow changes from green to orange. Once approximately 90% of the maximum power consumption has been reached, the colour changes to red.

Add power modules

2555/30	100 mA	
29	R	Add power module
	DC24V 2	Delete power module
D MP VIPA	UIPA	

reached, the colour changes to red.

You can expand the voltage supply in a SLIO system by adding power modules.

- Right-click with the mouse button on the arrow at the slot position where you want to add a power module. Select 'Add power module'.
 - ⇒ The added power module is shown at the slot position. The power consumption on the right beside the power module is recalculated.

6.12.2 Show output signals



If you have transferred the hardware configuration and the user program into the control, you can show the condition of the output signals (green LEDs) on the components in the "Device configuration is "editor.

Create a communication connection to the control. & Chapter 6.18.2 'Communication settings (PLC)' on page 109

- Select one of the following options to switch the display on or off:
 - Menu bar: Select 'Device configuration → Hardware configuration online view'.
 - "Device configuration" editor :: Click on the button in the toolbar of the editor.
 - ⇒ The condition of the output signals (green LEDs) is displayed in the editor.

6.13 "Device configuration" editor (slave) 🌆

Images of the slave layout and a list of device details are provided in the *'Device configuration'* editor. Here you can configure the device and included components as well as add or remove components.

If a project is opened and it includes a slave, you can open the *'Device configuration'*. Select one of the following options to this end:

- **Project tree:** Click on *'Device configuration'* within the slave.
- "Devices and networking" editor : Double-click on a slave.

"Device configuration" editor (slave)



Fig. 74: Device configuration of a slave

- (1) Device configuration
- (2) Device details

(1) Device configuration The device configuration shows all components which are connected with the device via the rack. Here you can add or remove components. You can also access further component functions.

Showing/hiding slots

- For a clear presentation, you can show or hide ten slots. The slots are displayed in groups "1..9", "10..19", etc.
 - Hiding slots/components <

Showing slots/components >



Hidden components are not displayed in the editor. They are, however, still present in the project configuration.

Adding components				
Adding components				
	Drag the desired component from the 'Components' register of the catalog to a free slot. Chapter 6.14 'Adding components' on page 102			
	\Rightarrow The component is added to the device.			
Removing components				
	Right-click with the mouse button on the component and select 'Delete component'.			
	\Rightarrow The component is removed from the device and the project.			
Opening the properties of the component				
	Double-click on a component.			
	⇒ The dialogue window of the Component properties will open. Schapter 6.21 (Properties of the module (CPU) (Properties (MICRO modules)) (Properties (MICRO modules)) (Properties of the module (SLIO modules)) (Properties of the mo			
Accessing further func- tions				
	Right-click with the mouse button on the component and select the desired com- mand, e.g. 'Component properties'.			
(2) Device details	Provides a list of details on the device, e.g. component assignment, order numbers or I/O addresses.			
	'Slot' – Slot number within the rack			
	<i>'Component'</i> – Component name			
	'Order number' – Order number of the component			
	<i>'I-Address'</i> – Configured input address (byte address) of an input component or an input module			
	'O-Address' – Configured output address (byte address) of an output component or an output module			
	<i>'Comment'</i> – Any comment e.g. remark or explanation			
Adding components				
	Drag the desired component from the 'Component' register of the catalog to a free line.			

 \Rightarrow The component is added to the device.

6.14 Adding components

You can add components e.g. signal or interface modules to a control. The order of the components in the project must comply with the order of the actually connected components.

A control must already be available in the project. \Leftrightarrow Chapter 6.3 'Add new device (PLC)' on page 77

Adding components

The 'Device configuration' editor must be open.

- ♦ Chapter 6.12 "Device configuration" editor (PLC) Loi on page 97
- ♦ Chapter 6.13 "Device configuration" editor (slave) 100

You can add components in a variety of ways:

- Drag & drop component
- Highlight slot and select component

Drag & drop component You can drag the component out of the catalog and drop it either in the device configuration or in the table with the device details: Adding components



Fig. 75: Add the component (device configuration)

- (1) Select the component (hold left mouse button down)
- (2) Drag the component
- (3) Drop the component at a free slot (release mouse button)

Adding components



Fig. 76: Add component (table with device details)

- (1) Select the component (hold left mouse button down)
- (2) Drag the component
- (3) Drop the component at a free slot (release mouse button)
- Drag the desired component from the 'Components' register of the catalog to a free slot.
 - \Rightarrow The component is added to the device.

Removing components

Highlight slot and select component



Fig. 77: Add component (highlight slot and insert component)

- (1) Highlight slot (click)
- (2) Select component (double click)
- **1.** With the left mouse button, highlight the slot into which the component is to be inserted.
 - \Rightarrow The slot is highlighted.
- 2. In the 'Components' register of the catalog, double click on the desired component
 - \Rightarrow The component is added to the device.

6.15 Removing components

Any component which is no longer required, e.g. if you want to replace it by a component of another type, can be removed from the device.

Changing device properties



- In the "Device configuration" editor is, right-click with the mouse button on the component and select 'Delete component'.
 - ⇒ The component is removed from the device and the project. The I/O addresses formerly assigned to the component are available.

6.16 **Printing labels**

You can create a labelling strip as a PDF file for each component. On the labelling strip, the designations are shown that are indicated in the "Alias" column of the system hardware configuration (& Chapter 8.13 "System hardware configuration" editor on page 232).

- **1.** Mark the desired component in the *'Device configuration'* editor. If you want to save labelling strips for several components in one PDF file, mark all the desired components. To do so, keep the *[Ctrl]* key pressed down.
- **2.** Right-click with the mouse button on a component and select 'Printing labels'.
 - ⇒ The 'Save as' dialogue window will open.
- 3. Select a directory, enter a file name and click on 'Save'.
 - ⇒ The labelling strip is saved as a PDF document.

6.17 Changing device properties

You can change the comment of PLC, HMI or slaves and perform the communication settings for PLC and HMI.

- PLC: Shapter 6.12 "Device configuration" editor (PLC) so on page 97
- HMI: 🗞 Chapter 9.3 "Device properties" editor (HMI device) 🐻 on page 289

"Device properties" editor (PLC) > General device properties (PLC)

6.18 "Device properties" editor (PLC) h

General information on the control, as well as the communication settings are displayed in the *'Device properties'* editor. Here you can change the device name and the comment as well as make communication settings.

If a project is open and a control is included, you can open the 'Device properties':

- **Project tree:** Click on *'Device properties'* in the PLC.
- "Devices and networking" editor :: Right-click with the mouse button on the device and select 'Device properties'.

For the device properties of a visualisation device (HMI): Schapter 9.3 "Device properties" editor (HMI device) on page 289

The 'Device propertie	s' editor is divided	d into several sections.
-----------------------	----------------------	--------------------------

6.18.1 General device properties (PLC)

Device properties

2

General Communication

To display or change the device properties of the control, you must proceed as follows:

You have accessed the 'General' section in the 'Device properties' editor of the control. & Chapter 6.18 "Device properties" editor (PLC) b' on page 108

	Name:	PLC_01	
7 -	Author:	Administrator	
mment:			

Fig. 78: Device properties of a PLC, as an example

'Device type' - Name of the CPU

'Name' – Device name: The name is displayed in the project tree. To change the name: *Chapter 6.1 "Project overview" editor (i) on page 72* and *Chapter 6.21.1 General on page 117*

'Author' - Name of the responsible person who created the block

'Comment' – Any comment e.g. remark or explanation
"Device properties" editor (PLC) > Communication settings (PLC)

Click on the input field and enter any comment, e.g. an annotation or explanation. With the [Enter] key, you can add a new line to the input field.

6.18.2 Communication settings (PLC)

The communication settings are used to configure the interface for the data exchange between programming device and control (PLC). You can directly connect the devices with each other or via a network. The data exchange takes place via a serial or Ethernet interface.

Under 'Extras \rightarrow Configurations' you can determine which network adapters or ports should be used as a standard. \Leftrightarrow Chapter 4.6 'Select interfaces' on page 23

You have accessed the 'Communication' section in the 'Device properties' editor of the control. Chapter 6.18 "Device properties" editor (PLC) on page 108

Communication	configurations		
Active pc interfa	ce: Ethernet interface	*	law Verify connection
	🗰 Accessible p	artners	
Properties of Ser	ial interface		
PC interface:			
COM port	-	Baudrate 11	5,200 Bit/s *
CPU interface:	-X2: MPI interface	-	interface configuration
Properties of eth PC interface: CPU interface:	Microsoft 192.168.178.22 -X4: PG_OP_Ethernet 192.168.10.100	•) interface configuration
Properties of sim	ulation interface		
PC interface:	Microsoft	*	
CPU interface:	192.168.178.22 SPEED7 Simulation	•) interface configuration
	0.0.0.0		

Fig. 79: Communication settings

"Device properties" editor (PLC) > Communication settings (PLC)

- If you wish to select the serial interface for the data exchange between the programming device and the control, continue with 'Setting the serial interface' on page 110.
- If you wish to select the Ethernet interface for the data exchange between the programming device and the control, continue with ♦ 'Setting the Ethernet interface' on page 110.

Setting the serial interface

- **1.** Active PC interface': Select 'Serial interface'.
- 2. COM port': Select the desired port number of the serial interface of the programming device from the list.



If no port number is displayed, there is no serial interface installed on your programming device, or the interface is deactivated.

- 3. **Baud rate**': Select the desired transmission rate (Bit/s).
- 4. CPU interface': Select the desired interface of the control from the list.
- **5.** To perform further configuration of the interface, click on *'interface configuration'*. \Leftrightarrow *Chapter 6.21.1 'General' on page 117*
- **6.** In order to check whether a connection between the programming device and the control can be established with the selected communication settings, click on *'Verify connection'*.
 - ⇒ You can see in the status line, whether the connection could be established successfully.
- **7.** In order to check whether your programming device is connected with the correct control, you can retrieve information from the connected control. Click on *'Accessible partners'*.
 - ⇒ The 'Search for accessible partners' dialogue window will open. 5.19 'Search for accessible partners' on page 112

Setting the Ethernet interface

- **1.** Active PC interface': Select 'Ethernet interface'.
- **2.** *PC interface*': Select the network adapter for the communication connection from the list.
 - ⇒ If an IP address is already configured in the network adapter, it is shown under the input field.
- 3. CPU interface': Select the desired interface of the control from the list.
 - ⇒ If an IP address is already configured in the control, it is shown under the input field.
- **4.** To perform further configuration of the interface, click on *interface configuration*'.
 - ⇒ The 'Interface properties' dialogue window will open. S Chapter 6.20 'Interface properties (Ethernet)' on page 114

"Device properties" editor (PLC) > WebVisu Configuration (PLC)

- **5.** In order to check whether a connection between the programming device and the control can be established with the selected communication settings, click on *'Verify connection'*.
 - ⇒ You can see in the status line, whether the connection could be established successfully.
- **6.** In order to check whether your programming device is connected with the correct control, you can retrieve information from the connected control. Click on 'Accessible partners'.
 - ⇒ The 'Search for accessible partners' dialogue window will open. ♦ Chapter 6.19 'Search for accessible partners' on page 112

Set interface for the simulation

- **1.** *Active PC interface'*: Select *Simulation'*.
- **2.** *PC interface'*: Select the network adapter for the virtual communication connection from the list. If you select "Loopback Adapter", the simulation is run on the PC without using the network adapter.
 - ⇒ If an IP address is already configured in the network adapter, it is shown under the input field. For "Loopback Adapter" the IP address is always "127.0.0.1".
- **3.** In order to check whether a connection between the programming device and the virtual interface can be established with the selected communication setting, click on *'Verify connection'*.
 - ⇒ You can see in the status line, whether the connection could be established successfully.
- **4.** To perform further configurations and to start the simulation, click on *'interface configuration'*.

In order to perform a simulation: 5 Chapter 8.19 'Simulate user program b' on page 246

6.18.3 WebVisu Configuration (PLC)

This section is only displayed if the control has an integrated web server for the web visualisation.

You have accessed the 'WebVisu configuration' section in the 'Device properties' editor of the control. Chapter 6.18 "Device properties" editor (PLC) on page 108

Add WebVisu

Click on + 'Add WebVisu'.

A new WebVisu project is created and displayed in the project tree. Under 'General configurations' and 'SSL configurations', you can configure WebVisu further. Search for accessible partners

General configurations	'Port number' – Access to the web visualisation:
	"8080" (standard port): Access to the web visualisation via the IP address of the CPU with indication of the port, e.g. http://192.168.72.120:8080
	Access to the device web page via the IP address of the CPU (port 80), e.g. http:// 192.168.72.120
	"80" (HTTP port): Access to the web visualisation via the IP address of the CPU without indication of the port, e.g. http://192.168.72.120
	Access to the device web page via the IP address of the CPU with indication of the port, e.g. http://192.168.72.120:8080
	"443" (SSL port): Secured access to the web visualisation via the IP address of the CPU with indication of the port, e.g. http://192.168.72.120:8080
	Unsecured access to the device web page via the IP address of the CPU with indica- tion of the port, e.g. http://192.168.72.120:8080
	'Query interval (ms)' - Interval for the cyclic update of the web visualisation
	'Execution device' on which this WebVisu project shall be executed:
	CPU: The WebVisu project is executed on the CPU
	CP: The WebVisu project is executed on the Ethernet CP.
SSL configurations	Configurations for secured access:
	'Activate encryption' – Secured access to the web visualisation
	'Disable HTTP'
	'Original path of the certificate used' – Loading security certificate into CPU
	Please note that the secured access may have a negative impact on the CPU's performance and on the reaction time of the entire system!

Removing WebVisu

Right-click with the mouse button on the *WebVisu* project in the project tree and select *'Delete WebVisu'*.

6.19 Search for accessible partners

This dialogue window will open if you click on 'Accessible partners' at 'Communication' in the 'Device properties' editor. (Chapter 6.18.2 'Communication settings (PLC)' on page 109

You may also open this dialogue window if you want to transfer the hardware configuration and the user program to the control. Schapter 8.20 'Transfer the hardware configuration and user program to the control' on page 248

Search for accessible partners

Det	ermine acces	sible p	partner						×
eterm	nine access	ible	partner						
]						
Activ	ve interface	:	Ethernet int	erface					
Netv	work interfac	e card:	D-Link DUB-	E100 USB2.0 Fast E	thernet Adapter 🔹	Devi	ce:	PLC_01 *	
IP ac	ddress:		192.168.10.99)					
								👫 Search	
0 I	nly PROFINE	r	ID Address	MAC address	Device time	Ctation name	Constructio	an identification	
N 1	Device har	ne	IP Address	00-20-D5-01-56-47	VIDA 215, 24 G12 DeOr	Station name	Constructio	on Identification	
-	Change com P address:	<i>munia</i> 192 .	ation setting:	5	Bus device name	2:			
Sub	net mask:	255 .	255 . 255 . 0)		set 🔣	PROFINET de	evice name	
	Gateway:	192 .	168 10 10	0			- Factory r	eset	
			Set IP address						
Activ	ve CPU interf	ace:	Ethernet interf	ace			*	Apply settings	5
Statu	us:								
3/16/ 3/16/ 3/16/	/2017 3:33:30 PN /2017 3:33:33 PN /2017 3:33:34 PN	/: Searci /: Load /: Loadi	hing for accessible details of IP Addr ng of details for II	e partners. ess: 192.168.10.100. P address: 192.168.10.10	00 complete.			~	
								V Close	2

Fig. 80: Dialogue window "Search for accessible partners" (Ethernet interface)

Search for accessible partners

- **1.** Under 'Active CPU interface', select the connection which connects the control with the programming device. Click on 'Apply settings'.
- **2.** *• COM port*' (only for serial interface): Select the desired port number of the serial interface of the programming device for the connection test.

'Network interface card' (only for Ethernet interface): Select the network adapter of the programming device for the connection test.

- **3.** If you want to find only PROFINET devices (only possible via Ethernet interface), select the option *'Only PROFINET'*.
- **4.** *Active CPU interface*': Select the desired interface of the CPU from the list, if required.
- 5. Click on 'Search'.
 - ⇒ The search for connected devices is started and displayed at 'Status'.

Any device that has been found by the Search function is displayed in a table.

6. As soon as the desired device is shown in the table, you can stop the search. Select the desired device.

Interface properties (Ethernet)

7. Then, click on 'Apply settings'.

 Problem with USB network adapters
 If you use a USB network adapter for the first time in SPEED7 Studio, it might not be able to find the accessible partners.
 In that case, call up the Windows function "Execute" with the key combination [Windows]+[R]. Run "net stop npf".
 Call up the Windows function "Execute" again and run "net start npf". - or -Restart your PC.

Set IP address

Change communication settings					
IP address:	192 . 168 . 10 . 100				
Subnet mask:	255 . 255 . 255 . 0				
Gateway:	192 . 168 . 10 . 100				
Set IP address					

You can change the IP address of a connected device.

- 1. Show the input area "Change communication settings".
- 2. Click on 'Search'.
 - ⇒ The search for connected devices is started and displayed at 'Status'.
 - Any device that has been found by the Search function is displayed in a table.
- **3.** As soon as the desired device is shown in the table, you can stop the search. Select the desired device.
- **4.** Enter the new IP address and if necessary the subnet mask and the gateway address.
- 5. Click on 'Set IP address'.
 - \Rightarrow The new address is loaded into the device.

Change PROFINET-Con-	If you have selected a PROFINET connection under 'Active CPU interface', you can set
figurations	the PROFINET device name or perform a factory reset of the IO controller.

6.20 Interface properties (Ethernet)

This dialogue window will open if you click on *'interface configuration'* in the *'Properties of Ethernet interface'* section at *'Communication'* in the *'Device properties'* editor. & Chapter 6.18.2 *'Communication settings (PLC)'* on page 109

Interface properties (Ethernet)

General

Interface pro	operties	×
General Add	resses	
General		
Name:	PG_OP_Ethernet	
Subnet ID:	4000 BBCC	
PDU size:	240 Bytes *	
IP settings		
IP address:	192 . 168 . 10 . 100	
Subnet mask:	255 . 255 . 255 . 0	
	🗸 ок	

Fig. 81: Dialogue window "Interface properties – General"

'Name' - Name of the connection point

'Subnet ID' – Address for the communication with connection partners via routing functions, e.g. via teleservice

'PDU size' – Data size of a Protocol Data Unit for the *'Watch block'* function \bigotimes Chapter 8.23 *'Watch block* $\boxed{}_{I\!\!R}$ on page 257:

- 240 byte: Standard
- 480 byte: Siemens
- 960 byte: VIPA

'IP address' and 'Subnet mask' - Address of the CPU interface of the control

Properties of the module (CPU)

Addresses

Interface properties		
General Addresses		
Input addresses	Output addresses	
Start address: 864	Start address: 736	
End Address: 879	End Address: 751	
		🗹 ОК

Fig. 82: Dialogue window "Interface properties – Addresses"

'Input addresses' and *'Output addresses'* – Reserved address section (byte address) for the exchange of diagnostics data between CPU and PC

6.21 Properties of the module (CPU)

You can customize the properties of the CPU. You can parametrize the following settings:

- General, e. g. Device name, MPI interface & Chapter 6.21.1 'General' on page 117
- Feature sets ♦ Chapter 6.21.2 'Feature sets' on page 118
- Startup & Chapter 6.21.3 'Startup' on page 118
- Synchronous cycle interrupts & Chapter 6.21.5 'Cycle / Clock memory' on page 120
- Cycle / clock memory & Chapter 6.21.5 'Cycle / Clock memory' on page 120
- Retentive memory & Chapter 6.21.6 'Retentive memory' on page 121
- Local data 🌣 Chapter 6.21.7 'Local data' on page 121
- Interrupts ♦ Chapter 6.21.8 'Interrupts' on page 121
- Time of day interrupts 🖏 Chapter 6.21.9 'Time of day interrupts' on page 122
- Cyclic interrupts & Chapter 6.21.10 'Cyclic interrupts' on page 122
- Diagnostics/Clock & Chapter 6.21.11 'Diagnostics/Clock' on page 123
- Protection Chapter 6.21.12 'Protection' on page 123

Properties of the module (CPU) > General

- Advanced configurations & Chapter 6.21.13 'Advanced configurations' on page 124
- Properties of the CPU components
 - PG/OP Ethernet Schapter 6.21.14 'PG/OP Ethernet' on page 125
 - General 🏷 Chapter 6.21.15 'General' on page 126
 - I/O addresses
 Chapter 6.21.16 'I/O addresses' on page 126
 - I/O (digital) ఈ Chapter 6.21.17 'Inputs (digital)' on page 127
 - I/O (analog) Schapter 6.21.19 'Inputs (analog)' on page 128
 - Basic parameters & Chapter 6.21.21 'Basic parameters' on page 128
 - Channel & Chapter 6.21.22 'Channel ...' on page 128
 - Parameter & Chapter 6.21.23 'Parameter' on page 129

Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

If a project is open and a control is included, you can open the properties of the CPU.

- **1.** Select one of the following options:
 - **Project tree:** Right-click with the mouse button on the desired control (PLC) and select *'Local components* → *CPU...* → *Component properties'*.
 - Device configuration so "editor: Double-click on the CPU.
 - ⇒ The dialog window 'Component properties (CPU)' will open.

2. Click on the desired parameter block, e. g. 'Startup'.

 \Rightarrow The page with the appropriate parameters will open.

3. Change the parameters, if necessary, and click on 'OK'.

⇒ The changed properties are applied in the project configuration. After the changed parameters have been transferred (♦ Chapter 5.10 'Transferring a project) on page 64) and once the CPU has been started, the changed parameters are activated in the control.

6.21.1 General

Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

Here you can make general settings for the current CPU.

'Name' - Name of the control: This name is shown in the project tree.

'Plant designation' – Specific plant designation: Here you can uniquely identify parts of the plant on the basis of functional aspects. The construction identification has a hierarchic structure according to IEC 1346-1.

'Location designation' - Any comment

MPI dataHere you can configure the MPI subnet (Multi Point Interface) for the serial connection
between accessible MPI partners.

'Address' - MPI address of the CPU

G	eneral	
St	artup	
C۷	/cle/Clock Memory	~0
Re	etentive Memory	

Properties of the module (CPU) > Startup

Address 2 for VIPA CPUs is pre-set as a standard. Address 0 is reserved for programming devices.

'Max address' - Highest address number in the MPI subnet

Secondary baud rate MPI' – The transmission rate (Bit/s) of the MPI subnet must not be higher than the transmission rate of the slowest accessible MPI partner.

6.21.2 Feature sets



Depending on the used CPU and firmware version, the setting options differ. Selection or input fields that are grayed out can not be edited at this CPU type.

Here you can activate the corresponding additional functions in the *SPEED7 Studio*. *'Motion control'*

- *inactive'* Motion control is de-activated
- 'Motion Control + ... Axes' Isochronous mode with activation of OB 60 and OB 61 for the corresponding number of axes.

'PROFIBUS'

- *'inactive'* PROFIBUS functionality is de-activated
- 'PROFIBUS slave functionality' PROFIBUS functionality is activated: The control can be used as a DP slave.
- 'PROFIBUS master functionality' PROFIBUS functionality is activated: The control can be used as a DP slave.



Please consider the additional functions in the SPEED7 Studio can only be activated, if you have valid license for these functions!

6.21.3 Startup

Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

Here you can make general configurations for the start-up behavior of the current CPU.

'Start-up if present configuration does not match actual configuration'

- The expected configuration is the configuration of the components which is defined in the project and uploaded to the CPU.
- The actual configuration is the implemented configuration of the components.

If this option is deselected, the CPU remains in the STOP mode for the following cases:

- One or more components are not located in the configured slot.
- A component of another type is located in the configured slot.

If this option is selected, the CPU switches to the RUN mode even if the components are not located in the configured slots or if components of another type are located there.

Properties of the module (CPU) > Synchronous cycle interrupt

'Delete PAA at hot restart' – If this option is selected, the process image of the outputs (PAA) is deleted after the warm restart of the CPU.

'Disable hot restart by operator' – The types of start-up are restricted when triggered by the operation or communication job:

If this option is selected, only restart or cold start are possible. Warm restart is not possible.

If this option is deselected, all types of start-up are possible.

Start-up after PowerON Here you can select whether a restart, warm restart or cold start should be made after having activated the power supply (PowerON).

- Cold start: All variables and memory ranges are initialised.
- Restart (warm start): The non-retentive memory areas are initialised, the retentive memory areas are restored. Chapter 6.21.6 'Retentive memory' on page 121'
- Warm restart: The user program is continued where it has been interrupted.

Monitoring time for ... The time base of the following parameters is 100 milliseconds. Multiply the entered value with the time base.

Example: Entered value 650 * 100 ms = 65.000 ms of monitoring time

'Finished message from components (100 ms)' – Maximum duration of the ready signal of all configured components after having switched on the power supply (PowerON).

'Transfer of parameters to components (100 ms)' – Maximum duration of the parameter transfer to the parametrizable components.

'Hot restart (100 ms)' – Maximum duration of the warm restart:

If the time between PowerOFF and PowerON or between STOP mode and RUN mode is longer than the time entered here, there is no warm restart. The CPU remains in STOP mode.

6.21.4 Synchronous cycle interrupt



Depending on the used CPU and firmware version, the setting options differ. Selection or input fields that are grayed out can not be edited at this CPU type.

Here you can make settings for synchronous cycle and type.

OB 61 Currently you can not make any settings here. These data are information on OB 61 and may not be changed.

Behavior at runtime violation *Warn threshold'* – Enter a value in μ s, which serves as a threshold for the runtime violation, as soon as the application cycle time is exceeded.

'Error behavior'

- disabled: Runtime violations are ignored.
- CPU stops: If the runtime is violated, the CPU goes to STOP.
- OB 80 is requested If the runtime is violated, OB 80 is requested.

'Error count limit' – Specify here how often the runtime may be violated until it is reported to the system as runtime error.

Properties of the module (CPU) > Cycle / Clock memory

Synchronicity local SLIO bus

'Synchronize all local modules' –If selected, the address range of the System SLIO modules on the backplane bus is mapped in the process image of OB 61.

6.21.5 Cycle / Clock memory

	Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.
	Here you can make general configurations for the cycle / clock memory of the current CPU.
	'Refresh process image cyclically' – If this option is selected, the process image of the organisation block OB1 is cyclically updated. This expands the cycle time.
	'Scan cycle monitoring time (ms)' – If the run time of the user program exceeds the scan cycle monitoring time, the CPU switches to the operating mode STOP (time base: milli-seconds).
	Reasons for time-out:
	 Communication processes Accumulation of interrupt events Error in the CPU program
	<i>'Minimum cycle time (ms)'</i> – Guaranteed compliance with a minimum scan cycle time: The start of a new cycle is delayed until the minimum scan cycle time has been reached (time base: milliseconds).
	'Scan cycle load from Communication (%)' – Percentage of communication processes compared to the complete cycle time.
	Example: If e.g. set to 50%, the cycle time might double.
	'OB 85 Calling at periphery access errors' – Reaction of the CPU after periphery access errors during the update of the process image.
	'Size of the process image inputs' – Size of the memory range for the input operand areas (I) in byte
	<i>'Size of the process image outputs'</i> – Size of the memory range for the output operand areas (Q) in byte
Clock memory	Clock memories periodically change their value in pre-set intervals.
	'Clock memory' – Enable this option, if the CPU should provide clock memories.
	<i>'Memory byte'</i> – Number of the memory byte for the clock memory. The memory byte is used only if you select the <i>'Clock memory'</i> option.
	The selected memory byte cannot be used for temporary data storage.

6.21.6 Retentive memory

	 Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.
	In order to maintain data in case of power failure, certain data areas can be marked as retentive. A restart (warm start) will restore the values of the retentive memory areas from the last program cycle.
	<i>'Number of memory bytes starting with MB0'</i> – Number of retentive memory bytes from memory byte 0
	Example: Input value 16 = memory bytes 0 to 15 are retentive
	<i>'Number of timers starting with T0'</i> – Here you can enter the number of retentive timers starting from T0. Each timer requires 2 bytes.
	<i>Number of counters starting with C0'</i> – Here you can enter the number of retentive counters starting from C0.
	Please also not & Chapter 6.21.13 'Advanced configurations' on page 124.
S	You can define up to 8 retentive memory areas in the data blocks:
	'DB No.' – Number of the retentive data block
	'Byte address' – Starting address within the retentive data block
	<i>'Number of bytes'</i> – Number of retentive bytes from the starting address within the data block

6.21.7 Local data

Area



Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

Local data are the temporary data of a block.

'1...29' – Number of local data bytes for the priority classes 1 to 29

'Maximum bytes' - Display of the memory range totally available for local data

'Occupied' – Display of the memory range which is currently occupied by local data (total of the local data bytes of the priority classes 1 to 29)

6.21.8 Interrupts



Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

Here you can define the order for processing the individual interrupt organisation blocks. OBs with the smallest number have lowest priority. OBs with priority 0 are not processed.

Properties of the module (CPU) > Cyclic interrupts

The following interrupt OBs are listed:

- OB 40 OB 47: Hardware interrupts
- OB 20 OB 23: Time delay interrupts
- OB 50, OB 51, OB 55 OB 57: Communication interrupts
- OB 81 OB 87: Async. error interrupts

6.21.9 Time of day interrupts



Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

The cyclic interrupt organisation blocks OB 10 to OB 17 can interrupt the processing of OB 1 once or at a certain interval.

Depending on the CPU used, you can parametrize up to 8 time of day interrupts:

'Priority' – Order in which a time of day interrupt organisation block is processed: OBs with the smallest number have lowest priority. OBs with priority 0 are not processed.

'Active' – If this option is activated, the time-of-day interrupt OB is started after the next CPU restart. If this option is not activated, the time-of-day interrupt OB is de-activated after the next CPU restart.

'Execution' – Execution of the interrupt once or at certain intervals (repetition period)

'Start data' and 'Time' - Time of the initial execution of the time of day interrupt

Example With the configuration '*Execution*' Last day of month, '*Start date*' 0/9/2013 and '*Time*' 08:30 am, the time of day interrupt is initially displayed on 30/9/2013 at 8:30 am and then every month at the same time at the end of the month. Every interrupt is displayed on the last day of the month.

6.21.10 Cyclic interrupts



Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

The cyclic interrupt organisation blocks OB 30 to OB 38 can interrupt the processing of OB 1 at a certain interval.

Depending on the CPU used, you can parametrize up to 9 cyclic interrupts:

'Priority' – Order in which a cyclic interrupt organisation block is processed: OBs with the smallest number have lowest priority. OBs with priority 0 are not processed.

'Execution (ms)' – Interval of the periodic execution of the cyclic interrupt OB in milliseconds. The starting time is the switching from operating mode STOP to RUN.

'Phase offset (ms)' – Time in milliseconds by which the execution time of the cyclic interrupt is to be delayed. By selecting several cyclic interrupts, you can use the phase offset to make sure that the cyclic interrupts do not start at the same time.

6.21.11 Diagnostics/Clock

	Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.
	<i>'Extended functional scope'</i> –This parameter has no function. The extended functional scope for diagnostics is not supported.
	<i>'Report cause of stop'</i> – If this option is selected and if the operating mode switches from RUN to STOP, the CPU will report the reason for STOP to the programming and/or control device.
	'Report to process control active' – This parameter does not have any function.
Clock	Here you can define, which clock is to be synchronised with another clock.
	The following synchronisations are possible:
	Synchronisation in PLC: Application memory (internal)
	 Synchronisation on MPI: Multi point interface (external) Synchronisation on MFI: Multifunctional interface (external via the 2. interface)
	'Synchronization type' –
	<i>'None'</i> : The clocks are not synchronized
	 <i>As master</i>': The clock of the CPU synchronizes other clocks as master. <i>As slave</i>': The clock of the CPU is synchronized by another clock.
	'Time interval' - Time interval of the periodic execution of the synchronization
	<i>Correction factor (ms)</i> – The correction factor is used to compensate for deviations in the clock that occur within 24 Hours. You can enter positive and negative values in milliseconds.
Example	If the clock runs slow by 1 second within 24 Hours, you can adjust this deviation with the correction factor "+1000".
6.21.12 Protection	
	<i>'Protection level'</i> – Here you can set one of 3 protection levels to protect the CPU against unauthorized access.
	 <i>'No protection'</i>: Write or read access is possible without a password <i>'Write-protection'</i>: Read access is possible without a password; for write access, a
	 <i>Read/write protection</i>': Write or read access is only possible with a password
Password	<i>'Password (max. 8 characters)'</i> –Enter a password, if you want to protect the access to the CPU.
	'Re-enter password' – Enter the password once more.
	Use alphanumeric characters and the following special characters:
	!#~ ^\$%(){}[]*+.,:=?_@-

Properties of the module (CPU) > Advanced configurations



6.21.13 Advanced configurations

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Depending on the used CPU and firmware version, the setting options differ. Selection or input fields that are grayed out can not be edited at this CPU type.

'Function X <nr>'</nr>	If the CPU has a configurable interface (port X <nr> , nr = any number), this interface can be configured:</nr>
	 <i>'Disabled'</i> – Disables the RS485 interface <i>'MPI/DP'</i> – This setting is to be selected for CPUs whose PROFIBUS functionality is enabled by means of a feature set
	 'MPI' – With this operating mode the interface serves for the connection between programming unit and CPU via MPI. By means of this the project engineering and programming happens. In addition MPI serves for communication between several CPUs or between HMIs and CPU.
	'PtP' – With this operating mode the RS485 interface acts as an interface for serial point-to-point communication. Here data may be exchanged between two stations by means of protocols.
	'PROFIBUS-DP async' – PROFIBUS DP master operation asynchronous to the CPU cycle: Here, the CPU cycle and the cycles of all VIPA PROFIBUS-DP masters on the CPU run independently of each other.
	 <i>PROFIBUS-DP syncln'</i> – The CPU is waiting for DP master input data. <i>PROFIBUS-DP syncOut'</i> The DP master system is waiting for CPU output data.
	 <i>PROFIBUS-DP synchout</i> – The DF master system is waiting for or o output data. <i>PROFIBUS-DP synchout</i> – CPU and DP master system are waiting for each other thus forming cycle.
'MPI address X <nr>'</nr>	If the configurable interface X <nr> of the CPU (port X <nr> , nr = any number) is set to MPI, you can specify an MPI address for the interface here.</nr></nr>
'MPI baud rate X <nr>'</nr>	If the configurable interface X <nr> of the CPU (port X <nr> , nr = any number) is set to MPI, you can specify a baud rate for the MPI communication.</nr></nr>
'MPI HSA'	This parameter is used to specify the highest MPI address and thus to limit the range of the MPI addresses. Currently, this parameter is not evaluated in the CPU.
'Token Watch'	Switching the token time monitoring (PROFIBUS bus parameter) off or on. The token time is the time that elapses until the token arrives at the DP master again.
'Extended retentive memory bytes'	Number of retentive memory bytes starting from memory byte 0: If you enter 0, the value indicated at the <i>'Retentive memory'</i> is applied. <i>Schapter 6.21.6 'Retentive memory'</i> on page 121

Properties of the module (CPU) > PG/OP Ethernet

	By entering a different value (not equal to 0), the information under ' <i>Retentive memory</i> ' will be overwritten.
'Extended retentive memory timers'	Number of retentive timers starting from T0: If you enter 0, the value indicated at the ' <i>Retentive memory</i> ' is applied. Schapter 6.21.6 'Retentive memory' on page 121
	By entering a different value (not equal to 0), the information under ' <i>Retentive memory</i> ' will be overwritten.
'Extended retentive memory counters'	Number of retentive counters starting from Z0: If you enter 0, the value indicated at the 'Retentive memory' is applied. Schapter 6.21.6 'Retentive memory' on page 121
	By entering a different value (not equal to 0), the information under <i>'Retentive memory'</i> will be overwritten.
'Priority OB'	Here you can set a priority for the corresponding OB. By "reprioritizing" asynchronous error OBs, you can influence the behavior of the CPU in the event of an error and, if necessary, keep it in RUN for longer time.
'Diagnostic interrupt'	Enable or disable diagnostic interrupts.
'Direct DX transition'	If this parameter is activated, the integrated PROFIBUS-DP master, which is to be activated by means of a feature set, shows the following behavior:
	If byte 0, bit 1 and byte 1, bit 0 of the received standard diagnostic data of a DP slave have the status 0, this DP slave is directly taken to data exchange without a SetPrm- and CheckConfig telegram was being sent to the DP Slave.
	 When a DP slave is taken to data exchange, the status of the output data is retained. If the CPU goes from RUN to STOP, the DP master is deactivated for at least the duration of the <i>Response monitoring time</i>, which is to be set in the PROFIBUS parameters. Afterwards the DP master returns to RUN. In this case, the status of the output data of the connected DP slaves is retained.
	 If the power supply of the CPU fails, the status of the output data of the connected DP slaves is retained.
'PN MultipleWrite'	In the activated state, parameter record sets are combined at PROFINET to one or more Ethernet frames during the connection setup. This speeds up the connection setup, since a separate Ethernet frame is not used for each parameter record set.
'OB 28 and OB 29 priority'	Defines the order in which the interrupt organisation blocks are interrupted: OBs with the smallest number have lowest priority. OBs with priority 0 are not processed.
'OB 80 for cyclic interrupt error'	Defines for which interrupt organization blocks the time error organization block OB 80 is called.
6.21.14 PG/OP Etherne	et
0	(News) - Here was an ending a group to the Ethernet DO/OD shares I

General	'Name' – Here you can assign a name to the Ethernet PG/OP channel.			
	'Subnet ID' – Here you can assign a subnet ID for your network.			
	<i>'PDU size'</i> – Here you can specify the buffer size for the Ethernet PG/OP communication.			

Properties of the module (CPU) > I/O addresses

'IP address' – Here you can assign an IP address to your Ethernet PG/OP channel.

'Subnet mask' – Here you can specify an IP address to your Ethernet PG/OP channel.

Addresses Here you can adapt the address range which is used by the Ethernet PG/OP channel. By confirming the entry with *[Enter]*, the address is accepted and the *'End address'* is calculated automatically. If an address is already occupied, you will receive a message. Enter a different address.

6.21.15 General

Here you can find general information about the selected component. Such as the 'Short name' under which the component is listed in the 'Device configuration'.

6.21.16 I/O addresses

In the user program, the individual channels of a component can be addressed via the symbolic I/O addresses (names). The allocated input and output addresses (I/O addresses) and the transfer range in the I/O address room of the selected component are presented in a table. You can change the I/O addresses, names and comments.

SPEED7 Studio	Development Line			×
General	I/O addresses			
I/O addresses				
Basic parameters	Input addresses	Output add	resses	
·	Start address: 81	6 🗘 Start addres	s: 816	•
Channel 0	End Address: 83	1 End Addres	s: 831	
Channel 1				
Channel 2				
Channel 3	Address	Name	Data type	Comment
	ED 816	d_DI_CH01_684	DINT	E 816 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	ED 820	d_DI_CH02_684	DINT	E 820 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	ED 824	d_DI_CH03_684	DINT	E 824 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	ED 828	d_DI_CH04_684	DINT	E 828 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	AD 816	d_DO_RESERVED1_684	DWORD	A 816 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	AD 820	d_DO_RESERVED2_684	DWORD	A 820 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	AD 824	d_DO_RESERVED3_684	DWORD	A 824 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
	AD 828	d_DO_RESERVED4_684	DWORD	A 828 - CPU 013-CCF0R00 [Device: , Slot: 0, Subslot
				🖌 ОК

Fig. 83: I/O addresses of a CPU component

Each line corresponds to a channel of the CPU:

'Address' – Configured input or output address. To change addresses: see Changing I/O addresses.

'Name' – Name of the variables: Symbolic I/O address

Properties of the module (CPU) > Outputs (digital)

___ Click on the input field to change the variable name.

'Data type' – Data type of the variables, e. g. "BOOL" for bit addresses. The data type is preset according to the channels and cannot be changed.

'Comment' - Any comment e.g. remark or explanation

Click on the input field to change the comment.

Address range Depending on the number of channels, one CPU component occupies different numbers of addresses.

Changing I/O addresses

1. Enter the new input or output address (byte address) in the suitable 'Start address' field.

If this address is already occupied, a note pops up. Enter a different address.

- **2.** Confirm your input with [Enter].
 - ⇒ The address is changed. If the component occupies several byte addresses, the 'End address' is automatically calculated and the complete address range is assigned to the channels.

6.21.17 Inputs (digital)

Here you can make settings for the function of digital inputs of your CPU. Depending on the CPU type, the number and type of parameters as well as the setting options, e. g. diagnostic and alarm settings, selection of the triggering edge and adjustment of the input delay for the corresponding channel. Thus, the parameters are precisely tailored to the task of the selected CPU.

More information about the parameters can be found in the your module.

6.21.18 Outputs (digital)

Here you can make settings for the function of digital outputs of your CPU. Depending on the CPU type, the number and type of parameters as well as the setting options differ for the corresponding channel. Thus, the parameters are precisely tailored to the task of the selected CPU.



More information about the parameters can be found in the manual of your module.

e manual of

Properties of the module (CPU) > Channel ...

6.21.19 Inputs (analog)

Here you can make settings for the function of analog inputs of your CPU. Depending on the module type, the number and type of parameters as well as the setting options differ, e. g. diagnostic and alarm settings, function of the encoders, measuring methods and measuring ranges for the corresponding channel. Thus, the parameters are precisely tailored to the task of the selected analog component.



6.21.20 Outputs (analog)

Here you can make settings for the function of analog outputs of your CPU. Depending on the module type, the number and type of parameters as well as the setting options differ for the corresponding channel. Thus, the parameters are precisely tailored to the task of the selected analog component.

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More information about the parameters can be found in the manual of your module.

6.21.21 Basic parameters

'Select interrupt'

Here you can define the interrupts the CPU will trigger. The following parameters are supported:

- None: The interrupt function is disabled.
- Process: The event set at the corresponding channel triggers a hardware interrupt.
- Diagnostics+process: A diagnostics interrupt is only triggered when a hardware interrupt was lost.



More information about the parameters can be found in the manual of your module.

6.21.22 Channel ...

'Operating mode'

By specifying an operating mode for the corresponding channel, all required parameters are listed with their default values.



More information about the parameters can be found in the manual of your module.

6.21.23 Parameter 'Operating mode'

Here you can edit the corresponding parameters of the selected CPU component. All parameters are listed with their default values.



6.22 Component properties (300S modules)

You can change the properties of a component (signal module of the 300S control system). Depending on the component type, you can perform the following configurations:

- Show general properties, e. g. designation and order number & Chapter 6.22.1 'General' on page 129
- I/O addresses <a>§ Chapter 6.22.2 'I/O addresses' on page 130
- Functions of the inputs of analog modules Chapter 6.22.5 'Inputs (analog)' on page 131
- Functions of the outputs of analog modules Chapter 6.22.6 'Outputs (analog)' on page 132

options. Selection or input fields highlighted in grey cannot be edite this component.

- **1.** Select one of the following options if you want to change the component properties:
 - Project tree: Within the PLC under 'Local components', double click on the desired component.
 - "Device configuration is "editor: Double-click on the desired component.
 - ⇒ The dialog window 'Component properties' will open.
- 2. Click on the desired section, e. g. 'I/O addresses'.
 - ⇒ The page with the appropriate configurations will open
- **3.** Change the configurations, if necessary, and click on 'OK'.
 - ⇒ The changed properties are applied in the project configuration. After the changed configurations have been transferred (Schapter 5.10 'Transferring a project '' on page 64) and once the CPU has been started, the changed configurations are activated in the control.

6.22.1 General

General information on the selected component are displayed here.

'Info' – The info is shown in the project tree and in the device configuration. It contains, e. g., the number of channels, the voltage and/or current range.

'Order number' - Order number of the component.

Component properties (300S modules) > I/O addresses

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Depending on the module further information can be displayed.

6.22.2 I/O addresses

In the user program, the individual channels of a component can be addressed via the symbolic I/O addresses (names). The allocated input and output addresses (I/O addresses) and the transfer range in the I/O address room of the selected component are presented in a table. You can change the I/O addresses, names and comments.

SPEED7 Studio	Development L	.ine				×
General	I/O Addre	sses				
	Input ac	ldresses	Outpu	t addresses		
	Start add	dress: 0	💂 Start ad	ddress: 0	4 	
	End add	ress: 1	End ad	dress:		
	A	ddress	Name	Data type	Comment	*
	I	0.0	x_DI_0_0_20	BOOL	E 0.0 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.1	x_DI_0_1_20	BOOL	E 0.1 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.2	x_DI_0_2_20	BOOL	E 0.2 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.3	x_DI_0_3_20	BOOL	E 0.3 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.4	x_DI_0_4_20	BOOL	E 0.4 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.5	x_DI_0_5_20	BOOL	E 0.5 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.6	x_DI_0_6_20	BOOL	E 0.6 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	0.7	x_DI_0_7_20	BOOL	E 0.7 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	1.0	x_DI_1_0_20	BOOL	E1.0 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	1.1	x_DI_1_1_20	BOOL	E1.1 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	I	1.2	x_DI_1_2_20	BOOL	E1.2 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	
	т	17	DI 1 2 20	POOL	E1.2 DNG/DC24V (Devices DLC 01 Clear A Beels 01	Ŧ
					🖌 ок	

Fig. 84: I/O addresses of a 300S module

Each line corresponds to a channel of the module:

'Address' – Configured input or output address. To change addresses: see Changing I/O addresses.

'Name' - Name of the variables: Symbolic I/O address

____ Click on the input field to change the variable name.

'Data type' – Data type of the variables, e. g. "BOOL" for bit addresses. The data type is preset according to the channels and cannot be changed.

'Comment' - Any comment e.g. remark or explanation

Click on the input field to change the comment.

Component properties (300S modules) > Inputs (analog)

Address range	Depending on the number of channels, a component occupies a different number of addresses.			
	Examples:			
	The digital output module "DO 16xDC24V" occupies two consecutive output bytes, e. g. byte A4 and A5.			
	The digital input component "DI 4xDC24V" occupies the first four bits of an input byte. The remaining bits of this input byte cannot be used.			
	The analog input component "AI 8x12Bit" occupies eight consecutive input words (corresponding to 16 input bytes).			

Changing I/O addresses

1. Enter the new input or output address (byte address) in the suitable 'Start address' field.

If this address is already occupied, a note pops up. Enter a different address.

- **2.** Confirm your input with [Enter].
 - ⇒ The address is changed. If the component occupies several byte addresses, the 'End address' is automatically calculated and the complete address range is assigned to the channels.



To edit I/O addresses for all configured components of the control: Chapter 8.14 "Address overview" editor ? on page 233

6.22.3 Inputs (digital)

Here you can make settings for the function of digital inputs. Depending on the module type, the number and type of parameters as well as the setting options differ, e. g. diagnostic and alarm settings, edge selection and input delay adjustment for the corresponding channel group. Thus, the parameters are precisely tailored to the task of the selected digital component.

6.22.4 Outputs (digital)

Here you can make settings for the function of digital outputs. Depending on the module type, the number and type of parameters as well as the setting options differ, e. g. diagnostic and alarm settings and parametrization of the output signal. Thus, the parameters are precisely tailored to the task of the selected digital component.

6.22.5 Inputs (analog)

Here you can make settings for the function of analog inputs. Depending on the module type, the number and type of parameters as well as the setting options differ, e. g. diagnostic and alarm settings, function of the encoders, measuring methods and measuring ranges. Thus, the parameters are precisely tailored to the task of the selected analog component.

Properties of the module (SLIO modules) > I/O addresses

6.22.6 Outputs (analog)

Here you can make settings for the function of analog outputs. Depending on the module type, the number and type of parameters as well as the setting options differ, e. g. diagnostic and alarm settings, parametrization of the output signal. Thus, the parameters are precisely tailored to the task of the selected analog component.

6.23 Properties of the module (SLIO modules)

You can change the properties of a component (signal module of the slize I/O system). Depending on the component type, you can perform the following configurations:

- Show general properties, e. g. designation and order number & Chapter 6.23.1 'General' on page 132
- I/O addresses & Chapter 6.23.2 'I/O addresses' on page 132



Depending on the component type, there are different configuration options. Selection or input fields highlighted in grey cannot be edited for this component.

- **1.** Select one of the following options if you want to change the component properties:
 - Project tree: Within the PLC under 'Local components', double click on the desired component.
 - "Device configuration is "editor: Double-click on the desired component.
 - ⇒ The dialog window *'Component properties'* will open.
- 2. Click on the desired section, e. g. 'I/O addresses'
 - \Rightarrow The page with the appropriate configurations will open
- 3. Change the configurations, if necessary, and click on 'OK'.

6.23.1 General

General information on the selected component are displayed here.

'Info' – The info is shown in the project tree and in the device configuration. It contains, e. g., the number of channels, the voltage and/or current range.

'Order number' – Order number of the components.

6.23.2 I/O addresses

In the user program, the individual channels of a component can be addressed via the symbolic I/O addresses (names). The allocated input and output addresses (I/O addresses) and the transfer range in the I/O address room of the selected component are presented in a table. You can change the I/O addresses, names and comments.

Properties of the module (SLIO modules) > I/O addresses

General	I/O Addresses			
/O Addresses	Input addresse	s Outpu	t addresses	
	Start address: 0 End address:	Start a	ddress: 0	▲ ▼
	Address	Name	Data type	Comment
	Q 0.0	x_DO_0_0_25	BOOL	A 0.0 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: (
	Q 0.1	x_DO_0_1_25	BOOL	A 0.1 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: (
	Q 0.2	x_DO_0_2_25	BOOL	A 0.2 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: 0
	Q 0.3	x_DO_0_3_25	BOOL	A 0.3 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: (
	Q 0.4	x_DO_0_4_25	BOOL	A 0.4 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack:)
	Q 0.5	x_DO_0_5_25	BOOL	A 0.5 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: 0
	Q 0.6	x_DO_0_6_25	BOOL	A 0.6 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: 0
	Q 0.7	x_DO_0_7_25	BOOL	A 0.7 - DO8xDC24V 0,5A [Device: PLC_01, Slot: 1, Rack: 0

Fig. 85: I/O addresses of a SLIO module

Each line corresponds to a channel of the module:

'Address' – Configured input or output address. To change addresses: see Changing I/O addresses.

'Name' – Name of the variables: Symbolic I/O address

____ Click on the input field to change the variable name.

'Data type' – Data type of the variables, e. g. "BOOL" for bit addresses. The data type is preset according to the channels and cannot be changed.

'Comment' – Any comment e. g. remark or explanation

▶ Click on the input field to change the comment.

 Address range
 Depending on the number of channels, a component occupies a different number of addresses.

 Examples
 Image: The digital output component "DO 8xDC24V" occupies one output byte.

 Image: The digital input component "DI 4xDC24V" occupies the first four bits of an input byte. The remaining bits of this input byte cannot be used.

 Image: The analogue input component "AI 4x12Bit" occupies four consecutive input words (corresponding to eight input bytes).

Component properties (MICRO modules)

Changing I/O addresses

1. Enter the new input or output address (byte address) in the suitable 'Start address' field.

If this address is already occupied, a note pops up. Enter a different address.

- 2. Confirm your input with [Enter].
 - ⇒ The address is changed. If the component occupies several byte addresses, the 'End address' is automatically calculated and the complete address range is assigned to the channels.



To edit I/O addresses for all configured components of the control: Chapter 8.14 "Address overview" editor : on page 233

6.23.3 Parameter

Here you can configure parameters of communication processors, analogue, interface or functional modules. The number and type of parameters as well as the configuration possibilities differ depending on the component type, e. g. diagnostics and interrupt configurations, parameters for analogue modules, bus parameters for interface modules. Thus, the parameters are precisely tailored to the task of the selected component.

6.24 Component properties (MICRO modules)

You can change the properties of a component (signal module of the MICRO control system). Depending on the component type, you can perform the following configurations:

- Show general properties, e. g. designation and order number
 - I/O addresses



Depending on the component type, there are different configuration options. Selection or input fields highlighted in grey cannot be edited for this component.

- **1.** Select one of the following options if you want to change the component properties:
 - Project tree: Within the PLC under 'Local components', double click on the desired component.
 - Device configuration solution: Double-click on the desired component.
 - ⇒ The dialog window *'Component properties'* will open.
- **2.** Click on the desired section, e. g. 'I/O addresses'.
 - ⇒ The page with the appropriate configurations will open
- **3.** Change the configurations, if necessary, and click on 'OK'.

6.24.1 General

General information on the selected component are displayed here.

'Info' – The info is shown in the project tree and in the device configuration. It contains, e. g., the number of channels, the voltage and/or current range.

'Order number' - Order number of the component.

6.24.2 I/O addresses

SPEED7 Studio	Development Line				×
General	I/O Addresses				
/O Addresses	Input addresses	Output	t addresses		
	Start address: 0	🗧 Start ac	Idress: 0	*	
	End address:	End ad	dress: 0		
	Address	Name	Data type	Comment	*
	I 0.0	x_DI_0_0_224	BOOL	E 0.0 - D116xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	1
	I 0.1	x_DI_0_1_224	BOOL	E 0.1 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 0.2	x_DI_0_2_224	BOOL	E 0.2 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 0.3	x_DI_0_3_224	BOOL	E 0.3 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	E
	I 0.4	x_DI_0_4_224	BOOL	E 0.4 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 0.5	x_DI_0_5_224	BOOL	E 0.5 - D116xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 0.6	x_DI_0_6_224	BOOL	E 0.6 - D116xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 0.7	x_DI_0_7_224	BOOL	E 0.7 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 1.0	x_DI_1_0_224	BOOL	E 1.0 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	I 1.1	x_DI_1_1224	BOOL	E 1.1 - DI16xDC24V [Device: PLC_02, Slot: 1, Rack: 0]	
	117	v DI 1 2 22/	ROOL	E1.2 _ DI16vDC2/IV [Device: PLC 02_Slot: 1_Rack: 0]	*

Fig. 86: I/O addresses of a MICRO module

Each line corresponds to a channel of the module:

'Address' – Configured input or output address. To change addresses: see Changing I/O addresses.

'Name' - Name of the variables: Symbolic I/O address

____ Click on the input field to change the variable name.

'Data type' – Data type of the variables, e. g. "BOOL" for bit addresses. The data type is preset according to the channels and cannot be changed.

'Comment' - Any comment e.g. remark or explanation

Click on the input field to change the comment.

Export all (WLD)

Address range	Depending on the number of channels, a component occupies a different number or addresses.			
	Examples			
	 The digital output module "DO 16xDC24V" occupies two consecutive output bytes, e. g. byte A4 and A5. The digital input module "DI 16xDC24V" eccupies two consecutive input bytes 			
	The angles input module "AL4x16Bit" accurates four consecutive input words (cor			
	responds to 8 input bytes).			

Changing I/O addresses

- **1.** Enter the new input or output address (byte address) in the suitable 'Start address' field.
 - If this address is already occupied, a note pops up. Enter a different address.
- **2.** Confirm your input with [Enter].
 - ⇒ The address is changed. If the component occupies several byte addresses, the 'End address' is automatically calculated and the complete address range is assigned to the channels.



To edit I/O addresses for all configured components of the control: ♦ Chapter 8.14 "Address overview" editor : on page 233

6.24.3 Parameter

Here you can configure parameters of the System MICRO modules. The number and type of parameters as well as the configuration possibilities differ depending on the component type, e. g. diagnostics and interrupt configurations, parameters for analogue modules, bus parameters for interface modules. Thus, the parameters are precisely tail-ored to the task of the selected component.



More information about the parameters can be found in the manual of your module.

6.25 Export all (WLD)€

You can archive the hardware configuration along with the user program as a WLD file.

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Export all (WLD)'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Export all (WLD)'.

- 2. If you have made changes in the project which have not yet been compiled (\bigotimes *Chapter 8.18 'Compile user program' on page 245*), a dialogue window will open. You can choose whether to cancel the procedure or to archive in the last compiled state. All uncompiled changes in the project will not be saved.
 - ⇒ The 'Save as' dialogue window will open.
- **3.** Select a directory, enter a file name and click on 'Save'.
 - \Rightarrow The hardware configuration and the user program are archived.

6.26 Export user program (WLD)

You can archive the user program as a WLD file.

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Export user program (WLD)'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Export user program (WLD)'.
- 2. If you have made changes in the project which have not yet been compiled (\Leftrightarrow *Chapter 8.18 'Compile user program' on page 245*), a dialogue window will open. You can choose whether to cancel the procedure or to archive in the last compiled state. All uncompiled changes in the project will not be saved.
 - ⇒ The 'Save as' dialogue window will open.
- **3.** Select a directory, enter a file name and click on 'Save'.
 - \Rightarrow The user program is archived.

6.27 Export hardware configuration (WLD)

You can archive the hardware configuration as a WLD file.

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Export hardware configuration (WLD)'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Export hardware configuration (WLD)'.
 - ⇒ The 'Save as' dialogue window will open.
- **2.** Select a directory, enter a file name and click on 'Save'.
 - \Rightarrow The hardware configuration is archived.

6.28 Copy RAM to ROM

With this function, you can store the project from the working memory (RAM) of the control on a MMC (Multimedia Card).

- **1.** Switch the control into the operating mode STOP.
- **2.** Select one of the following options:
 - Menu bar: Select 'Device → Copy RAM to ROM'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Copy RAM to ROM'.
 - A dialogue window will display whether the project has been saved successfully on the MMC.

"Component state" editor > General

6.29 "Component state" editor 🗗

Here you are provided with the following information on the connected control (PLC):

- General information, e.g. device name, serial number, order number, version & Chapter 6.29.1 'General' on page 138
- Information on blocks and operands used <a> Chapter 6.29.2 'Blocks' on page 140
- Communication information & Chapter 6.29.3 'Communication' on page 141
- Memory information & Chapter 6.29.4 'Memory' on page 143
- Diagnostic buffer & Chapter 6.29.5 'Diagnostic buffer' on page 144
- Cycle times & Chapter 6.29.6 'Cycle times' on page 146
- Block, interruption and local data stack (B-Stack, U-Stack, L-Stack) & Chapter 6.29.7 'B-Stack/U-Stack/L-Stack' on page 146

If a project is open and a control is included, you can open the *'Component state'* editor. Create a communication connection to the control. *Schapter 6.18.2 'Communication settings (PLC)' on page 109*

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Component state'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Component state'.
 - Editor "Devices and networking : Right-click with the mouse button on the desired control (PLC) and select 'Component state'.
 - CPU control centre: Click on
 - ⇒ Information is read from the connected control and shown in the *'Component state'* editor.
- 2. Click on the desired section, e.g. 'Blocks'.
 - \Rightarrow The page with the desired information will open.

Refresh information

2

Refresh: The information is read again from the connected control and shown.

6.29.1 General

Here you are provided with general information on the connected control.



"Component state" editor > General

Device information PLC_01 [CPU 315-2AG13 315SB/DPM]		
Name of station:	315-2AG13	
Device name:	PLC_01	
Plant designation:		
Location designation:		
Serial number of PLC:	22183	
Serial number of MMC:	No MMC-card	
Order number:	VIPA 315-2AG13-0110	
Version of component:	0001	
Name:		
Firmware:	V3.6.0.9	
Active interface:	Ethernet interface	
Address:	192.168.10.100	
Network:	192.168.10.10	

Fig. 87: Component state, General

■ To read the information again from the connected control, click on 2.

'Name of station'
'Device name' – & Chapter 6.21.1 'General' on page 117
'Plant designation' – & Chapter 6.21.1 'General' on page 117
'Location designation' – & Chapter 6.21.1 'General' on page 117
'Serial number of PLC'
'Serial number of the MMC or SD card'
'Order number'
'Version of module' – Output status of the hardware
'Name' – Expanded order designation, e.g. Version information
'Firmware' – Firmware version of the control (CPU)
'Active interface' – communication connection with the control & Chapter 6.18.2 'Communication settings (PLC)' on page 109
'Address' – IP address (Ethernet connection) or MPI-address (serial connection) of the control
'Network' – IP address of the network interface card of the programming device

"Component state" editor > Blocks

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5	

The following information is also shown in the CPU control centre ⇔ Chapter 4.16 'CPU control centre
→ 'on page 45: Device name, order number, firmware, active interface, address.

6.29.2 Blocks

Here you are provided with information on the blocks of the connected control.

Blocks:				Addres	s areas:			
Max. numb	er of OBs:	23 Max. length	64 kByte	Process in	nage inputs:	256 Byte	From: E0.0	To: E255.7
Max. numb	er of FBs:	2.048 Max. length	64 kByte	Process in	nage outputs:	256 Byte	From: A0.0	To: A255.7
Max. numb	er of FCs:	2.048 Max. length	64 kByte	Bit Memo	ry:	8.192 Byte	From: M0.0	To: M8191.7
Max. numb	er of DBs:	4.096 Max. length	64 kByte	Timers:		512	From: T0	To: T511
Max. numb	er of SDBs:	4.096 Max. length	64 kByte	Counter:		512	From: Z0	To: Z511
				Local data		11.264 Byte		
Block list:								
OBs:	FCs:	FBs:	DBs:	SDBs:	SFBs:	SFCs:	Su	pported OBs:
1	1	1	100	0	0	0	<u> </u>	L Â
	100	100	101	1	≡ 1	1	1	.0
	101	101	102 =	2	2	2	2	20
	102		103	3	3	3	2	21
	103		104	4	4	4	2	28
			105	7	5	5	2	29
			106 -	, 22	• 7	т б	. ∃	•

Fig. 88: Component state, blocks

Blocks	Here, the number of different blocks is shown that can be used for the user program. In addition, the maximum size of a block is shown in kByte.
Operand areas (= Address areas)	Here, the size and ranges of the inputs, outputs, memories, timers, counters and local data are shown that can be used for the user program.
Block list	Here, the number of the OB, FC, FB and DB blocks are shown that are loaded in the control.

To read the information again from the connected control, click on 2.

"Component state" editor > Communication

In addition, the numbers of the SDB, SFB and SFC system blocks contained in the firmware as well as pre-defined OBs are shown.

6.29.3 Communication

Here you are provided with data on the communication information of the connected control.

Communication information of connected component:			
Number of reserved PG communications:	1		
Number of occupied PG communications:	1		
Number of reserved OP communications:	1		
Number of occupied OP communications:	0		
Number of unreserved communications:	30		
Number of occupied, unreserved communications:	0		
Number of configured communications:	0		
Number of occupied, configured communications:	0		
Max. communication load:	20 %		
Max. number of communications:	32		
Number of reserved S7 communications:	0		

Fig. 89: Component state, communication

To read the information again from the connected control, click on 2.

For each communication connection, connection resources are required on the devices involved. The connection resources are the maximum possible connections of a device. The number of connections differs depending on the component. If all connection resources of a communication partner are used (occupied), no further connection can be established.

- reserved: For connections between certain communication partners, connection resources can be reserved that cannot be occupied by other connections. You can reserve connection resources with Siemens SIMATIC NetPro.
- configured: Number of connections configured in the project, e.g. connections between this CPU and another CPU
- occupied: Number of actually created connections

"Component state" editor > Communication

Example of reserved con- nections	If, for example, you use a type 315-2AG13 CPU, you can use a maximum of 32 connections. As standard, one connection each is reserved for communication with a programming device (PD) and an HMI device (OP). Thus, the remaining connection resources (number of unreserved connections) decrease by two connections. The following information is shown:				
	Number of reserved PD connections	1			
	Number of reserved OP connections	1			
	Number of unreserved connections	30			
	Maximum number of possible connections	32			
Example of used connec- tions	In addition to the reserved connections, you can also create (use) furth a communication partner if there are still connection resources availab	ner connections to le. Example:			
	Number of reserved PD connections	1			
	Number of PD connections used	1			
	Number of reserved OP connections	1			
	Number of OP connections used	4			
	Number of unreserved connections	30			
	Number of occupied, unreserved connections	3			
	Maximum number of possible connections	32			
Example of configured connections	You can configure connections to a communication partner, e.g. a connection to another CPU. Example: Number of configured connections 1				
	Number of occupied, configured connections	1			
	<i>'Number of reserved/used PD connections'</i> – Connection resources that are reserved or actually created for connections between the control and programming devices <i>'Number of reserved/used OP connections'</i> – Connection resources that are reserved or actually created for connections between the control and HMI devices <i>'Number of unreserved connections'</i> – Free connection resources				
	 'Number of occupied, unreserved connections' – Actually created connections that are not reserved 'Number of configured connections' – Other connections configured in the project 'Number of occupied, configured connections' – Other actually created connections configured in the project 'Max. communication load' – Percentage of communication processes compared to the complete cycle time. You can configure this proportion using the parameter " Scan cycle load from Communication". Schapter 6.21.5 'Cycle / Clock memory' on page 120 				
	' <i>Max. number of possible connections</i> ' – Maximum number of connection on the device type)	ctions (dependent			

"Component state" editor > Memory

'*Number of reserved basic S7 connections*' – Reserved connection resources for nonconfigured connections, e.g. for data exchange using communication functions in the user program

6.29.4 Memory

Here you are provided with data on the memory of the connected control.



Fig. 90: Component state, memory

To read the information again from the connected control, click on 2.

Working and load memory

- Load memory: The compiled user program and system data (e.g. configuration information, connection information, component parameters) are saved in the load memory.
- Working memory: The compiled user program is copied into the working memory. The code and the user program data are processed there.

"Component state" editor > Diagnostic buffer

Three bar charts show the percentage of memory occupancy:

- User program in the working memory
- Data blocks in the working memory
- Load memory

The available memory space, the occupied memory space and the percentage of occupancy of the individual memories are shown under the bar charts.

Detailed memory informa- The table shows the distribution for the following memory types:

tion

Working memory – Code and user program data

- Integrated load memory Permanently available load memory in the CPU
- Plugged load memory External memory card connected to the CPU slot
- Pluggable load memory Memory space for external memory cards

The table lines contain the following information:

'Size of memory' - Maximum total available memory space

'Size of non static memory' – Maximum memory space available in the non-retentive memory

'Assigned non static memory' – Actually used memory space in the non-retentive memory

'Largest free block in the non static memory' – Largest cohesive block available in the non static memory. If this block is smaller than the maximum memory space minus the occupied memory space, then the memory is fragmented.

'Size of static memory' - Maximum memory space available in the retentive memory

'Assigned static memory' - Actually used memory space in the retentive memory

'Largest free block in the static memory' – Largest cohesive block available in the static memory. If this block is smaller than the maximum memory space minus the occupied memory space, then the memory is fragmented.

6.29.5 Diagnostic buffer

The content of the diagnostic buffer of the connected control is shown here. The diagnostics messages are saved and shown in the order of their occurrence. The number of diagnostics messages that can be shown differs depending on the component, e.g. 100 messages with the CPU of type 315-2AG13. Other diagnostics messages can be present in the component that are not shown here.
Selecting and configuring devices and components

"Component state" editor > Diagnostic buffer

No	time stamp	description	Event-ID	OB	РК	DatId	ZInfo 1	ZInfo 2	ZInfo 3	-
1	2/3/2016 5:46:13 PM.024	Dezentrale Peripherie: Ende der Synchro	0x5371	0x02	0x17	0x5000	0x0000	0x0002	0xB530	II.
2	2/3/2016 5:46:04 PM.000	NETZ-EIN gepuffert	0x4300	0xF3	0xFF	0x0000	0x0000	0x0000	0x0000	
3	1/20/2016 8:15:24 PM.856	STOP durch Netzausfall	0x494E	0x3F	0xFF	0x00C0	0x0000	0x0000	0x0000	
4	1/20/2016 6:16:32 PM.024	Dezentrale Peripherie: Ende der Synchro	0x5371	0x02	0x17	0x5000	0x0000	0x0002	0xB530	
5	1/20/2016 6:16:23 PM.000	NETZ-EIN gepuffert	0x4300	0xF3	0xFF	0x0000	0x0000	0x0000	0x0000	
6	1/19/2016 10:44:54 AM.948	STOP durch Netzausfall	0x494E	0x3F	0xFF	0x00C0	0x0000	0x0000	0x0000	
7	1/18/2016 4:05:46 PM.024	Dezentrale Peripherie: Ende der Synchro	0x5371	0x02	0x17	0x5000	0x0000	0x0002	0xB530	
8	1/18/2016 4:05:37 PM.000	NETZ-EIN gepuffert	0x4300	0xF3	0xFF	0x0000	0x0000	0x0000	0x0000	
9	1/11/2016 7:25:27 PM.542	STOP durch Netzausfall	0x494E	0x3F	0xFF	0x00C0	0x0000	0x0000	0x0000	
10	1/11/2016 6:13:48 PM.024	Dezentrale Peripherie: Ende der Synchro	0x5371	0x02	0x17	0x5000	0x0000	0x0002	0xB530	-
Details	1 1							Ex	port	

Fig. 91: Component state, diagnostic buffer

	To read the information again from the connected control, click on \mathfrak{S} .
Details	Detailed information is available with some diagnostics messages. Click on a diagnostics message to show further information under <i>'Details'</i> .
Changing the sort sequence	
	The diagnostics messages are sorted in the order of their occurrence (column 'No.'). The newest message is first. You can also sort the diagnostics messages shown in a different order.
No time stamp description	In the title line of the table, click on the term according to which you would like to sort the diagnostics messages, e.g. 'Description'.
1 4/15/2014 8:11:55 AM.264 Mole transitio 2 4/15/2014 8:11:55 AM.247 Automatic res	\Rightarrow The table entries are sorted in alphabetical or numerical order:
	In ascending order
	In descending order
Export diagnostics mes- sages	

You can export the diagnostics messages into an XPS file (XML paper specification format).

1. Click on 'Export'.

 \Rightarrow A dialogue window will open allowing you to save the XPS file.

"Component state" editor > B-Stack/U-Stack/L-Stack

- **2.** Select a directory and enter a file name.
- 3. Click on 'Export'.
 - ⇒ The export process is started. All diagnostics messages are saved in the XPS file. You can then open and print the file, e.g. with the XPS Viewer.

6.29.6 Cycle times

Here you are provided with the cyclic data of the connected control.

Cycle data of connected device:							
Max. configured cycle time :	150						
Shortest cycle time:	0						
Current cycle time:	0						
Longest cycle time:	0						

Fig. 92: Component state, cycle times

 \longrightarrow To read the information again from the connected control, click on \Im .

'Max. parametrised cycle time' – Maximum duration of a program processing cycle (time base: milliseconds). You can configure the cycle time using the parameter "Scan cycle monitoring time". *Schapter 6.21.5 'Cycle / Clock memory' on page 120*

'Shortest cycle time' – Shortest measured program processing cycle since the last transition from STOP to RUN (time base: milliseconds)

'Current cycle time' – Duration of the most recently run program processing cycle (time base: milliseconds)

'Longest cycle time' – Longest measured program processing cycle since the last transition from STOP to RUN (time base: milliseconds)



6.29.7 B-Stack/U-Stack/L-Stack

Here you are provided with information on the following memory ranges of the connected control:

- Block stack (B-Stack)
- Interruption stack (U-Stack)
- Local data stack (L-Stack)

"Component state" editor > B-Stack/U-Stack/L-Stack

BStack:				UStack for priority class:
Block	DB1 register 🔝	DB2 register	Priority class	Akku 1:
				Akku 2:
				Akku 3:
				Akku 4:
				Ar 1:
				Ar 2:
				Status word:
				Interrupted block:
				Last relevant byte address:
				Continue in block:
				Next relevant byte address:
				1. DB:
				2. DB:
∢	III		•	LStack for block:

Fig. 93: Component state, B-Stack/U-Stack/L-Stack

Information is saved in the stacks if the CPU either reaches a breakpoint or changes to operating mode STOP due to a stop command or an error in the user program.

____ To read the information again from the connected control, click on 23.

Block stack (B-Stack) If the following events occur, the operating system saves the CPU data in the block stack:

- The processing of a block is interrupted by the calling of another block.
- The processing of a block is interrupted by a higher priority class, e.g. interrupt OB or error treatment.

The block stack shows all the blocks the processing of which was not completed at the time when the CPU was put into operating mode STOP. The block that was called last in the calling hierarchy is shown first.

The following block data are shown:

'Block' - Block that was interrupted

'DB1 register' – Data block from the DB1 register that was open at the time of the interruption

'DB2 register' – Data block from the DB2 register that was open at the time of the interruption

'Priority class' - priority class that was interrupted

Setting the time

Interruption stack (U- Stack)	If the program processing is interrupted by an organisation block with higher priority, the operating system saves the following data in the interruption stack (U-Stack):
	Current contents of the accumulators and address registersNumber and size of the open data blocks
	In the block stack, select the organisation block for which you would like to show the interruption stack data.
	\Rightarrow The interruption stack of the selected organisation block is shown.
	'Accu 14' – Contents of the accumulators
	'AR 12' – Contents of the address register
	<i>Status word</i> ' – Contents of the first bits (08) of the status word: /FC, RLO, STA, OR, OS, OV, CC0, CC1 and BR
	'Interrupted block' – Block that was interrupted
	<i>'Last relative byte address'</i> – Point in the program code at which the program was inter- rupted
	' Continue in block' – Block in which the interrupted program is continued
	'Next relative byte address' – Point in the program code at which the program is con- tinued
	<i>'DB1 register'</i> – Data block from the DB1 register that was open at the time of the inter- ruption
	<i>'DB2 register'</i> – Data block from the DB1 register that was open at the time of the inter- ruption
Local data stack (L-Stack)	The local data stack contains the local data values of the blocks that were open at the time when the CPU was put into operating mode STOP.
	Local data are the temporary data of a block. Alongside the temporary and interface variables in the user program as well as inter- mediate results in ladder diagrams, further local data are required for each organisation block. The size of the local data stacks differs depending on the component.
	In the block stack, select the block for which you would like to show the local data stack.
	\Rightarrow The local data stack of the selected block is shown.

6.30 Setting the time 🕑

Here you can set the clock of the connected control.

Setting the time

A			
SPEED7 Studio Develo	opment Line		
et time			
	20	D .	
	PC	Device	
	Time: 4:52:08 PM	5:52:41 PM	
	Date: 2/3/2016	2/3/2016	
	🔲 Take PC time	😂 Refreshing	
Status:			
Reading of time is do	ne.		
			~
		💞 Save	X Close

Fig. 94: Set time

If a project is open and a control is included, you can set the clock of the control.

Create a communication connection to the control. & Chapter 6.18.2 'Communication settings (PLC)' on page 109

1. Select one of the following options:

- Menu bar: Select 'Device → Set time'.
- Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Set time'.
- Editor "Devices and networking :: Right-click with the mouse button on the desired control (PLC) and select 'Set time'.
- ⇒ The 'Set time' dialogue window will open.

The time and date of the programming device (PC) and the connected control (device) are shown in the dialogue window. Click on *'Refreshing'* to read the time and date from the control again and to show them.

2. Select '*Take PC time*' to adopt the time and date of the programming device into the control.

- or -

Enter a time and a date into the input fields under 'Device'.

- 3. Click on 'Apply'.
 - ⇒ The desired time and the desired date are adopted into the control. The processing steps are shown in the 'Status' field.

Memory reset

6.31 Memory reset -

With memory reset, you can reset the connected control to the "initial state":

- The working memory is completely deleted.
- The data on the memory card of the load memory are preserved.



Fig. 95: Memory reset

If a project is open and a control is included, you can carry out a memory reset of the CPU.

Online diagnostics (300S module) > General

Create a communication connection to the control. Settings (PLC)' on page 109

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Memory reset'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Memory reset'.
 - Editor "Devices and networking :: Right-click with the mouse button on the desired control (PLC) and select 'Memory reset'.
 - CPU control centre: Click on —.
 - ⇒ The 'Memory reset' dialogue window will open.

Information on the control selected in the project and the connected control as well as on the communication connection between the programming device and the control are shown in the dialogue window.

- 2. Click on 'Memory reset'.
 - ⇒ If the control is not in operating mode STOP, a dialogue window will open in which you can switch the control into operating mode STOP. After having carried out a memory reset, a dialogue window will open in which you can switch the control into operating mode RUN again.

The memory reset processing steps are shown in the 'Status' field.

6.32 Online diagnostics (300S module)

In the online diagnostics, information about a component (300S module) is displayed, e.g. position of the module, I/O address, status of the component and diagnostic interrupts.

Create a communication connection to the control & Chapter 6.18.2 'Communication settings (PLC)' on page 109



- Select one of the following options:
 - Project tree: Right-click with the mouse button on the desired 300S module and select 'Online diagnostics'.
 - "Device configuration" editor : Right-click with the mouse button on the desired 300S module and select 'Online diagnostics'.
 - ⇒ The diagnostics window will open.
 - 🄄 General
 - Solution Diagnostic interrupt

6.32.1 General

General diagnostic information on the selected component are displayed here.

Online diagnostics (300S module) > Diagnostic interrupt

1 2 .				
General	General inform	nation		
Diagnostic interrupt	Short description:	DI 16xDC24V		
	Order Number:	321-1BH01		
	Device name:	PLC_01		
	Rack:	0	Address: E0	D
	Slot:	4		
	Status:			_
	Component exists]

Fig. 96: Online diagnostics of a component – General
To read the information again from the connected control, click on S.
'Short description' – Component name
'Order number' – Order number of the component
'Device name' – Name of the control
'Rack' – Number of the rack if there are several racks
'Slot' – Slot number within the control or the rack
'Address' – Configured start address (byte address) of the component
'Status' – Diagnostic information on the component, e.g. "Component exists"

6.32.2 Diagnostic interrupt

Detailed diagnostic information on the selected component are displayed here.

Online diagnostics (MICRO module)

12 L						
General Diagnostic interrupt	Diagnostic interrupt					
	Standard diagnostics:					
	Channel specific diagnostics:					
	Channel number 🛆 Error code					

Fig. 97: Online diagnostics of a component – Diagnostic interrupt

To read the information again from the connected control, click on 23.

'Standard diagnostics' – Manufacturer-related diagnostic texts, e.g. "Module on wrong slot"

'Channel specific diagnostics' – Channel-related diagnostic texts with channel number and error text, e.g. "Line break"

6.33 Online diagnostics (SLIO module)

In the online diagnostics, information about SLIO module is displayed, e.g. position of the module, I/O address, status of the component and diagnostic interrupts.

Create a communication connection to the control & Chapter 6.18.2 'Communication settings (PLC)' on page 109

Select one of the following options:

- Project tree: Right-click with the mouse button on the desired SLIO module and select 'Online diagnostics'.
- "Device configuration" editor : Right-click with the mouse button on the desired SLIO module and select 'Online diagnostics'.
- \Rightarrow The diagnostics window will open.
 - Schapter 6.32.1 'General' on page 151
 - Schapter 6.32.2 'Diagnostic interrupt' on page 152



PLC_01 [CPU 315-2AG13 315SB/DPM]
 Device overview

6.34 Online diagnostics (MICRO module)

In the online diagnostics, information about a module of the MICRO system is displayed, e.g. position of the module, I/O address, status of the component and diagnostic interrupts.

Online diagnostics (MICRO module)

4	PLC_03 [CPU M13-CCF0000]								
	O Device overview								
		bevice properties							
	Device configuration								
		A 📰	ddress overview						
	⊳	🗐 Pl	C program						
	4	📕 Lo	cal components						
	CPU M13-CCF0000 [Rack:0, Slot0]								
			DI16xDC24V [Slot1: M21-1BH00	0]					
			Component properties						
			Delete component	Del					
		8	Cut component	Ctrl+X					
			Copy component	Ctrl+C					
		6	Online diagnostics						
			Printing labels						
		E	Export hardware configuration	(WLD)					
		_							

Create a communication connection to the control & Chapter 6.18.2 'Communication settings (PLC)' on page 109

- ___ Select one of the following options:
 - Project tree: Right-click with the mouse button on the desired module and select 'Online diagnostics'.
 - "Device configuration" editor : Right-click with the mouse button on the desired module and select 'Online diagnostics'.
 - ⇒ The diagnostics window will open.
 - & Chapter 6.32.1 'General' on page 151
 - Schapter 6.32.2 'Diagnostic interrupt' on page 152

Bus system properties (PROFIBUS DP)

7 Connect devices

7.1 Bus system properties (PROFIBUS DP) 🖨

Here you can configure the PROFIBUS DP master and the connected slaves.

 Decentralised periphery A PP-Mastersystem M Add new device 	 In the project tree within a control, click on 'Bus system properties', under 'Decentralised periphery', 'DP master system'. ⇒ The 'Bus system properties' dialogue window will open. 						
Pierre Bus system online diagnostics DP_Slave_001 [SLIO 053-1DP00] Fig. 98: Bus system properties	SPEED7 Studio Development Line SPEED7 Studio Development Line Provide the system Pr	General Bus parameter Address overview General Bus name: DP-Mastersystem IO-System no: 1 * Subnet ID: 000D 0001	×				
			🗹 ОК				

Fig. 99: Dialogue window "Bus system properties"

- 2. Select an object from the list on the left, and then a tab, in order to make configurations for this object:
 - Spreaster system General configurations
 - Ø DP master system Bus parameter
 - ♦ DP master system Address overview
 - Ø BP master General configurations
 - Ø DP master Addresses
 - Ø BP slave General configurations
 - Ø BP slave Station parameters
 - Gomponent General configurations
 - Component I/O addresses

Bus system properties (PROFIBUS DP) > DP master system – General configurations

7.1.1 DP master system – General configurations

4	SPEED7 Studio Development Line		×
4	DP-Mastersystem	General Bus parameter Address overview	
	PLC_01 [CPU 315-2AG13 315SB/DPM] DP_Slave_001 [SLIO 053-1DP00]	General Bus parameter Address overview General Bus name: DP-Mastersystem IO-System no: 1 • Subnet ID: 000D 0001	
			🖌 ОК

Fig. 100: DP master system: General configurations

'Bus name' - Name for the DP master system

'IO-system-no' – Number between 1 and 9, for the differentiation of several DP master systems within one project

'Subnet ID' – Address for the communication with connection partners via routing functions, e.g. via teleservice. Bus system properties (PROFIBUS DP) > DP master system – Address overview

7.1.2 DP master system – Bus parameter

SPEED7 Studio Development Line		×
	General Bus parameter Address overview Network settings	
	Highest PROFIBUS address: 126 • IO cycle Baud rate: 1,5 Mbit/s •	
	✓ ок	

Fig. 101: DP master system: bus parameter

'Highest PROFIBUS address' – Highest station address (HSA) of an accessible partner in the PROFIBUS DP network

'Baud rate' - Baud rate of the data in the PROFIBUS DP network

7.1.3 DP master system – Address overview

^o DP-Mastersystem		G	eneral	Bus parameter Address	overvi	ew				
 PLC_01 [CPU 315-2AG13 315SB/DPM] DP_Slave_001 [SLIO 053-1DP00] 		Ing Sta En	p ut add art addre d Addre	resses ss: 2 2						
		Filt	ter: 🗹	Inputs 🕢 Outputs	ts (Component	Slot	I-Address	O-Address	Or
	> !		1	DP_Slave_001 [SLIO 053-1DP	P00] [DI2xDC24V	1	2		021
			2	DP_Slave_001 [SLIO 053-1DP	P00] I	M 053DP	0	8189*		053
			3	DP_Slave_001 [SLIO 053-1DP	P00] [DO8xDC24V 0,5A	2		0	022

Fig. 102: DP master system: Address overview

Bus system properties (PROFIBUS DP) > DP master system – Address overview

Each table line corresponds to a cohesive address range of a component:

'No.' - Consecutive number

'Device' - Device name and device type of the slave

'Component' - Component (module) within the slave

'Slot' – Slot number within the rack

'I-Address' – Configured input address (byte address) of an input component. To change the addresses, see below.

'O-Address' – Configured output address (byte address) of an output component. To change the addresses, see below.

'Order number' - Order number of the component

You can change the address areas:

- **1.** Select **I** *(Inputs'* and/or *'Outputs'*.
 - \Rightarrow The table lists all projected input or output modules.
- **2.** Highlight the desired module in the table.
 - ⇒ In the fields 'Start address' and 'End Address', the current address attribution (byte address) of the module is displayed.

Example of input addresses: Start address = 8, end address = 9 – The module occupies the two input bytes E8 and E9.

3. Select the new input or output address in the field 'Start address'.

If this address is already occupied, a note pops up. Enter a different address.

 \Rightarrow The address is changed in the selected module.

\bigcirc

To edit I/O addresses for all configured components of the control: Chapter 8.14 "Address overview" editor and page 233 Bus system properties (PROFIBUS DP) > DP master – Addresses

7.1.4 DP master – General configurations

SPEED7 Studio Development Line		×
SPEED7 Studio Development Line Provide PLC_01 [CPU 315-2AG13 315SB/DPM] Provide PLC_01 [SLIO 053-1DP00] Provide PLC_01 [SLIO 053-1DP00]	General General Device name: PLC_01 Network settings DP address master: 1	×
		✔ ОК

Fig. 103: Control: General configurations

'Device name' - Device name of the control

'DP address master' - Station address of the integrated PROFIBUS DP master



7.1.5 DP master – Addresses

Fig. 104: Control: Addresses

Bus system properties (PROFIBUS DP) > DP slave – General configurations

'Interface' – Input address (byte address) for the exchange of diagnostics data between CPU and DP master system

7.1.6 DP slave – General configurations

SPEED7 Studio Development Line		×
PP-Mastersystem	General Station parameters	
	General Device name: DP_Slave_001 Network settings DP address station: 2 Diagnostic addresses Interface: 8189	
	A OK	C

Fig. 105: Slave: General configurations

'Device name' - Device name of the slave

'DP address station' - Station address of the slave

'Interface' – Input address (byte address) for the exchange of diagnostics data between CPU and slave

Bus system properties (PROFIBUS DP) > DP slave – Station parameters

7.1.7 DP slave – Station parameters

SPEED7 Studio Development Line			×
PP DP-Mastersystem	General Station parameter	s	
■ PC_01 [CP0 513-2A015 51356/DFM] ■ DP_Slave_001 [SLIO 053-1DP00]	DPV1 interrupt DP interrupt mode: DPV1 ☑ Vend ☑ Diagr	• or specific interrupt (OB 57) nostic interrupt (OB 82)	
	♥ Proce ♥ Plug/	ess interrupt (OB 40 bis 47) Pull interrupt (OB 83)	
	Identifier-related diagnostics	enable *	
	Submodule status	enable *	
	Channel-related diagnostics	enable •	
	SLIO-version Data Format	Motorola *	
			or or

Fig. 106: Slave: Station parameters

'DP interrupt mode' - Mode of the interrupt version

DPV1 mode: In case of an interrupt, the slave will trigger the interrupt OB's activated here $\boxed{\ensuremath{\checkmark}}$.

DPV0 mode: The slave will not trigger any interrupt.

'Station parameters' - Manufacturer specific parameters from the GSD file

Bus system properties (PROFIBUS DP) > Component – I/O addresses

7.1.8 Component – General configurations

SPEED7 Studio Development Line		×
Pe DP-Mastersystem	General I/O addresses	
 Image: PLC_01 [CPU 315-2AG13 315SB/DPM] Image: DP_Slave_001 [SLIO 053-1DP00] D12xDC24V [Slot1: 021-1BB00] D08xDC24V 0,5A [Slot2: 022-1BF[General I/O addresses Info: DI2xDC24V Order No: 021-1BB00	
< m ▶		
		🖌 ОК

Fig. 107: Component: General configurations 'Info' – Component name *'Order number' –* Order number of the component

7.1.9 Component – I/O addresses

SPEED7 Studio Development Line					×
PB DP-Mastersystem	Ge	neral I/O	addresses		
 PLC_01 [CP0 51-2AG13 31558/0PM] DP_Slave_001 [SLIO 053-1DP00] D12xDC24V [Slot1: 021-1BB00] D08xDC24V 0,5A [Slot2: 022-1BF(Input Start a End A	addresses address: 2 ddress: 2	Outpu Start a End Ad	t addresses ddress: 0 ddress:	A V
		Address	Name	Data type	Comment
		E 2.0	x_DI_2_0_542	BOOL	E 2.0 - DI2xDC24V [Device: DP_Slave_001, Slot: 1, Rack:
		E 2.1	x_DI_2_1_542	BOOL	E 2.1 - DI2xDC24V [Device: DP_Slave_001, Slot: 1, Rack:
< <u> </u>	•			"	
					🖌 ОК

Fig. 108: Component: I/O addresses

Each table line corresponds to a channel of the component:

'Address' - Configured input or output address. To change the addresses, see below

'Name' – Name of the variables: Symbolic I/O address

'Data type' – Data type of the variables, e.g. "BOOL" for bit addresses. The data type is preset according to the channels and cannot be changed.

'Comment' - Any comment e.g. remark or explanation

You can change the address areas:

Select the new input or output address in the field 'Start address'.

If this address is already occupied, a note pops up. Enter a different address.

⇒ In the fields 'Start address' and 'End Address', the current address attribution (byte address of the component is displayed.

Example of input addresses: Start address = 8, end address = $9 - \text{The component occupies the two input bytes } \mathbb{E}8$ and $\mathbb{E}9$.



To edit I/O addresses for all configured components of the control: Chapter 8.14 "Address overview" editor a page 233

7.2 Bus system properties (PROFINET-IO system) 🚓

Here you can make general configurations for the PROFINET-IO system.



Fig. 109: Bus system properties

- **1.** In the project tree within a control, click on 'Bus system properties', under 'Decentralised periphery', 'PROFINET-IO system'.
 - ⇒ The 'Bus system properties' dialogue window will open.

Bus system properties (PROFINET-IO system)

Bus system properties		×
 PROFINET-IO-System PLC_03 [CPU 015-CEFPR00] PN_Device_001 [SGDV-aaaaE5a] PN_Device_002 [SLIO 053-1PN00] 053-1PN00 Profinet Device Port 1 Port 2 	General IO cycle Address overview General Bus name: PROFINET-IO-System IO-System no: 101 * Subnet ID: 0010 0065	
		ОК

Fig. 110: Dialogue window "Bus system properties"

- 2. Select an object from the list on the left, and then a tab, in order to be able to make configurations for this object:
 - Ø PROFINET-IO system General configurations
 - PROFINET-IO system IO cycle
 - ØROFINET-IO system Address overview
 - IO controller General configurations
 - 🔄 IO controller addresses
 - IO device General configurations
 - IO device IO cycle
 - 🤄 IO device Parameter
 - IO module General configurations

Bus system properties (PROFINET-IO system) > PROFINET-IO system – General configurations

7.2.1 PROFINET-IO system – General configurations

Bus system properties		×
Bus system properties Bus system properties PROFINET-IO-System PLC_03 [CPU 015-CEFPR00] PLC_03 [CPU 015-CEFPR00] PLC_03 [CPU 0153-1PN00] PLC_03 [SID 053-1PN00] S053-1PN00 Profinet Device Port 1 Port 1 Port 2	General IO cycle Address overview General Bus name: PROFINET-IO-System IO-System no: 101 * Subnet ID: 0010 0065	×
	🖌 ок	

Fig. 111: PROFINET-IO system: General configurations

'Bus name' - Name for the PROFINET-IO system

'IO-system no' – Number for the differentiation of several PROFINET-IO systems within one project

'Subnet ID' – Address for the communication with connection partners via routing functions, e.g. via teleservice. Bus system properties (PROFINET-IO system) > PROFINET-IO system – IO cycle

7.2.2 PROFINET-IO system – IO cycle

Bus system properties	×
PROFINET-IO-System PLC_03_[CPU_015-CEEPR00]	General IO cycle Address overview
 ▶ [I.e. of [cl of 0.0] Self Hooj ▶ PN_Device_001 [SGDV-□□□□E5□] ■ PN_Device_002 [SLIO 053-1PN00] Ø 053-1PN00 Profinet Device Ø Port 1 Ø Port 2 	IO cycle Send clock: 1000 • µs
	No. Name Bus name Type Time (μs) 1 PN_Device_001 SGDV-OCB03A-001 SGDV-OCB03A 2000 2 PN_Device_002 VIPA053-1PN00-002 VIPA053-1PN00 2000
	🗸 ок

Fig. 112: PROFINET-IO system: IO cycle

'Send clock' – Smallest possible transmission interval for the data exchange of the RT or IRT communication

Each table line corresponds to a PROFINET accessible partner:

'No.' - Consecutive number

'Name' - PROFINET accessible partner

'Bus name' - PROFINET device name (IO device)

'Type' - Device type

'Time (μ s)' – Calculated refresh interval \Leftrightarrow Chapter 7.2.7 'IO device – IO cycle' on page 171

Bus system properties (PROFINET-IO system) > PROFINET-IO system – Address overview

7.2.3 PROFINET-IO system – Address overview

a						
PROFINET-IO-System	0	General	IO cycle Address overview			
PLC_03 [CPU 015-CEPPR00] Isophysic PN_Device_001 [SGDV-aaaaE5a] Implevice_002 [SLIO 053-1PN00] f 053-1PN00 Profinet Device f Port 1 f Port 2	In St Er Fil	put add art addr nd Addre ter: 📝	resses ess: 0 + Inputs I Outputs			
		No.	Device	Component	Slot	I-Address
		1	PLC_03 [CPU 015-CEFPR00]	DI8xDC24V	1	0
		2	PLC_03 [CPU 015-CEFPR00]	DI2xDC24V 2µs4ms	2	1
		3	PLC_03 [CPU 015-CEFPR00]	CP 343-1 Industrial Ethernet	104	864 - 879
		4	PN_Device_002 [SLIO 053-1PN00]	IF Port 2: Port 2	0	2033*
		5	PN_Device_002 [SLIO 053-1PN00]	IF Port 1: Port 1	0	2034*
		6	PN_Device_002 [SLIO 053-1PN00]	IF: 053-1PN00 Profinet Device	0	2035*
		7	PN_Device_002 [SLIO 053-1PN00]	IM 053PN	0	2036*
		8	PN_Device_001 [SGDV-DDDDE5D]	X1 P2: Port 2	0	2037*
		9	PN_Device_001 [SGDV-0000E50]	X1 P1: Port 1	0	2038*
		10	PN_Device_001 [SGDV-DDDDE5D]	X1: PN-IO	0	2039*
			DLC 02 (CDU 015 CEEDP00)	vipa-slio-cpu015-cefpr00 Port 1	0	20418

Fig. 113: PROFINET-IO system: Address overview

Each table line corresponds to a cohesive address range of an accessible partner:

'No.' – Consecutive number

'Device' – Device name and device type

'Component' - Component (module) within the accessible partner

'Slot' – Slot number within the rack

'I-Address' – Configured input address (byte address) of an input component. To change the addresses, see below.

'O-Address' – Configured output address (byte address) of an output component. To change the addresses, see below.

'Order number' - Order number of the accessible partner or component

You can change the address areas:

- **1.** Select **I** 'Inputs' and/or 'Outputs'.
 - ⇒ The table lists all projected input or output modules.
- **2.** Highlight the desired module in the table.
 - ⇒ In the fields 'Start address' and 'End Address', the current address attribution (byte address) of the module is displayed.

Example of input addresses: Start address = 8, end address = 9 - The module occupies the two input bytes E8 and E9.

3. Select the new input or output address in the field 'Start address'.

If this address is already occupied, a note pops up. Enter a different address.

 \Rightarrow The address is changed in the selected module.

Bus system properties (PROFINET-IO system) > IO controller – General configurations



To edit I/O addresses for all configured components of the control: Chapter 8.14 "Address overview" editor "' on page 233

7.2.4 IO controller – General configurations

Bus system properties			×
PROFINET-IO-System	General Addresses		
 PLC_03 [CP0 013-CEPPR00] PN_Device_001 [SGDV-====E5=] 	General		
 PN_Device_002 [SLIO 053-1PN00] 053-1PN00 Profinet Device 	Object name:	PLC_03	
💉 Port 1	Bus device name:	pn-io	
🔊 Port 2	IP settings		
	IP address:	192 . 168 . 0 . 1	
	Subnet mask:	255 . 255 . 255 . 0	
	Router address:	192 . 168 . 0 . 1	
			🖌 ОК

Fig. 114: IO controller: General configurations

'Device name' – Device name of the control (IO controller)

'Bus device name' - PROFINET device name (IO controller)

'IP address' and 'Subnet mask'- Address of the control in the PROFINET-IO network

'Router address' – IP address of the router if the communication should be realised beyond the PROFINET-IO network (routing)



Bus system properties (PROFINET-IO system) > IO controller – addresses

7.2.5 IO controller – addresses

Bus system properties	×
Image: PROFINET-IO-System General Addresses Image: PROFINET-IO-System General Addresses Image: PROFINET-IO-System Diagnostic addresses Image: PROFINET-IO-System Interface: 2046 Image: Profinet Device PROFINET-IO system: 2043 Image: Profinet Device PROFINET-IO system: 2043	
	🖌 ОК

Fig. 115: IO controller: Addresses

'Interface' – Input addresses (byte address) for the exchange of diagnostic data between CPU and PROFINET-IO system

'PROFINET-IO system' – Diagnostic address for fault messages of the IO controller, e.g. in case of a failure of the PROFINET-IO system

Bus system properties (PROFINET-IO system) > IO device – General configurations

7.2.6 IO device – General configurations

Bus system properties			×
PROFINET-IO-System	General IO cycle	Parameter	
 PLC_03 [CPU 015-CEPPR00] PN_Device_001 [SGDV-aaaaE5a] PN_Device_002 [SLIO 053-1PN00] 053-1PN00 Profinet Device Port 1 Port 2 	General Device type: Order No: Vendor ID: Hardware release:	VIPA053-1PN00 053-1PN00 0x022B Device ID: Software release:	0x18C5
	Object name: Bus device name: Device number:	PN_Device_002 vipa053-1pn00-002	
	Diagnostic addresses	2036	
	IP settings IP address:	192 . 168 . 0 . 3	Accessible partners

Fig. 116: IO device: General configurations

The dialogue window includes information about the IO device, such as device type, order number, etc.

'Device name' - Device name of the accessible partner (IO device)

'Bus device name' - PROFINET device name (IO device)

'Device number' – Configured device number

'Interface' – Input address (byte address) for the exchange of diagnostics data between IO controller and IO device

'IP Address' - Address of the accessible partner in the PROFINET-IO network

Bus system properties (PROFINET-IO system) > IO device - IO cycle

7.2.7 IO device - IO cycle

Bus system properties		×
Sus system properties Image: Syst	General IO cycle Parameter Refresh interval automatic • Mode: • • Factor Send clock [µs] Refresh interval [µs]: 2000 • = 2 • × 1000 Watchdog Time •	×
	Number of accepted update cycles with missing IO data: 3 • Watchdog Time [µs]: 6000	
	🗸 ОК	

Fig. 117: IO device: IO cycle

Refresh interval	The PROFINET device with the highest configured refresh interval determines the trans- mission cycle in which all PROFINET devices will receive and/or send data at least once.
	The smaller the refresh interval, the more bandwidth will be occupied by the cyclic real time communication.
	The bigger the refresh interval, the longer the reaction time.
	'Mode:'
	 'Automatic' – The refresh interval is optimised so that no warnings or errors can occur.
	<i>'Fixed refresh interval'</i> – With this configuration, you can change the refresh interval of the IO device. If you change the refresh intervals, errors might occur in the consis- tency check.
	 'Fixed factor' – With this configuration, you can determine how often the IO device should be refreshed. This configuration changes the response monitoring time. 'Response monitoring time' on page 171.
	Example: Factor = 2, send clock = 1000 μ s – The IO device is refreshed after each second send clock, i.e. every 2000 μ s.
	'Refresh interval (μ s)' – Refresh interval of the IO device
	'Factor' – Number of send clocks, after which the IO device should be refreshed
	'Send clock (μ s)' – Smallest possible transmission interval for the data exchange of the RT or IRT communication
Response monitoring time	<i>'Number of accepted refresh cycles with missing IO data'</i> – Number of faulty telegrams until disconnection
	If no valid IO data is received after this number of refresh cycles, the connection between IO device and IO controller is interrupted. The input and output data are monitored separately. If input data is still received but output data are not transmitted anymore, the connection will be interrupted after the number of accepted refresh cycles.

Bus system properties (PROFINET-IO system) > IO device - Parameter

'Response monitoring time' μs – Time until fault detection, determined from refresh interval and number of accepted refresh cycles with missing IO data.

7.2.8 IO device – Parameter

Bus system properties		×
	General IO cycle Parameter Parameter ***** General Parameters **** Allow Descent Alama	1
💉 Port 1 💉 Port 2	Allow Frocess Alarms Allow Diagnosis Alarms Type of Diagnosis Alarms Auto Acknowledge Alarms	Image: Image of the second
	Enable WebServer Process Data Format **** Free Module Mapping Parameters ****	0 * Motorola (Big-Endian) *
	Enable FMM FMM Restart Mode	0 • Manual •
		🖋 ОК

Fig. 118: IO device: Parameter

'Parameter' - Manufacturer specific parameters from the GSDML file

Online diagnostics of the bus system (PROFINET-IO system)

7.2.9 IO module – General configurations

Bus system properties			×
Bus system properties Bus system properties Bus system properties Bus system properties PROFINET-IO-System PILC_03 [CPU 015-CEFPR00] PILS PN_Device_001 [SGDV-=====55] PILS PN_Device_002 [SLIO 053-1PN00] PILS POS3-1PN00 Profinet Device PILS POR 1 PILS POR 2	General General Info: Diagnostic addresses Interface:	053-1PN00 Profinet Device	×
			√ ок

Fig. 119: IO module: General configurations

'Info' - Module or channel designation

'Interface' – Input address (byte address) for the exchange of diagnostics data between CPU and master system

7.3 Online diagnostics of the bus system (PROFINET-IO system) 😼

You can monitor the PROFINET-IO system using the online diagnostics. You receive diagnostic information on devices, components and network ports.



- **1.** In the project tree within a control, click on *'Online diagnostics of the bus system'*, under *'Decentralised periphery'*, *'PROFINET-IO system'*.
 - ⇒ The 'Online diagnostics of the bus system' dialogue window will open.

Fig. 120: Online diagnostics of the bus system

Online diagnostics of the bus system (PROFINET-IO system)

PROFINET-IO-System PROFINET-IO-System PLC_01 [CPU 015-CEFPR00]	General Bus information: Bus name: PROFINET-IO-System IO-System no: 100 Status:	
	At least one component disturbed.	

Fig. 121: "Online diagnostics of the bus system" dialogue window

- 2. Select an object from the list on the left, and then a tab, in order to show the diagnostic information for this object.
 - ØROFINET-IO system General
 - 🔅 IO controller General
 - 🔄 IO controller Interface
 - IO device General
 - 🔄 IO device Diagnostics
 - 🖏 IO device Interface
 - 🤄 IO device Network connection
 - Ø Port General
 - Ørit Network connection
 - IO module General
 - 🤄 IO module Diagnostics

Online diagnostics of the bus system (PROFINET-IO system) > PROFINET-IO system – General

7.3.1 PROFINET-IO system – General

🙀 PROFINET-IO-System 🗥	General	
▶ ₩ PLC_01 [CPU 015-CEFPR00] ▲	Bus information: Bus name: PROFINET-IO-System IO-System no: 100	
	Status:	
	At least one component disturbed.	

Fig. 122: Online diagnostics PROFINET-IO system: General

Bus information

'Bus name' – Name for the PROFINET-IO system *'IO-system no'* – Number for the differentiation of several PROFINET-IO systems within one project

status

Status information of the PROFINET-IO system:

Examples of status information	
"At least one component disturbed."	
"Diagnostics messages present."	
"Maintenance requirements"	

Online diagnostics of the bus system (PROFINET-IO system) > IO controller – General

7.3.2 IO controller – General

 PN_Device_001 [SLIO 053-1PN00] PN_Device_002 [SLIO 053-1PN00] PN_Device_003 [SLIO 053-1PN00] 	Device name: PLC_01 Diagnostic address: 2046 Bus information: Bus name: PROFINET-IO-System IO-System no: 100 Bus device name: pn-io Status: At least one component disturbed.	
--	--	--

Fig. 123: Online diagnostics IO controller: General

Device information	'Device name' – Device name of the control (IO controller)
	'System recognition' – Identification of the automation system
	<i>'Diagnostic address'</i> – Input address (byte address) for the exchange of diagnostic data between CPU and PROFINET-IO system
	'Slot' – PROFINET port (port number) on IO controller
Bus information	'Bus name' – Name for the PROFINET-IO system
Bus information	
	<i>'IO-system no'</i> – Number for the differentiation of several PROFINET-IO systems within one project
	'Bus device name' – PROFINET device name (IO controller)
status	Status information of the IO controller:
	Examples of status information
	"At least one component disturbed."
	"Diagnostics messages present."
	"Maintenance requirements"

Online diagnostics of the bus system (PROFINET-IO system) > IO controller – Interface

7.3.3 IO controller – Interface

PROFINET-IO-System	General Interface	Network connec	tion		
PLC_01 [CPU 015-CEFPR00] 🔥	IP parameter:				
PN Device 001 [SLIO 053-1PN00] •	Interface	IP Address	Subnet mask	Default router	MAC address
	R/S/X4	192.168.20.1	255.255.255.0	192.168.20.1	00-20-D5-01-7A-DE
PN_Device_002 [SLIO 053-1PN00]					
PN_Device_003 [SLIO 053-1PN00]					
PN_Device_003 [SLIO 053-1PN00]					
PN_Device_003 [SLIO 053-1PN00]					
PN_Device_003 [SLIO 053-1PN00]					
PN_Device_003 [SLIO 053-1PN00]					
▶ 📓 PN_Device_003 [SLIO 053-1PN00] 🤇					
▶ 📓 PN_Device_003 [SLIO 053-1PN00] 🧲					
▶ 📲 PN_Device_003 [SLIO 053-1PN00] 🧲					
▶ 📱 PN_Device_003 [SLIO 053-1PN00] 🧲					
▶ 📲 PN_Device_003 [SLIO 053-1PN00] 🧲					
▶ 📱 PN_Device_003 [SLIO 053-1PN00] 🧲					

Fig. 124: Online diagnostics IO controller: Interface

IP parameter

The table lists all interfaces of the IO controller. Each table line corresponds to an interface.

'Interface' – Rack number / Slot number / Port (port number)

'*IP address*' and '*Subnet mask*' – Address of the accessible partner in the PROFINET-IO network

'Default router' – IP address of the router if the communication is realised beyond the PROFINET IO network (routing).

'MAC address' – Hardware address of the network adapter, for clear identification of the device

Online diagnostics of the bus system (PROFINET-IO system) > IO controller – Network connection

7.3.4 IO controller – Network connection

PROFINET-IO-System 🔔	General Interface Ne	twork connection		
▶ ■ PN_Device_001 [SLIO 053-1PN00] ✓ ▶ ■ PN_Device_002 [SLIO 053-1PN00] ✓	Name (R/S/X4 P1)	Port status Active	Configurations Automatic	mode 100BASETXFD
	MAC address of the in Type of connection:	terface: 00-20-D5 Copper c	-01-7A-DE able	

Fig. 125: Online diagnostics IO controller: Network connection

Physical properties The table lists all Ethernet ports of the IO controller. Each table line corresponds to an interface.

'Name' - Rack number / Slot number / Port and port number

'Port status'

- "Active": A device has been connected to the interface and the connection was established.
- "Inactive": No device has been connected to the interface.

'Configurations'

- "Automatic" if the port status is "Active"
- "---" if the port status is "Inactive"

'Mode' - Configuration of the network adapter: Transfer rate and transfer procedures

Details about the port

- Click on an active port in the table.
 - \Rightarrow The details on the selected port are shown below the table

'MAC address of the interface' - Hardware address of the network adapter

'Type of connection' - Transfer medium, e.g. copper cable

'Neighbouring ports' – If connected devices can be determined, they will be listed in the following way:

- Device name.Port name, e.g. vipa053-1pn00-002.port001
- MAC address of the network adapter of the connected device
- Line length in meters (m) and signal run time in nanoseconds (ns)

Online diagnostics of the bus system (PROFINET-IO system) > IO device – General

7.3.5 IO device – General

📅 PROFINET-IO-System 🛕	General Diagn	ostics	Interface	Network cor	nnection		
 PLC_01 [CPU 015-CEFPR00] PN_Device_001 [SLI0 053-1PN00] PN_Device_002 [SLI0 053-1PN00] PN_Device_003 [SLI0 053-1PN00] 	Device informa Device name: System recogn Diagnostic add Bus informatio Bus name: IO-System n Bus device n Device numi Status: Component o Diagnostics n Component o	ntion: Pf ition: Pf iress: 20 n: Pf o: 10 ame: vi ame: vi ame: 3 listurbed nessages xists.	N_Device_[ROFINET-I)32 ROFINET- 00 ipa053-1pi i. present.	003 O IO-System n00-003	Hardware version: Firmware version:	3 V1.3.7	

Fig. 126: Online diagnostics IO device: General

Device information	'Device name' – Device name of the device (IO device)
	'System recognition' – Identification of the automation system
	<i>'Diagnostic address'</i> – Input address (byte address) for the exchange of diagnostic data between IO controller and IO device
	'Hardware version' - Output version of the hardware of the device
	'Firmware version' – Output version of the firmware of the device
Bus information	'Bus name' – Name for the PROFINET-IO system
	<i>'IO-system no'</i> – Number for the differentiation of several PROFINET-IO systems within one project
	'Bus device name' – PROFINET device name (IO device)
	'Device number' – Configured device number
status	Status information of the IO controller:
	Examples of status information
	"Component exists"
	"Component configured but not available"
	"Component disturbed"
	"Diagnostics messages present."
	"Maintenance requirements"

Online diagnostics of the bus system (PROFINET-IO system) > IO device – Diagnostics

7.3.6 IO device – Diagnostics

PN_Device_001 [SLI0 053-1PN00]	Manufacturer name: VIPA GmbH Device ID: 0x18C5 (6341)
 PN_Device_002 [SLIO 053-1PN00] • PN_Device_003 [SLIO 053-1PN00] • 	Standard diagnostics: Slot No. 3 : Correct module. Channel specific diagnostics:
	Slot No. 3 Subslot No. 1 Channel No. 0 : Line break.

Fig. 127: Online diagnostics IO device: Diagnostics

Extended device informa- tion	<i>'Manufacturer name'</i> – Name of the device manufacturer or Vendor ID (hexadecimal) <i>'Device ID'</i> – Device ID (hexadecimal and in brackets: decimal)
Standard diagnostics	Manufacturer-related diagnostic texts of the IO device:
	Examples of standard diagnostics
	"Slot No. 3: Correct module"
	"Slot No. 1: Module on wrong slot"
Channel-specific diagnos- tics	Channel-related diagnostic texts for all modules of the IO device; each channel is described by the slot of the component and the channel number:
	Examples of channel-specific diagnostics
	"Slot No. 3 Subslot No. 1 Channel No. 0: Line break"
	"Slot No. 5 Subslot No. 1 Channel No. 3: short circuit"
Online diagnostics of the bus system (PROFINET-IO system) > IO device – Interface

7.3.7 IO device – Interface

ROFINET-IO-System 🔔	General Diagnost	ics Interface	Network connection				
PLC_01 [CPU 015-CEFPR00] A	IP parameter:	IP parameter:					
PN Device 001 [SLIO 053-1PN00]	Interface	IP Address	Subnet mask	Default router	MAC address		
PN Device 002 [SLIO 053-1PN00]	IF	192.168.20.4	255.255.255.0	192.168.20.4	00-20-D5-09-5D-6		
PN_Device_003 [SLIO 053-1PN00] 10							

Fig. 128: Online diagnostics IO device: Interface

IP parameter

The table lists all interfaces of the IO device. Each table line corresponds to an interface.

'Interface' - Rack number / Slot number / Port (port number)

'*IP address*' and '*Subnet mask*' – Address of the accessible partner in the PROFINET-IO network

'Default router' – IP address of the router if the communication is realised beyond the PROFINET-IO network (routing)

'MAC address' – Hardware address of the network adapter, for clear identification of the device

Online diagnostics of the bus system (PROFINET-IO system) > IO device – Network connection

7.3.8 IO device – Network connection

PROFINET-IO-System 🧥	General Diagnostics I	nterface Network	k connection	
PLC_01 [CPU 015-CEFPR00] 🛕	Physical properties:			
PN Device 001 [SLIO 053-1PN00]	Name	Port status	Configurations	mode
	Port 1 (IF Port 1)	Active	Automatic	100BASETXFD
PN_Device_002 [SLIO 053-1PN00] V	Port 2 (IF Port 2)	Inactive		Reserved
			the 0.10 me (Cincred over the	net I mel

Fig. 129: Online diagnostics IO device: Network connection

Physical properties The table lists all Ethernet ports of the IO device. Each table line corresponds to an interface. 'Name' - Name of the port and port number 'Port status' "Active": A device has been connected to the interface and the connection was estab-lished. "Inactive": No device has been connected to the interface. 'Configurations' "Automatic" if the port status is "Active" "---" if the port status is "Inactive" 'Mode' - Configurations of the network adapter: Transfer rate and transfer procedures Details about the port Click on an active port in the table. ⇒ Details on the selected port are shown below the table. 'MAC address of the interface' - Hardware address of the network adapter 'Type of connection' - Transfer medium, e.g. copper cable 'Neighbouring ports' - If connected devices can be determined, they will be listed in the following way: Device name.Port name, e.g. vipa053-1pn00-002.port001 MAC address of the network adapter of the connected device Line length in meters (m) and signal run time in nanoseconds (ns)

Online diagnostics of the bus system (PROFINET-IO system) > Port – General

7.3.9 Port – General

📅 PROFINET-IO-System 🛕	General Network connection		
 ■ PLC_01 [CPU 015-CEFPR00] ▲ □ PN_Device_001 [SLIO 053-1PN00] □ PN_Device_002 [SLIO 053-1PN00] □ PN_Device_003 [SLIO 053-1PN00] ● Port 1 ● Port 2 □ DO8xDC24V 0,5A □ D18xDC24V ▲ Al2x16Bit TC 	Device information: Device name: Port 1 System recognition: PROFINET Diagnostic address: 2030	Slot: -IO	0.2 (IF Port 1)

Fig. 130: Online diagnostics port: General

Device information

'Device name' - Name of the port

'System recognition' – Identification of the automation system

'Diagnostic address' – Input address (byte address) for the exchange of diagnostic data between CPU and the port

'Slot' - PROFINET port (port number) on the device

Online diagnostics of the bus system (PROFINET-IO system) > Port – Network connection

7.3.10 Port – Network connection

PROFINET-IO-System 🛕	General Network conn	ection		
PLC_01 [CPU 015-CEFPR00] 🔥	Physical properties:			
PN Device 001 [SLIO 053-1PN00]	Name	Port status	Configurations	mode
PN_Device_002 [SLIO 053-1PN00]	Port 1 (IF Port 1)	Active	Automatic	100BASETXFD
 ✓ Port 1 ✓ Port 2 DO8xDC24V 0,5A ✓ DI8xDC24V ✓ AI2x16Bit TC ✓ 	Details about the port: MAC address of the in Type of connection: Neighbouring ports:	Port 1 (IF Port 1 terface: 00-20-D5 Copper o vipa053- MAC add Line leng	.) 5-09-5D-67 :able 1pn00-002.port-002 dress of the interface: 00- gth: 0.18 m (Signal run tir	20-D5-09-5D-40 ne: 1 ns)

Fig. 131: Online diagnostics port: Network connection

Physical properties	The table contains the following information on the port:					
	<i>Name'</i> – Name of the port and port number					
	'Port status'					
	 "Active": A device has been connected to the interface and the connection was established. "Insertion": No device has been connected to the interface. 					
	"Inactive": No device has been connected to the interface.					
	'Configurations'					
	 "Automatic" if the port status is "Active" "" if the port status is "Inactive" 					
	'Mode' – Configurations of the network adapter: Transfer rate and transfer procedures					
Details about the port	The details on the selected port are shown below the table:					
	'MAC address of the interface' – Hardware address of the network adapter					
	'Type of connection' – Transfer medium, e.g. copper cable					
	<i>'Neighbouring ports'</i> – If connected devices can be determined, they will be listed in the following way:					
	 Device name.Port name, e.g. vipa053-1pn00-002.port001 MAC address of the network adapter of the connected device Line length in meters (m) and signal run time in nanoseconds (ns) 					

Online diagnostics of the bus system (PROFINET-IO system) > IO module – General

7.3.11 IO module – General

FN	General Diagnostics	
 PLC_01 [CPU 015-CEFPR00] PN_Device_001 [SLIO 053-1PN00] PN_Device_002 [SLIO 053-1PN00] PN_Device_003 [SLIO 053-1PN00] POrt 1 Port 2 DO8xDC24V 0,5A D18xDC24V 	Device information: 031-1BB90 AI2x16Bit TC Slot: 3 System recognition: PROFINET-IO Hardware version: 2 Input addresses: 132 - 135 Firmware version: V1.2.9 Status: Component error (detected by diagnostic interrupt). Diagnostics messages present. V1.2.9 Component exists: V1.2.9 V1.2.9 V1.2.9	

Fig. 132: Online diagnostics IO module: General

Device information	<i>Device name'</i> – Name of the module
	'System recognition' – Identification of the automation system
	'Input addresses' – Area of the input addresses (byte) assigned to the module
	'Output addresses' – Area of the output addresses (byte) assigned to the module
	<i>Slot'</i> – Slot of the module
	'Hardware version' – Output version of the hardware of the module
	'Firmware version' – Output version of the firmware of the module
status	Status information of the module:
	Execution of status information

Examples of status information

"Component exists"

"Component configured but not available"

"Component disturbed"

"Diagnostics messages present."

Bus system properties (EtherCAT)

7.3.12 IO module – Diagnostics

PROFINE I-IO-System ▲ ■ PLC_01 [CPU 015-CEFPR00] ▲ ▷ ■ PN_Device_001 [SLIO 053-1PN00] ✓ ▷ ■ PN_Device_002 [SLIO 053-1PN00] ✓	Standard diagnostics: Correct module.	
 PN_Device_003 [SLIO 053-1PN00] Port 1 Port 2 D08xDC24V 0,5A D18xDC24V Al2x16Bit TC 	Channel specific diagnostics: Channel No. 0 : Line break.	

Fig. 133: Online diagnostics IO module: Diagnostics

Standard diagnostics	Manufacturer-related diagnostic texts of the module:				
	Examples of standard diagnostics				
	"Correct module"				
	"Module on wrong slot"				
Channel-specific diagnos- tics	Channel-related diagnostic texts of the module:				
	Examples of channel-specific diagnostics				
	"Channel No. 0: Line break"				
	"Channel No. 3: short circuit"				

7.4 Bus system properties (EtherCAT) 🚓

Here, you can make configurations on the EtherCAT master and the connected slaves. & Chapter 11 'Deployment SPEED7 EtherCAT Manager' on page 355

7.5 Configure Ethernet connections

7.5.1 Insert new connection

In the 'Devices and networking' editor you can add Ethernet connections in order to connect devices. The devices that are to be connected must already be present in the project.



- **1.** Right-click with the mouse button on the left connection point of the device from which the connection comes and select *'Insert new connection'*.
 - ⇒ The 'Insert new connection' dialogue window will open.

SPEED7 Studio Development Line	×
Insert new connection	
Local end point: PLC_03 [CPU 015-CEFPR00]	
Connection partner:	
PLC02 [CPU 315-4EC12 315SN/EC]	
Connection type: S7 connection	
V Canc	:el

Fig. 134: Insert new connection

- **2.** Select the desired *'connection type'*, e.g. S7 connection.
- 3. Under 'Connection partners', select the device you want to connect.
- 4. Click on 'OK'.
 - ⇒ The new connection is added and the 'Connection settings' dialogue window will open. In this dialogue window you can configure the connection. *S Chapter* 7.5.2 'Connection settings – General' on page 188

Configure Ethernet connections > Connection settings - Local ID

For details on displaying connections in the *'Devices and networking'* editor: *S Chapter* 6.2.2 *'Connections' on page* 76

7.5.2 Connection settings – General

Here you can configure the connection between devices.

SPEED7 Studio	Development Line	
General	General	
Local ID		
Special properties	Local:	Partner:
Address details	End point: PLC_03 [CPU 015-CEFPR00]	End point: PLC_02 [CPU 315-4EC12 315SN/EC]
	Name: PLC_03-1	Name: PLC_02-1
	Interface: -X4: PROFINET-IO-System *	Interface: -X8: EC-Mastersystem •
	Address: 192.168.0.1	Address: 192 . 168 . 0 . 2
		V OK X Cancel

Fig. 135: Connection settings "General"

'End point' – Device name

'Name' – Name of the connection point

'Interface' - Device interface

'Address' - IP address of the device at the device interface

7.5.3 Connection settings – Local ID

Here you can configure the "Local ID" for the connection between devices. The local ID is required for some communication function blocks. The value of the local ID must match the value of the calling interface in the communication function block.

Configure Ethernet connections > Connection settings – Special properties

- 1					
SPEED7 Studio	Development Line				
General	Local ID				
Local ID					
Special properties		Local:		Partner:	
Address details			1		
	Local Id (hex):	1	Local Id (hex):	1	
	ID:	W#16#0001	ID:	W#16#0001	
	LADDR:	W#16#07FE	LADDR:	W#16#07FE	
			1		
				ок	X Cancel

Fig. 136: Connection settings "Local ID"

7.5.4 Connection settings – Special properties

You can choose here, which connection partner should be used for establishing the active connection.

Configure Ethernet connections > Connection settings – Address details

SPEED7 Studio	Development Line	
General	Special properties	
Local ID		
Special properties	Local:	Partner:
Address details		_
	Active connection build-up	Active connection build-up
		V OK X Cancel

Fig. 137: Connection settings "Special properties"

7.5.5 Connection settings – Address details

"Address details" include information about the communication interface and the connection resources.

Configure Ethernet connections > Connection settings – Address details

SPEED7 Studio	Development Line			
General Local ID	Address details			
Special properties	Loca	al:	Partn	er:
Address details	Rack / Slot:	0 2	Rack / Slot:	0 2
	Connection resource (hex):	10	Connection resource (hex):	10
	TSAP (hex):	10.02	TSAP (hex):	10.02
			🗹 ОК	🔀 Cancel

Fig. 138: Connection settings "Address details"

'Rack/Slot' – Position of the rack and the slot in the communication interface. The values can only be changed for unspecified connection partners.

'Connection resource' - Address of the connection resource

'TSAP (hex)' - TSAP (Transport Service Access Point)

"Device overview" editor (PLC)

8 Creating, transferring and testing the user program

8.1 Program blocks

Different types of program blocks can be edited, configured, synchronised with the control and monitored in the block editor. The blocks include the user program (PLC program). The blocks are divided into code blocks (OB, FB and FC) and data blocks (DB and UDT).

- Organisation blocks (OB) form the interface between the operating system of the control and the user program. Cyclic events as well as time-controlled or interrupt-controlled events are processed in the organisation blocks. The OB1 block contains the main program. A template of OB1 with the block name "Main" is already available in the project.
- Function blocks (FB) are block types which are primarily used for programming. Function blocks can be configured on the basis of input and output variables. They may contain static or temporary local variables. All variables of a function block (except for the temporary variables) are persistently stored in the data blocks. Thus, function blocks have kind of a memory.
- Functions (FC) are used to process input variables in order to produce a result. They are used for recurring tasks e.g. mathematical functions. They can be configured on the basis of input and output variables. Functions may contain temporary local variables. The variables of a function are not persistently stored. Thus, functions do not have a memory.
- Data blocks (DB) contain data for the user program but no program instructions.
- Structure blocks (UDT, User Defined Data Type) contain data structures for the user program but no program instructions.

8.2 "Device overview" editor (PLC) @

In the *'Device overview'* editor, the blocks of the user program and the system blocks are displayed in a table. Here you can select blocks and compile them or transfer them to the control.

If a project is opened and a control is included, you can open the *'Device overview'*. Select one of the following options to this end:

- Menu bar: Select 'Device → Device overview'.
- Project tree: Click on 'Device overview' in the control (PLC).
- "Start page" . Click on 'Project overview'.

"Device overview" editor (PLC)

PLC_01 [CPU 315-2AG13 3155B/DPM]-Device overview 2										
	Block	Version	Name	Author	Size	Modified interface	Modified code	Comment		
	OB1	1.0.0.0	Main		182	31.05.2001 - 12:18:24	05.04.2014 - 17:09:39			
J FB	FB1	0.0.1.0	Function_block_1		Compilation required!	31.05.2001 - 12:18:03	19.02.2015 - 17:31:02			
DB	DB1	1.0.0.0	Function_block_1_1		84	31.05.2001 - 12:18:11	05.04.2014 - 17:08:19			
	SDB0	-	-		280	-	15.02.2016 - 10:51:54	-		
	SDB1	-	-		230	-	15.02.2016 - 10:51:54	-		
- 5	SDB3	-	-		136	-	15.02.2016 - 10:51:54	-		
5	SDB4	-	-		244	-	15.02.2016 - 10:51:54	-		
<i>139:</i> Toolb Block	<i>Device ove</i> ar t list	erview (PLC	C)							
ect bl	ocks		You can select <u>1.</u> Highlight	blocks a	and compile them esired blocks in th	or transfer them to ne first column of t	o the control. the device list.			
					hlocks are compil	od or transforred	to the control			
				Selected	nocks are compli					

(1) Toolbar

Send selected blocks: The blocks selected in the block list (2) are transferred to the -8 control.

Compile selected blocks: The blocks selected in the block list (2) are compiled. 2 Schapter 8.18 'Compile user program' on page 245

(2)

Block list	Provides a list of blocks used in the project.
	<i>'Block'</i> – Block type and number
	'Version' – Version and revision number of the block, e.g. 🗞 '(3) Block information' on page 205
	<i>'Name'</i> – Block name
	'Author' – Name of the responsible person, e.g. \Leftrightarrow '(3) Block information' on page 205
	<i>'Size'</i> – Block size in kByte
	<i>'Modified interface'</i> – Date and time of the last change in the declaration section of the block
	'Modified code' – Date and time of the last change in the declaration section of the block
	'Comment' – Any comment e.g. remark or explanation

Creating, transferring and testing the user program

Add new block (OB, FB, FC)

Opening a block in the block editor

____ Double-click on the desired block.

 \Rightarrow The selected block is opened in the block editor.

8.3 Add new block (OB, FB, FC)

PLC_01 [CPU 315-4EC12 315SN/EC]
 Device overview
 Device properties
 Device configuration
 Address overview
 Address overview
 PLC Program
 Program Blocks
 Add new Block
 System blocks

Fig. 140: Adding new block via the "project tree"

If you want to create a new block, a project must be opened and a control must be contained in the project.

- **1.** In the project tree within a control, click on 'Add new block' in the 'PLC program' at 'Program blocks'.
 - ⇒ The dialogue window 'Add new block' will open.

Add new block		×
OB	Add function k	olock
OB-Block	Name:	Function block_1
	Number:	FB 1 [0 - 2047]
FB-Block	Syntax:	IL - Instruction list *
FC-Block		
DB-Block	Information: Function block blocks.	ks are program blocks, which save their values persistently in assigned instance data
UDT		
	To take som	e more inputs
	Name:	Title:
	Comment:	
	Version:	0 · 1 · 0 Rev. 0 Family:
	Author:	•
📝 Open block		V OK X Cancel

Fig. 141: Dialogue window "Add new block" for FB as an example

- 2. Select the block type OB, FB or FC.
- **3.** *Name'*: Enter a different block name, if required. You can access the block in the user program with this name.

Editing program blocks



Fig. 142: Select OB

4. *Number*': Select a free block number. Blocks that are already present cannot be selected.

OB: You can select predefined organisation blocks from a list: Click on 'Show selection' and select the desired OB from the list. Fig. 142

5. *Syntax*': Select the desired PLC programming language.



The programming language can be changed later in the block editor between IL, FBD and LD. Please note that the syntax conversion from one programming language to another is not always possible due to the different choice of commands.

The programming language SCL cannot be changed later.

- **6.** Click on *'To take some more inputs..'* if you want to enter further block details. The following details can be entered: Title, comment, version / revision numbers, control family and author. You can make or change these entries later in the block editor.
- 7. Click on 'OK'.



If you select the option 'Open block' and click on 'OK', block editor will open.

 \Rightarrow The block is added and displayed in the project tree.

8.4 Editing program blocks

Different types of program blocks can be edited in the block editor. The block editor is divided into two entry sections: "Declaration section" and "Instruction section".

Declaration section In the declaration section, you can define all variables used in the block. You can edit the input and output parameters of the block interface, the local variables, the return value of functions and the I/O addresses in the organisation blocks.



Prior to start programming in the instruction section, you should declare al variables in the declaration section.

Information on the declaration section:

- ♦ Chapter 8.5.1 'Declaration section' on page 197
- ♦ Chapter 8.5.2 'Selecting the variable type' on page 202
- ♦ Chapter 8.5.3 'Using variable names ' on page 202
- Chapter 8.5.4 'Assigning data types' on page 203

Instruction section In the instruction section of the block editor you can enter the PLC instructions which are to be executed by the control. Furthermore, you can configure the block as well as each block network in the instruction section.

Information on the instruction section:

■ ♦ Chapter 8.5.5 'Instruction section' on page 203

Block editor for program blocks (OB, FB, FC)

8.5 Block editor for program blocks (OB, FB, FC) 🔤 🖳

Different types of program blocks can be edited, transferred to the control, synchronised with the control and monitored in the block editor. The blocks include the user program (PLC program). S *Chapter 8.1 'Program blocks' on page 192*

If a project is opened and a control is included, you can open the block editor. You can create new blocks or open existing blocks.

If you want to add a new block, please note \Leftrightarrow Chapter 8.3 'Add new block (OB, FB, FC)' on page 194.

Select one of the following options if you want to open an existing block (OB, FB, FC) in the block editor:

- Project tree: Double-click on the desired block (block name) in the control at 'PLC program', 'Program blocks'.
- "Device overview" editor 1: Double-click on the desired block.

: 🕞 🔙	£ 2 G G	4 🔤 🖶	iii 🖹 🚔 🐐 海	12 12 12	i 🛍 🚊 🚺		
	Group 🛆	Address	Name	Datatype		Default value	Comment
	IN	0.0	bSignal	BOOL		False	
		0.1	bReset	BOOL		False	
		÷		BOOL		False 🛛 🙎	
Þ 🖬	OUT	2.0	dwCounter	DWORD		DW#16#00000000	
		÷		BOOL		False	
	IN_OUT	÷		BOOL		False	
	STAT	÷		BOOL		False	
	TEMP	¢		BOOL			
					A 7		

•	Networ	r k: 1	i	0 / 2)									4
Ado	Rew net	work	1 2 3		U ZV	#bSignal #dwCount	er			3				4 111
Syst	temadmir	nistrato	r - 10/	/29/2013 4	4:54 PN	A PLC_(Network: 1	LN: 0 COL: 0	unchanged	O Inactiv	e	-0) 1009	6

Fig. 143: Block editor of a function block (FB) as an example

- (1) Toolbar
- (2) Declaration section
- (3) Instruction section
- (4) Information bar

(1) Toolbar

Important commands you need for editing the block are provided in the toolbar.

🔄 '(1) Toolbar' on page 204

Block editor for program blocks (OB, FB, FC) > Declaration section

(2) Declaration section	In the declaration section, you can define all variables used in the block. You can edit the input and output parameters of the block interface, the local variables, the return value of functions and the I/O addresses in the organisation blocks.
	Schapter 8.5.1 'Declaration section' on page 197
(3) Instruction section	In the instruction section of the block editor you can enter the PLC instructions which are to be executed by the control. Furthermore, you can configure the block as well as each block network in the instruction section.
	Schapter 8.5.5 'Instruction section' on page 203
(4) Information bar	The information bar provides information on the block:
	 User name and date of the last stored change Name of the control, of the CPU and of the block Network number of the current position of the cursor Line (LN) and column (COL) of the current position of the cursor Status of the block since the last saving (changed/unchanged) Connection status to the control (inactive/active/error): If you move the mouse cursor

to this field, details on the connection status are displayed.

8.5.1 Declaration section

In the declaration section, you can define all variables used in the block. You can edit the input and output parameters of the block interface, the local variables, the return value of functions and the I/O addresses in the organisation blocks.

	Group	Address	Name	Datatype	 Default value	Comment
	IN	0.0	bSignal	BOOL	False	
		0.1	bReset	BOOL	False	
		÷		BOOL	False	
	OUT	2.0	dwCounter	DWORD	DW#16#00000000	
		÷		BOOL	False	
	IN_OUT	÷		BOOL	False	
	STAT	÷		BOOL	False	
	TEMP	÷		BOOL		

Fig. 144: Declaration section for a function block as an example

You can define the variables of the block interface (formal parameters) as well as the data for the intermediate results (local variables) of the block in the table.

'1st column' – Area to select the vectors of the data type ARRAY

'2nd column' - Area to select all other data

'Area' – Defines the type of variables & Chapter 8.5.2 'Selecting the variable type' on page 202

'Address' – Internal automatically created address for data filing in the instance data block

'Name' – Name of the variables & Chapter 8.5.3 'Using variable names ' on page 202

Block editor for program blocks (OB, FB, FC) > Declaration section

'Data type' – Data type of the variables & Chapter 8.5.4 'Assigning data types' on page 203

'...' – Further configurations for the selected data type e.g. dimensions and field boundaries of the ARRAY data type

'Default value' - Initial value of the variables

'Comment' - Any comment e.g. remark or explanation

The declaration section of the organisation block differs from the declaration section of the function block and functions. Here it is not possible to enter the 'Area' variable type and the 'Default value' initial value. Therefore, there are no corresponding columns.

Adding/declaring variables

		Group	4	Address	Name	Datatype		Default value
		IN		0.0	bSwitch	BOOL		False
	1	IN	-	2.0	awValues	ARRAY_OF_TYPE	[012] OF WORD	W#16#0000

Fig. 145: Adding/declaring variables

The variables can be declared line by line. Each line in the declaration section can contain a variable.



After having declared a variable, a new free line is automatically added.

- **1. OB:** Click on the free input field in the *'Name'* column.
 - FB and FC: Select the desired variable type in the 'Area' column. Click on the free input field in the 'Name' column. Example: If you want to add input parameters, you must click on the free input field of the 'Name' column in the "IN" 'Area'.
- **2. Enter a name for the variable e.g**.awValues.
- **3.** Click on the adjacent field in the *'Data type'* column and select the desired data type e.g. "ARRAY_OF_TYPE" for data fields.

Block editor for	or program	blocks (C)B, FB, F	=C) >	Declaration	sectior

Co	nfigurati	on array data typ	e	~	J	
Da	ta type:	WORD		•	0	* *
F	Rank 1:	1	‡		12	\$
F	Rank 2:	0	*		0	* *
F	Rank 3:	0	*		0	* *
F F	Rank 4:	0	*		0	*
F F	Rank 5:	0	*		0	*
F F	Rank 6:	0	*		0	* *

Fig. 146: Enter dimensions and field boundaries

- **4.** Any further configurations which are possible for the selected data type, z. B. dimensions and field boundaries of the data type are displayed in the '...' field. Click on the field to enter the configurations. Click on the field to enter the configurations using a dialogue window.
- **5.** If you want to assign an initial value to the variables, click on the *'Default value'* field and select a default value or enter a value.
- **6.** If you want to enter a comment on the variables, click on the *'Comment'* field and enter the comment.

Inserting variables



Click into the second column of a variable cell.

You can insert new variables above or below the current line in the table.

- 2. Right-click with the mouse button on it and select 'Add variable after' or 'Add variable after'.
 - \Rightarrow A new line is inserted in the table.

Fig. 147: (1) First and (2) second column

Creating, transferring and testing the user program

Block editor for program blocks (OB, FB, FC) > Declaration section

Changing variables

You can change various properties of an already declared variable.



Fig. 148: Changing the group via the Selection list

Click on the input field which you want to edit. Changes can be entered directly. For some fields, changes can be made via a selection list.

\bigcirc	Fields highlighted in grey cannot be changed.

Deleting variables

1. In the second column, highlight the variable line which you want to delete.



Individual vectors of the data type ARRAY can only be highlighted in the first column.

2. Press [Del].

- or -

Right-click with the mouse button on the line and select 'Delete selected variable'.

A dialogue window will open, where you can select whether you want to delete the variable.

 \Rightarrow The variable is deleted or removed from the declaration.

Copying variables

- **1.** In the second column, highlight the variable line which you want to copy.
- 2. Right-click with the mouse button on the line and select 'Copy highlighted variable'.
 - ⇒ The variable line is copied and inserted below the current line. The new variable has the same properties as the initial variable. The variable name is adopted and numbered consecutively.

Block editor for program blocks (OB, FB, FC) > Declaration section

Move variable with "Drag & drop"	
	1. In the second column, highlight the variable line which you want to move.
	2. Press and hold the mouse button while dragging the line to the desired position.
	\Rightarrow The variable line is inserted.
Copy variable with "Drag & drop"	
	1. In the second column, highlight the variable line which you want to copy.
	2. Press and hold the mouse button and the key <i>[Ctrl]</i> while dragging the line to the desired position.
	The variable line is copied and inserted. The new variable has the same proper- ties as the initial variable. The address and the variable name are adopted and numbered consecutively.
Move several variables with "Drag & drop"	
	1. Press and hold the key <i>[Ctrl]</i> while highlighting all desired variable lines in the second column.
	- or -
	In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.
	2. Press and hold the mouse button while dragging the lines to the desired position.
	\Rightarrow The variable lines are inserted.
Copy several variables with "Drag & drop"	
	1. Press and hold the key [<i>Ctrl</i>] while highlighting all desired variable lines in the second column.
	- or -
	In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.
	2. Press and hold the mouse button and the key <i>[Ctrl]</i> while dragging the lines to the desired position.
	The variable lines are copied and inserted. The new variables have the same properties as the initial variables. The addresses and the variable names are adopted and numbered consecutively.
Adding a block reference by Drag & drop	
	e.g. within the area "STAT".
	⇒ The block is inserted as reference. The block name is adopted and numbered consecutively. If the block is not yet present in the project, the block is added to the project and shown in the project tree.

Block editor for program blocks (OB, FB, FC) > Using variable names

Accessing variables In the declaration section, variables are declared with a variable name e.g.Input_01. You can access these variables in the instruction section via the variable name with the prefixed number sign "#", e.g. #Input_01.

8.5.2 Selecting the variable type

For adding, changing, copying or deleting variables in the declaration section of the block editor. & Chapter 8.5.1 'Declaration section' on page 197

Variable type The variable type is indicated in the declaration section of the program block in the 'Area' column:

Group	Variable type	Description	internal ¹	external ¹	<u>0</u> 8 2	FE 2	FC 2
IN	Input parameter	The parameter is read in the block and can only be specified in the calling block.	R	M		V	V
OUT	Output parameter	The parameter can be specified in the block and is only readable in the calling block.	RW	R		V	V
IN_OUT	In-out parameter	The parameter can be read and specified in the block and in the calling block.	RW	RW		✓	V
RETURN	Return value	The function value can be speci- fied in the block and is only read- able in the calling block.	W	R			V
STAT	Static local data	Variable for saving retentive inter- mediate results. Data are main- tained for several cycles until they are redefined.	RW	_		V	
TEMP	Temporary local data	Variable for the saving of tempo- rary intermediate results. Data are maintained for one cycle only.	RW	-	V	V	V
CONST	Constant (only available in SCL)	Constant to save a value which cannot be changed during pro- gram sequence (only available in SCL).	R	_		V	
1) Access rights, is	stornal = in the ourrent block, avtornal =	in the colling block \mathbf{P} = reading \mathbf{M} = writing	M = reading or	d writing			

1) Access rights: internal = in the current block, external = in the calling block, ℝ = reading, W = writing, ℝ W = reading and writing

2) Availability in the block type

8.5.3 Using variable names

Declaring variables

Only use admissible identifiers for the variable name:

- An identifier is a sequence of letters, numbers and underline characters "_". Space characters are not admitted in the identifier.
- Identifiers may consist of a maximum of 24 characters.
- There is no distinction between upper and lower case letters e.g. the identifier "Magazine_full" is identical with "MAGAZINE_FULL" and "magazine_full".

Block editor for program blocks (OB, FB, FC) > Instruction section

Accessing variables In the declaration section, variables are declared with a variable name e.g.Input_01.

You can access the variable in the instruction section via the variable name with the prefixed number sign "#", e.g. $\#Input_01$.

8.5.4 Assigning data types

The properties and data volume of a variable is defined by the data type. For example, for binary operations, other data types are required than for floating point arithmetic.

8.5.5 Instruction section

In the instruction section of the block editor you can enter the PLC instructions which are to be executed by the control. Furthermore, you can configure the block as well as each block network.

You can enter the instructions in the programming language (syntax) which you must select when you add a new block (OB, FB, FC). *Chapter 8.3 'Add new block (OB, FB, FC)'* on page 194

You can select different programming languages (not in SCL) for individual networks. (7) Network configurations' on page 206

Programming languages:

- Instruction list (IL)
- Function block diagram (FBD)
- Ladder diagram (LD)
- Structured Control Language (SCL)

Function ble	ock_3 [FB3]	-6			0		
Network: 1	i /	3	0				
<u>⊟</u> ⊿ ⊛_⊻	1 2 3 4	0 0 5	E E A	2.0 2.1 4.0	// Start01 // Start02 // Motor start	x_DI_2_0_20 x_DI_2_1_20 x_D0_4_0_21	
1000 A	5 6 7 8	O O R	E E A	2.2 2.3 4.0	// Stop01 // Stop02 // Motor stop	x_DI_2_2_20 x_DI_2_3_20 x_D0_4_0_21	
Add new networ	9 10 <u>/k</u> —8	1					

Fig. 149: Instruction section for the IL programming language as an example

- (1) Toolbar
- (2) Declaration section (not shown)
- (3) Block information
- (4) Input area for instructions and elements
- (5) Network
- (6) Network information
- (7) Network configurations
- (8) Add new network

Showing/hiding input areas

You can show or hide the input areas:

Block editor for program blocks (OB, FB, FC) > Instruction section

- Shows/opens the input area
- Hides/closes the input area

(1) Toolbar

Important commands you need for editing the block are provided in the toolbar.

- Compile block [Ctrl]+[B]: The block is compiled & Chapter 8.18 'Compile user program' on page 245
- **Load block into device** *[Ctrl]+[L]***:** The block is transferred to the control. To this end, a communication connection with the control is established. A dialogue window will open, where you can select the interface connection and make further configurations.
- Block watch On/Off [Ctrl]+[F7]: Watching the variables of the block in the control. To this end, a communication connection with the control is established. The variable values are cyclically read from the control and displayed. Schapter 8.23 Watch block are on page 257
- Watch block via the calling environment ON/OFF: If the block is called multiple times in the program, one calling can be watched here.
- Block status configurations: Pre-configurations and selection of the variables for watching the blocks. A dialogue window will open, where you can make the desired configuration. ♦ Chapter 8.24 'Status configurations for blocks' on page 260
- **Load block from device:** The block is transferred from the control to the project. To this end, a communication connection with the control is established.
- Compare blocks: The block is compared to the block which is present in the control. To this end, a communication connection with the control is established. Schapter 8.22 'Compare blocks 'P' on page 254'
- **Search in block:** Search for text or certain character patterns in the user program
- Replace in block:Search for and replace text or certain character patterns in the user program
- **Block synchronisation:** --- in preparation --- This function is not available in this version.
- Add several networks: You can add several networks at a certain position.
- Add new network: A network is added a the block end.
- **Delete network:** The current network and any program instructions and elements contained herein are deleted.
- Show all networks: All networks are opened to show all program instructions and elements.
- Hide all networks: All networks are closed to hide all program instructions and elements.
- AND
- KOP
- Select programming language: You can switch between the programming languages IL, LD and FBD (not for SCL). You can select the programming language for individual networks. § (7) Network configurations' on page 206



Please note that the syntax conversion from one programming language to another is not always possible due to the different choice of commands.

VIPA SPEED7 Studio		Creating, transferring and testing the user program
		Block editor for program blocks (OB, FB, FC) > Instruction section
(2) Declaration section		In the declaration section (not shown in Fig. 149), you can define all variables used in the block. <i>S Chapter 8.5.1 'Declaration section' on page 197</i>
(3) Block information		Here you are provided with further information, and you can enter a title and comment on the block. The following buttons are displayed if you hover with the mouse over a field with the <i>'Block information'</i> .
	1	Comment field: Here you can show or hide the comment field.
	i	Advanced Configurations: Here, you can show or hide further configurations, such as author and version.
		Block information: Here, you can show or hide information about the block.
	3	History: Here, you can show or hide the display of the block versions.
(4) Input area		 In the input area, you can give instructions in the IL and SCL programming language. Moreover, you can insert elements in the graphic programming languages FBD and LD. Chapter 8.6.1 'Programming language instruction list (IL) and 'on page 209 Chapter 8.6.2 'Programming language function block diagram (FBD) and 'on page 212 Chapter 8.6.3 'Programming language Ladder diagram (LD) and 'on page 215 Programming language Structured Control Language (SCL): and 'on preparation This programming language is not available in this version.
(5) Network		In order to improve the clear structure of the user program, you can divide the program in several networks (not for SCL). Networks are consecutively numbered, see (6).
Adding a network		Select one of the following options if you want to add one or more networks:
		 Adding a network at the block end: Click on 'Add new network' below the last network (8). - or - Click on ' in the toolbar (1). - or - Select in the menu bar 'Block → Networks → Add new network'. Adding a network before or after a network: Right-click with the mouse button on the network information (6) in the network and select 'Add network before' or 'Add network after'. Add several networks: Select in the menu bar 'Block → Networks → Add several networks'. - or - Click on ' in the toolbar (1). ⇒ A dialogue window appears where you can define the number of networks and the position where to add the networks.
Deleting networks		 ■ Right-click with the mouse button on the network information (6) in the network and select 'Delete network'. - or - Click on the toolbar (1). - or - Select in the menu bar 'Block → Networks → Delete network'. ⇒ The network and any program instructions and elements contained herein are deleted.

Creating, transferring and testing the user program

Block editor for program blocks (OB, FB, FC) > Instruction section

Copying and pasting net- works	1. Highlight the network which you want to copy. Right-click with the mouse button on the network header (6) and select <i>'Copy network'</i> .
	⇒ The network and any program instructions and elements contained herein are copied to the clipboard.
	2. Highlight the network behind which the copied network is to be pasted. Right-click with the mouse button on the network header (6) and select <i>'Paste network'</i> .
	\Rightarrow The network and any program instructions contained herein are pasted.
(6) Network information	Here you are provided with further information, and you can enter a title and comment regarding the network. The following buttons are displayed if you hover with the mouse over a field with the <i>'Network information'</i> .
i	Title: Here, you can show or hide further configurations, such as author and version.
1	Comment field: Here you can show or hide the comment field.
S	History: Here, you can show or hide the display of the network versions.
(7) Network configurations	You can make various configurations which will have impacts on the current network:
 	Make format settings: Here you can format or comment on the instruction lines of the program block (only IL, SCL).
•	Make zoom settings: Here you can change the font size and/or the display size of the elements in the network.
4	Add note: Here you can add notes and status information on the network (only IL, SCL).
KOP	
FUP	Select programming language: You can switch between the programming languages IL, LD and FBD for the network (not for SCL).
	 Please note that the syntax conversion from one programming language to another is not always possible due to the different choice of commands.

Block editor for program blocks (OB, FB, FC) > Create / edit symbol

8.5.6 Create / edit symbol

In the block editor, you can assign a symbolic address to an operand or edit an existing symbolic address. All changes are adopted in the variable table.



Fig. 150: Create symbol (Example: Absolute address in the IL editor)

____ Set the cursor on the absolute address or the symbolic address and press [Ctrl]+[J].

- or -

Right-click with the mouse button on the absolute address or the symbolic address and select 'Create / edit symbol'.

⇒ The dialogue window "Create / edit symbol" will open. The variable table will be displayed in the lower area of the dialogue window.

Creating, transferring and testing the user program

Block editor for program blocks (OB, FB, FC) > Create / edit symbol

Input sy Name Operar Data ty Group: Area of Use in ¹ Comm	tion of sym symbol prope and ype by f validity: Visu:	hol rties wValue MW 20 WORD Ungrouped Global					
Input sy Name Operar Data ty Group: Area of Use in ¹ Comm	symbol prope and ype of validity: Visu:	rties wValue MW 20 WORD Ungrouped Global					
Name Operar Data ty Group: Area of Use in ¹ Comm	e ype x of validity: Visu:	wValue MW 20 WORD Ungrouped Global					
Operar Data ty Group: Area of Use in ¹ Comm	nd ype y: of validity: Visu:	MW 20 WORD Ungrouped Global					-
Data ty Group: Area of Use in ¹ Comm	ype :: of validity: Visu:	WORD Ungrouped Global					*
Group: Area of Use in ¹ Comm	o: of validity: Visu:	Ungrouped Global					
Area of Use in ^v Comm	of validity: Visu:	Global					*
Use in ^v Comm	Visu:						*
Comm							
	nent						
Variable	le Table:	Standard project con	nfiguration				*
Conten	nt of variable	table					
G	Group	△ Operand	Variable	Data type	Area of validity	Type Visu	
Pla	lant 1	MW 42	Marker42	WORD	Global	Memory	
		MW 40	Marker40	WORD	Global	Memory	
Ur	Jngrouped	MW 20	wValue	WORD	Global	Memory	
<							>

Fig. 151: Create / edit symbol

- **1.** In the input field *'Name'*, enter the desired variable name (symbolic address). If the name has already been used for another variable, an error message is displayed.
- **2.** If required, change the 'Operand' and the 'Data type'.
- **3.** If you want to assign the variable to a group, enter a new group name into the input field *'Group'* or select an existing group.
- **4.** Under 'Area of validity', select the validity of the variable:
 - To use the variable only within one block, select the desired block.
 - to use the variable in the entire user program, select "Global".
- **5.** To be able to use the variable in HMI images, activate the option *'Use in Visu'*. You can then copy (synchronise) this variable into the variable table of the HMI project. *Chapter 9.4 ''Standard variables table'' editor* ? *on page 292*
- 6. Enter a 'Comment', if required.
- 7. Click on 'OK'.
 - ⇒ The new or edited variable is added to the variable table and set on the position of the operand in the block editor.

8.6 Programming languages

You can select the programming language (syntax) in which you want to edit the PLC instructions already when adding a new program block. (OB, FB, FC)' on page 194

- Instruction list (IL): Textual, machine-oriented programming language The execution instructions for the PLC are made line by line. A complete instruction sequence may extend over several instruction lines.
- Function block diagram (FBD): Graphic programming language for signal processing

Different functional elements may be connected with each other in order to control the signal flow.

- Ladder diagram (LD): Graphic programming language similar to a circuit diagram The connection of contacts and coils describe the current flow between two contact rails.
- Structured Control Language (SCL): Textual, higher programming language With SCL, the programming task can be expressed compact and structured. Several instructions can be included in one single line.

--- in preparation --- This programming language is not available in this version.

In the instruction section of the block editor you can enter the PLC instructions which are to be executed by the control.

8.6.1 Programming language instruction list (IL) 🚋

Instruction list (IL) is a textual and machine-orientated programming language. The execution instructions for the PLC are made line by line. A complete instruction sequence may extend over several instruction lines.

For the description of the commands, see Documentation "IL Operation".

Entering IL instructions

You can enter IL instructions in the entry section of the block editor.
 Enter the instructions in a blank line and confirm your entry with [Enter].

 \Rightarrow The text is automatically aligned, and a blank line is inserted.

Automatic alignment The individual parts of the instruction lines (label, operator, operand, comment) can be separated by spaces. After having confirmed your entry with *[Enter]*, the individual parts are automatically aligned based on a grid.

In the first line of the following example you see the unformatted entry. The second line shows the automatic alignment:



Automatic completion When you enter instructions, a selection list with input suggestions and other information will be shown as a tool tip. With each additional letter you enter, the suggestions are narrowed down.

Creating, transferring and testing the user program

Programming languages > Programming language instruction list (IL)





1	1			
		Count_3	Type	· Symbol variable
		Funktionsbaustein_1_1	Operand	: Count 3
		Funktionsbaustein_1_2	Address	: DB3
	▣	Funktionsbaustein_2_4	Data type	: BLOCK_DB



Automatic completion of symbolic addresses If you enter a symbolic address without quotation marks, the quotation marks are added automatically.

Parameter input for block calls	If you enter an instruction for After :=, you can enter the a comment:	a block call, all calli ssignments of the pa	ng parameters a arameters; after	are added automatically. ⁻ //, you can enter a
		DB 3		Count Count 3
	2 Reset	:=	11	TN : BOOL (1 Bit)
	3 PV	:=	11	IN : WORD (2 Byte)
	4 CV	:=	11	OUT : WORD (2 Byte)
Syntax highlighting	All changes are adopted in th on page 207 In order to be able to distingu	ie variable table. 🤝 iish different langua	Ghapter 8.5.6 °C	Create / edit symbol'
	are displayed in different colo	ours and font styles	in the block edit	or.
	Language element/meanir	ıg	Example	s

unknown

Programming languages > Programming language instruction list (IL)

Language element/meaning	Examples
Operators	Α
	ON
	L
	JC
Operands	12.0
	Q8.0
	MW 4
Numeral literals	16#FF00
	2#10110110
	-3.5
	2E7
Time literals	D#2015-04-09
Character string literals	'ABC'
Boolean constant	TRUE FALSE
Mathematic function	SQRT
Mathematic operators	+I
Block call and calling parameter	CALL FB 1, DB 3
	Reset := PV :=
	CV :=
Invalid or incomplete block call	CALL unknown
Blocks	DB 1
Indirect address	T [LW 8]
Symbolic address	"bSymbol"
Pointer (data type ANY)	P# DB1.DBX5.0 BYTE 10
jump address	JC <u>L001</u>
Jump destination	L001:
Code block (region)	#region Area1
Comments	// Comment

Watch block

Programming languages > Programming language function block diagram (FBD)



8.6.2 Programming language function block diagram (FBD) 🚋

Function block diagram (FBD) is a graphic programming language for signal processing. With function block diagram, different functional elements may be connected with each other in order to control the signal flow.

For the description of the commands, see Documentation "FBD Operation".



Fig. 154: Example for function block diagram

Element colours In order to be able to

In order to be able to distinguish different elements better from each other, they are displayed in different colours in the block editor:

Colour	FBD element
	Bit logic
	Comparator
	Converter

Programming languages > Programming language function block diagram (FBD)

Colour	FBD element
	Counter
	integer function
	floating point
	Move
	Program control
	Shift/Rotate
	Timers
	Word logic
	Status bits

Adding FBD elements from the catalog

You can add FBD elements in the input area of the block editor.

- **1.** Click on the input area.
- **2.** In the catalog under 'FBD elements', open an element group, e.g. 'Bit Logic'.
- **3.** Drag the desired element from the catalog to the desired position in the input area.
 - Note that you can add the FBD elements only to the input or output of an element or to a branch. The permitted adding position is marked in green.
 - \Rightarrow The FBD element is added.

Enter input and output variables

____ Click on '???' and enter the input and/or output variable.

Automatic completion During entry, a selection list with input suggestions and other information will be shown as a tool tip. With each additional letter you enter, the suggestions are narrowed down. Automatic completion of symbolic addresses If you enter a symbolic address without quotation marks, the quotation marks are added automatically.



Creating, transferring and testing the user program

Programming languages > Programming language function block diagram (FBD)



In order to jump from one parameter to the next, use the key [TAB]. With the key combination [Shift]+[TAB], you can jump back to the previous parameter.

Tool tips for the operands

If you hover the mouse pointer over an operand, a tool tip is displayed.



Create and edit symbols You can assign a symbolic address to an operand or edit an existing symbolic address. All changes are adopted in the variable table. Schapter 8.5.6 'Create / edit symbol' on page 207

Add input

M 7.1

In some FBD elements (e.g. bit logics), you can add more inputs.

In the FBD element, click on the '+' symbol at the bottom left.
- or -

Drag the input element from the catalog to the desired position in the input area. \Rightarrow A further input is added.

Remove input



1. Click on the line of the input you want to remove.

 \Rightarrow The input is marked in grey.

- 2. Press [Del].
 - \Rightarrow The input is removed.

Add branch



- **1.** Click on the middle of a connecting line.
 - \Rightarrow The connecting line is marked with two lines.
- 2. Right-click with the mouse button on the marking and select 'Branch'.

 \Rightarrow A branch is added to the connection.

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Programming languages > Programming language Ladder diagram (LD)

Remove branch

· -	

Click on the end of a branch. No FBD element may be added to this branch.
 ⇒ The branch is marked with two lines.

2. Press [Del].

 \Rightarrow The branch is removed.

Undo changes and restore them

With the key combination *[CTRL]+[Z]*, you can undo the last change. With the key combination *[CTRL]+[Y]*, you can restore the last change which you have undone.

8.6.3 Programming language Ladder diagram (LD) 📾

Ladder diagram (LD) is a graphic programming language for signal processing. With ladder diagram, different functional elements may be connected with each other in order to control the signal flow. The presentation can be compared to a circuit diagram. The connection of contacts and coils describe the current flow between two contact rails.

Ladder diagram is designed for controls where simple elements such as make and break contacts and outputs are used. More complex elements, such as time elements or counters are displayed like in the programming language function block diagram (FBD), see figure.



Char	Meaning
-	Left of the element: input parameter (incoming value)
>>	Right of the element: Output parameter (outgoing value), signal flow has not been completed
4	Signal flow has been completed
???	Specification of the parameter is mandatory
	Specification of the parameter is optional



Automatic completion

During entry, a selection list with input suggestions and other information will be shown as a tool tip. With each additional letter you enter, the suggestions are narrowed down. Adding new data blocks (DB)

Automatic completion of symbolic addresses If you enter a symbolic address without quotation marks, the quotation marks are added automatically.

Create and edit symbols You can assign a symbolic address to an operand or edit an existing symbolic address. All changes are adopted in the variable table. Schapter 8.5.6 'Create / edit symbol' on page 207

Tool tips for the operands

If you hover the mouse pointer over an operand, a tool tip is displayed.



8.7 Adding new data blocks (DB)



Fig. 155: Adding new block via the "project tree"

If you want to create a new block, a project must be opened and a control must be contained in the project.

- **1.** In the project tree within a control, click on 'Add new block' in the 'PLC program' at 'Program blocks'.
 - ⇒ The dialogue window 'Add new block' will open.
Adding new data blocks (DB)

Add new block			×
OB	Add data bloc	k	
OB-Block	Name:	Data block_1	
FBR	Number:	DB 1 (1 - 4095)	
FB-Block	Туре:	Global DB •	
FC-Block			
DB-Block	Information:		
UDT	(Instance) Data Types of data b PLC, the instar	blocks correspond the persistent data ranges which contain user information. blocks are separated. The global DB corresponds to the global data range of the ace DB corresponds to the private persistent data range of a FB or SFB.	
	🗇 🛛 To take som	e more inputs	
🖉 Open block		V OK X Cance	I

Fig. 156: Dialogue window "Add new block", data block

- **2.** Select the block type 'DB-Block'.
- 3. *Name'*: Enter a different block name, if required. You can reference the block in the user program with this name.
- **4.** *Number*': Select a free block number. Blocks that are already present cannot be selected.
- **5.** *Type*': Select between two types of data blocks:
 - Global DB: For the access to the global data range of the control. All program blocks (OB, FB, FC) have access to the data.
 - Instance DB [FB]: The data block contains the persistent data ranges of a certain function block (FB or SFB). Only this function block has access to the data.
 Chapter 8.1 'Program blocks' on page 192
- **6.** Click on '*To take some more inputs..*' if you want to enter further block details. The following details can be entered: Title, comment, version and revision number, control family, author and syntax language. You can make or change these entries later in the block editor.
- **7.** Click on ".

If you select the option	'Open block'	and click on	'OK', block editor
will open.			

 \Rightarrow The data block is added and displayed in the project tree.

Block editor for data blocks (DB)

8.8 Block editor for data blocks (DB) 🖳

Different types of data blocks (DB) can be edited, transferred to the control, synchronised with the control and monitored in the this editor. Data blocks contain data for the user program (PLC program), but no program instructions. & *Chapter 8.1 'Program blocks'* on page 192

If a project is opened and a control is included, you can open the block editor. You can create new blocks or open existing blocks.

If you want to add a data block, please note \Leftrightarrow Chapter 8.7 'Adding new data blocks (DB)' on page 216.

Select one of the following options if you want to open an existing data block in the block editor:

- Project tree: Double-click on the desired data block (block name) in the control at 'PLC program', 'Program blocks'.
- "Device overview" editor (1): Double-click on the desired data block.

Measured Title: Measured	Measure01 [Data block_2 - DB2] / 4 @ 😚 Z Title: Measure01													
Data blo	Data block structure													
	Address	Name	Data type		Default value	Actual value	Comment							
	0.0	rNiveau01	B REAL		0	0								
	4.0	rMaximum01	REAL		7.4	0								
	8.0	bStatus	BOOL		TRUE	FALSE								
	e e e		BOOL		FALSE	FALSE								
					4									
•							۱.							
System admin	istrator - 2/5/	/2016 1:59 PM PLC_01	L/CPU/Data block: DB1 - Date	enbau changed	O Inactive	Θ_Ū	— ⊕ 100%							

Fig. 157: Block editor for data blocks

- (1) Toolbar
- (2) Block information and title
- (3) Declaration section
- (4) Information bar

Showing/hiding input areas

You can show or hide the input areas:

- Shows/opens the input area
- Hides/closes the input area

(1) Toolbar

- **Compile block [Ctrl]+[B]:** The data block is compiled.
- **Load block into device** *[Ctrl]+[L]***:** The data block is transferred to the control. To this end, a communication connection with the control is established. A dialogue window will open, where you can select the interface connection and make further configurations.

	Ŷ	Load blo this end,	ck from o a commu	device: The da	ta block is transf ction with the cor	erred	from the contro s established.	l to i	the project. To
	±¶≊	Compare control. T & Chapte	e blocks: o this end er 8.22 'Co	The data block , a communica ompare blocks	tis compared to tion connection with the first term of term	the da with th	ata block which ne control is esta	is pr ablis	esent in the hed.
	ð	Use acturinto the fathe control	al values <i>Initial valu</i> ol is estab	as initial valu e' column in th lished.	es: All current va e project. To this	alues s end,	are transferred a communicatio	fron on c	n the control onnection with
		Initial va column a end, a co	lues to ta re transfe mmunicat	ke over actua rred into the co tion connection	I values: The va introl and are add with the control	lues e opted is esta	entered in the <i>'L</i> there as actual ablished.	Defa valu	<i>ult value'</i> les. To this
	<u>.85</u>	Block wa a commu cally read	atch On/C nication c I from the	off: Watching the onnection with control and dis	ne variables of th the control is est played.	e data tablisł	a block in the co ned. The variabl	ontro le va	I. To this end, alues are cycli-
(2) Block information		Here you the data I field with	are provi block. The the <i>'Blocl</i>	ded with furthe following butto k information'.	r information, and ons are displayed	d you d if yo	can enter a title u hover with the	e and e mo	d comment on ouse over a
	1	Commer	nt field: H	ere you can sh	ow or hide the co	omme	ent field.		
	i	Advance author ar	d Config d version	urations: Here	, you can show o	or hide	e further configu	iratio	ons, such as
		Block in	formation	: Here, you ca	n show or hide ir	nforma	ation about the b	oloc	k.
	3	History:	Here, you	can show or h	ide the display o	f the b	olock versions.		
(3) Declaration section		The varia	bles of the	e data block ar	e defined in the c	declar	ation section.		
		ʻ1st colui	<i>mn '</i> – Are	ea to select the	vectors of the da	ata typ	be ARRAY		
		ʻ2nd colu	<i>mn' –</i> Are	ea to select all o	other data				
		'Address	′ – Interna	al automatically	created address	s for d	lata filing in the	data	l block
		'Name' -	- Name of	the variables 4	& Chapter 8.5.3	ʻUsing	g variable name.	s'o	n page 202
		'Data typ on page :	e' – Data 203	type of the var	iables <i>Chapte</i>	r 8.5.4	4 'Assigning dat	a ty	pes'
		'' – Fur ries of the	ther confi e ARRAY	gurations for th data type	e selected data	type e	e.g. dimensions	and	field bounda-
		'Default v	<i>/alue'</i> – Ir	nitial value of th	e variables				
		<i>'Actual v</i> aswitched	a <i>lue' –</i> Ac on	tual value of th	e variables read	from	the control if "W	/atch	ı block" is
		'Comme	nt' – Any o	comment e.g. r	emark or explan	ation			
Adding/docloring verie									
bles	-		Address	Name	Datatype				Default value
			0.0	wStatus		WORD			W#16#0000
		1	2.0	awValues	ARRAY_OF_TYPE	-	[012] OF WORD	ò •	W#16#0000

Fig. 158: Adding/declaring variables

The variables can be declared line by line. Each line in the declaration section can contain a variable.

Block editor for data blocks (DB)

New variables can be declared at free positions. The reference in the 'Address' column indicates that the position is free and that a variable can be declared in this line.

After having declared a variable, a new free line is automatically added.

- **1.** Click on the free input field in the *'Name'* column.
- **2. Enter a name for the variable e.g.**awValues.
- **3.** Click on the adjacent field in the *'Data type'* column and select the desired data type e.g. "ARRAY_OF_TYPE" for data fields.

ARRAY_OF	TYPE	* [112] OF WORD	ið •	
	Configuratio	on array data type		-
	Data type:	WORD	*	0
	Rank 1:	1		12 🛟 -
	Rank 2:	0		0 ‡
	🔲 Rank 3:	0		0 ‡
	🔲 Rank 4:	0		0
	🔲 Rank 5:	0		0
	🔲 Rank 6:	0		0

Fig. 159: Enter dimensions and field boundaries

- **4.** Any further configurations which are possible for the selected data type, z. B. dimensions and field boundaries of the data type are displayed in the '...' field. Click on the field to enter the configurations. Click on the field to enter the configurations. Click on the field to enter the configurations.
- **5.** If you want to assign an initial value to the variables, click on the *'Default value'* field and select a default value or enter a value.
- **6.** If you want to enter a comment on the variables, click on the *'Comment'* field and enter the comment.

Inserting variables

Address

0.0

0.1

You can insert new variables above or below the current line in the table.

- **1.** Click into the second column of a variable cell.
- **2.** Right-click with the mouse button on it and select 'Add variable after'
 - or 'Add variable after'.
 - \Rightarrow A new line is inserted in the table.

Fig. 160: (1) First and (2) second column

Changing variables

You can change various properties of an already declared variable.

Click on the input field which you want to edit. Changes can be entered directly. For some fields, changes can be made via a selection list.



Deleting variables

1. In the second column, highlight the variable line which you want to delete.



Individual vectors of the data type ARRAY can only be highlighted in the first column.

2. Press [Del].

- or -

Right-click with the mouse button on the line and select 'Delete selected variable'. A dialogue window will open, where you can select whether you want to delete the variable.

 \Rightarrow The variable is deleted or removed from the declaration.

Copying variables

- **1.** In the second column, highlight the variable line which you want to copy.
- 2. Right-click with the mouse button on the line and select 'Copy highlighted variable'.
 - The variable line is copied and inserted below the current line. The new variable ⇒ has the same properties as the initial variable. The variable name is adopted and numbered consecutively.

Move variable with "Drag & drop"

- 1. In the second column, highlight the variable line which you want to move.
- 2. Press and hold the mouse button while dragging the line to the desired position.
 - \Rightarrow The variable line is inserted.

Copy variable with "Drag & drop"

- **1.** In the second column, highlight the variable line which you want to copy.
- 2. Press and hold the mouse button and the key [Ctrl] while dragging the line to the desired position.
 - The variable line is copied and inserted. The new variable has the same proper-ties as the initial variable. The address and the variable name are adopted and numbered consecutively.

Adding a new structure block (UDT)

Move several variables with "Drag & drop"

1. Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the second column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- **2.** Press and hold the mouse button while dragging the lines to the desired position.
 - \Rightarrow The variable lines are inserted.

Copy several variables with "Drag & drop"

1. Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the second column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- **2.** Press and hold the mouse button and the key *[Ctrl]* while dragging the lines to the desired position.
 - ⇒ The variable lines are copied and inserted. The new variables have the same properties as the initial variables. The addresses and the variable names are adopted and numbered consecutively.

(4) Information bar The information bar provides information on the data block:

- User name and date of the last stored change
- Name of the control, of the CPU and of the data block
- Status of the block since the last saving (changed/unchanged)
- Connection status to the control (inactive/active/error): If you move the mouse cursor to this field, details on the connection status are displayed.

8.9 Adding a new structure block (UDT)

If you want to create a new block, a project must be opened and a control must be contained in the project.

Image: PLC_01 [CPU 315-4EC12 315SN/EC]
 Device overview
 Device properties
 Device configuration
 Address overview
 Image: PLC Program
 PLC Program Blocks
 Add new Block
 System blocks

Fig. 161: Adding new block via the "project tree"

- **1.** In the project tree within a control, click on 'Add new block' in the 'PLC program' at 'Program blocks'.
 - ⇒ The dialogue window 'Add new block' will open.

Block editor for structure blocks (UDT)

Add new block		×
OB-Block	Add structure block Name: Data block_1	
FB-Block	Number: UDT 1 1 [1 - 65535] UDT1 - Data block_1	
FC-Block	Information	
DB-Block	The user defined data type UDT (User defined data type) displays a defined data structure which can be used multiply in the S7 developing project. The structure of a UDT is assembled from several components, which can have different data structures. Determine the type of the components when declaring the UDT. UDTs can be used as data types for variables in the variab declaration of code blocks or in data blocks.	le
	To take some more inputs	
📝 Open block	V OK X Cance	1

Fig. 162: Dialogue window "Add new block", structure block

- **2.** Select the block type 'UDT'.
- 3. S 'Name': Enter a different block name, if required. You can reference the data structure in the user program with this name.
- 'Number': Select a free block number. Blocks that are already present cannot be 4. selected.
- 5. Click on 'To take some more inputs..' if you want to enter further block details. The following details can be entered: Title, comment, version and revision number, control family, author and syntax language. You can make or change these entries later in the block editor.
- 6. Click on 'OK'.



If you select the option 'Open block' and click on 'OK', block editor will open.

 \Rightarrow The structure block is added and displayed in the project tree.

8.10 Block editor for structure blocks (UDT)

Different types of structure blocks (UDT, user-defined data type) can be edited, transferred to the control, synchronised with the control and monitored in the this editor. Structure blocks contain data structures for the user program (PLC program), but no program instructions. & Chapter 8.1 'Program blocks' on page 192

If a project is opened and a control is included, you can open the block editor. You can create new blocks or open existing blocks.

Block editor for structure blocks (UDT)

If you want to add a structure block, please note Chapter 8.9 'Adding a new structure block (UDT)' on page 222.

Select one of the following options if you want to open an existing structure block in the block editor:

- Project tree: Double-click on the desired structure block (block name) in the control at 'PLC program', 'Program blocks'.
- "Device overview" editor
 : Double-click on the desired structure block.

\$ S	Structure block_2 [UDT2] 🧪 💷 😳 🔹 😢														
	Parameter structure														
		Address	Name	Datatype		Default value	Comment								
		0.0	rNiveau01	REAL		0.000000e+000									
		4.0	rMaximum01	REAL		7.400000e+001									
		8.0	bStatus01	BOOL		True)								
	۵ (÷		BOOL		False									
							4								
Syste	madministr	rator - 10/29)/2013 5:43 PM	PLC_01/CPU/	Datatype: UDT1 - S	tructure Block_1	changed (∋—⊽—		100%					

Fig. 163: Block editor for structure blocks

- (1) Toolbar
- (2) Block information
- (3) Declaration section
- (4) Information bar

Showing/hiding input	You can show or hide the input areas
areas	

- Shows/opens the input area
- Hides/closes the input area

(1) Toolbar

Re-register block: Make UDT block known at the compiler interface

(2) Block information

Here you are provided with further information, and you can enter a title and comment on the structure block. The following buttons are displayed if you hover with the mouse over a field with the *'Block information'*.

- **Comment field:** Here you can show or hide the comment field.
- Advanced Configurations: Here, you can show or hide further configurations, such as author and version.
- Block information: Here, you can show or hide information about the block.
- History: Here, you can show or hide the display of the block versions.
- (3) **Declaration section** The variables of the structure block are defined in the declaration section.

Block editor for structure blocks (UDT)

'1st column' – Area to select the vectors of the data type ARRAY

'2nd column' - Area to select all other data

'Address' - Internal automatically created address for data filing in the structure block

'Name' – Name of the variables & Chapter 8.5.3 'Using variable names ' on page 202

'Data type' – Data type of the variables & Chapter 8.5.4 'Assigning data types' on page 203

'...' – Further configurations for the selected data type e.g. dimensions and field boundaries of the ARRAY data type

'Default value' - Initial value of the variables

'Comment' - Any comment e.g. remark or explanation

Adding/declaring variables

	Address	Name	ne Datatype		Default value
	0.0	wStatus	WORD		W#16#0000
1	2.0	awValues	ARRAY_OF_TYPE	[012] OF WORD	W#16#0000

Fig. 164: Adding/declaring variables

The variables can be declared line by line. Each line in the declaration section can contain a variable.

New variables can be declared at free positions. The + icon in the 'Address' column indicates that the position is free and that a variable can be declared in this line.

After having declared a variable, a new free line is automatically added.

- 1. Click on the free input field in the 'Name' column.
- **<u>2.</u>** Enter a name for the variable e.g.awValues.
- **3.** Click on the adjacent field in the *'Data type'* column and select the desired data type e.g. "ARRAY_OF_TYPE" for data fields.

Creating, transferring and testing the user program

Block editor for structure blocks (UDT)

ARRAY_OF	TYPE	* [112] OF WORD	10	,
	Configuratio	on array data type		-
	Data type:	WORD	*	0
	🗷 Rank 1:	1		12 \$
	🔲 Rank 2:	0		0
	🔲 Rank 3:	0		0 ‡
	🔲 Rank 4:	0		0
	🔲 Rank 5:	0		0
	🔲 Rank 6:	0		0

Fig. 165: Enter dimensions and field boundaries

- **4.** Any further configurations which are possible for the selected data type, z. B. dimensions and field boundaries of the data type are displayed in the '...' field. Click on the field to enter the configurations. Click on the field to enter the configurations using a dialogue window.
- **5.** If you want to assign an initial value to the variables, click on the *'Default value'* field and select a default value or enter a value.
- **6.** If you want to enter a comment on the variables, click on the *'Comment'* field and enter the comment.

Inserting variables



Fig. 166: (1) First and (2) second column

Changing variables

You can insert new variables above or below the current line in the table.

- **1.** Click into the second column of a variable cell.
- **2.** Right-click with the mouse button on it and select 'Add variable after' or 'Add variable after'.
 - \Rightarrow A new line is inserted in the table.

You can change various properties of an already declared variable.

Click on the input field which you want to edit. Changes can be entered directly. For some fields, changes can be made via a selection list.



Fields highlighted in grey cannot be changed.

Deleting variables	
	In the second column, highlight the variable line which you want to delete.
	Individual vectors of the data type ARRAY can only be highlighted in the first column.
	Press [Del].
	- or -
	Right-click with the mouse button on the line and select 'Delete selected variable'.
	A dialogue window will open, where you can select whether you want to delete the variable.
	\Rightarrow The variable is deleted or removed from the declaration.
Copying variables	
	In the second column, highlight the variable line which you want to copy.
	Right-click with the mouse button on the line and select ' <i>Copy highlighted variable</i> '.
	⇒ The variable line is copied and inserted below the current line. The new variable has the same properties as the initial variable. The variable name is adopted and numbered consecutively.
Move variable with "Drag & drop"	
	In the second column, highlight the variable line which you want to move.
	Press and hold the mouse button while dragging the line to the desired position.
	\Rightarrow The variable line is inserted.
Copy variable with "Drag & drop"	
	In the second column, highlight the variable line which you want to copy.
	Press and hold the mouse button and the key [Ctrl] while dragging the line to the desired position.
	⇒ The variable line is copied and inserted. The new variable has the same proper- ties as the initial variable. The address and the variable name are adopted and numbered consecutively.
Move several variables with "Drag & drop"	
	Press and hold the key [Ctrl] while highlighting all desired variable lines in the second column.
	- or -
	In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.
	Press and hold the mouse button while dragging the lines to the desired position.
	\Rightarrow The variable lines are inserted.

Add variable table and edit it

Copy several variables with "Drag & drop"

1. Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the second column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- **2.** Press and hold the mouse button and the key *[Ctrl]* while dragging the lines to the desired position.
 - ⇒ The variable lines are copied and inserted. The new variables have the same properties as the initial variables. The address and the variable names are adopted and numbered consecutively.

(4) Information bar The information bar provides information on the structure block:

- User name and date of the last stored change
- Name of the control, of the CPU and of the structure block
- Status of the block since the last saving (changed/unchanged)

8.11 Add variable table and edit it 🖪

In a variable table, you can declare, group and manage the variables pertinent to a CPU. For each CPU created in the project, a variable table with the name *'Standard project configuration'* is automatically created.

- You can declare variables in the 'Standard project configuration'.
- If necessary, you can create further variable tables in order to declare variables.

If a project is open and a control is included, you can add and edit variable tables.

Edit standard project configuration

- In the project tree within a control, click on 'Standard project configuration' in the 'PLC program' at 'PLC variables'.
 - ⇒ The "Variable table" editor with the *'standard project configuration'* is opened.
 ⊗ Chapter 8.12 "Variable table" and "Standard project configuration" editor and "on page 229

Add variable table

PLC_01 [CPU 315-2AG13 315SB/DPM]
 Device overview
 Device properties
 Device configuration
 Address overview
 PLC program
 PLC program blocks
 PLC variables
 Add variable table
 System hardware configuration

- 1. In the project tree within a control, click on *'PLC program'* on *'PLC variables* → Add variable table'.
 - ⇒ The dialogue window 'Add variable table' will open.
- **2.** *Name'*: Enter a different name, if required.

Fig. 167: Add variable table

"Variable table" and "Standard project configuration" editor

4. Click on 'OK'.



If you select the option 'Open edit window' and click on 'OK', the "Variable table" editor opens. Standard project configuration" editor and on page 229

 \Rightarrow The variable table is added and displayed in the project tree.

8.12 "Variable table" and "Standard project configuration" editor

In a variable table, you can declare, group and manage the variables pertinent to a CPU. For each CPU created in the project, a variable table with the name *'Standard project configuration'* is automatically created.

- You can declare variables in the 'Standard project configuration'.
- If necessary, you can create further variable tables in order to declare variables.



Edit variables directly in the block editor

You can create and edit individual variables in the block editor. All
 changes are adopted in the variable table. Schapter 8.5.6 'Create / edit symbol' on page 207

If a project is open and a control is included, you can add variable tables. *Add variable table and edit it* **[]**? *on page* 228

To open an existing variable table, in the project tree within a control double click on the desired variable table in the *'PLC program'* at *'PLC variables'*.

- :	Standard Project configuration												
Name Standard Project configuration													
c	Comment:												
	Group	△	Operand	Alias	Data type	Area of validity	Туре	Visu	Comment				
÷					BOOL 2	Global	Unknown						
	Plant 1		MW 40	Temp_01	WORD	OB1 - Main	flag	\checkmark					
			MW 42	Temp_02	WORD	OB1 - Main	flag	1					
	Ungrouped		MB 7	Status	вуте	Global	flag						

Fig. 168: "Variable table" editor

- (1) Information on the variable table
- (2) Add and group variables
- (3) Editing variable table

"Variable table" and "Standard project configuration" editor

Showing/hiding input areas	You can s	how or hide the i	input a	areas:		
\$	Shows/op	ens the input are	ea			
-	Hides/clos	ses the input are	а			
•	Hide slave	e objects				
*	Show slav	ve objects				
(1) Information on the vari- able table	Here you	can change the	name	of the variable tal	ble and enter a c	omment.
(2) Add and group variable	You can s	ort the variables	accor	ding to groups.		
		Group	△	Operand	Alias	Data type
	-0	Plant 1	*	MW 44		WORD *
	Fia. 169: .	Add variable			<u></u>	1
	You can p icon 🕁	perform inputs in	the fir	st line of the table	. You can recogr	ise these rows by
	1. If yc	ou would like to s	ort the	e variables accord	ling to groups, fir	st create the grou
	In th inpu	ne first table, click it field or select a	k on th an exis	ne <i>'Group'</i> colum sting group.	n and enter a nev	w group name into
	2. Clic	k on the input fie	ld of tl	ne <i>'Operand'</i> colu	umn and enter th	e operand, e.g.Mv
	3. Clic boli	k on the adjacen c address). <i>ড∖ Ch</i>	t field <i>apter</i>	in the <i>'Alias'</i> colu 8.5.3 <i>'Using varia</i>	mn and enter a sable names ' on p	variable name (sy bage 202
	4. ► Clic type "WC	k on the adjacen e. Here, the perm)RD" for the oper	t field iitted c rand ⊵	in the <i>'Data type</i> ' lata types suitable ^{IW.}	column and sele for the operand	ect the desired da I are shown, e.g.
	5. Clic	k on the <i>'Area of</i>	f validi	ty' column in the	adjacent field an	d select the validi
		To use the variat To use the variat The area of valid	ole onl ole in t lity is r	y within one block the entire user pro reset to "Global".	k, select the desi ogram, delete the	red block. e text in the input f
	6. ► To b ther & C	be able to use the copy (synchron Chapter 9.4 '"Star	e varia ise) th ndard	ble in HMI image is variable into th variables table" e	s, activate the op e variable table o ditor 🖬 ' on page	otion <i>'Visu'</i> . You c of the HMI project 292
	7. Ente	er a <i>'Comment'</i> ,	if requ	uired.		
	8. Con	firm your input w	/ith <i>[El</i>	nter].		
	⇔	The new variable	e is ins	serted into the tab	le.	
(2) Variable table	that asking	an' Coloction -				
(S) VARIADIE TADIE	'i st colun 'Group'	Sort and display	rea / tablo	entries by group		
	Operand	' – Address of th	e vari:	ables		

'Alias' – Name of the variables (symbolic address)

'Data type' – Data type of the variables $\,\, \&$ Chapter 8.5.4 'Assigning data types' on page 203

'Area of validity' - Use variable in a block or in the entire user program

'Type' - Operand area of the variables, e.g. input, output, memory

"Variable table" and "Standard project configuration" editor

'Visualisation' – Use variable in HMI images & Chapter 9.4 '"Standard variables table" editor editor ? on page 292.

'Comment' - Any comment e.g. remark or explanation

Changing the variable/ group

You can change existing variables or groups in the table.

Click on the input field which you want to edit. Changes can be entered directly. For some fields, changes can be made via a selection list.



Delete variable/group

	Group
÷	
0	

Fig. 170: (1) First column

Move variable with "Drag & drop"

Copy variable with "Drag & drop"

- **1.** In the first column, highlight the variable or group which you want to delete.
- 2. Press [Del].
 - A dialogue window will open, where you can select whether you want to delete the variable or group.
 - ⇒ The variable or group and all the variables contained therein are deleted and removed from the declaration.
- **1.** In the first column, highlight the variable line which you want to move.
- 2. Press and hold the mouse button while dragging the line to the desired position.
 - \Rightarrow The variable line is inserted.

1.
In the first column, highlight the variable line which you want to copy.

- **2.** Press and hold the mouse button and the key *[Ctrl]* while dragging the line to the desired position.
 - ⇒ The variable line is copied and inserted. The new variable has the same properties as the initial variable. The operand is adopted and numbered consecutively.

Move several variables with "Drag & drop"

1. Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the first column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

"System hardware configuration" editor

- **2.** Press and hold the mouse button while dragging the lines to the desired position.
 - \Rightarrow The variable lines are inserted.

Copy several variables with "Drag & drop"

1. Press and hold the key [Ctrl] while highlighting all desired variable lines in the first column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- 2. Press and hold the mouse button and the key [Ctrl] while dragging the lines to the desired position.
 - The variable lines are copied and inserted. The new variables have the same properties as the initial variables. the operands are adopted and numbered consecutively.

8.13 "System hardware configuration" editor

	System Hardware	konfiguration						
Ν	lame	System Hardware Configura	tion					
C	Comment:							
	Group	۵	Operand △	Name	Data type	Visu 🗖	Comment	Туре
	DI16xDC24V [De	vice: PLC_01, Slot: 4, Rack: 0]	1 0.0	x_DI_0_0_20	BOOL		E 0.0 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.1	x_DI_0_1_20	BOOL		E 0.1 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.2	x_DI_0_2_20	BOOL		E 0.2 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			1 0.3	x_DI_0_3_20	BOOL		E 0.3 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.4	x_DI_0_4_20	BOOL		E 0.4 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.5	x_DI_0_5_20	BOOL		E 0.5 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.6	x_DI_0_6_20	BOOL		E 0.6 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			10.7	x_DI_0_7_20	BOOL		E 0.7 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			l 1.0	x_DI_1_0_20	BOOL		E 1.0 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			11.1	x_DI_1_1_20	BOOL		E 1.1 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			I 1.2	x_DI_1_2_20	BOOL		E 1.2 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			I 1.3	x_DI_1_3_20	BOOL		E 1.3 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			I 1.4	x_DI_1_4_20	BOOL		E 1.4 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			I 1.5	x_DI_1_5_20	BOOL		E 1.5 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			I 1.6	x_DI_1_6_20	BOOL		E 1.6 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input
			11.7	x_DI_1_7_20	BOOL		E 1.7 - DI16xDC24V [Device: PLC_01, Slot: 4, Rack: 0]	Input

Fig. 171: System hardware configuration

All components of the control system are listed in the hardware configuration. The variable names for inputs and outputs are automatically generated.

If components are removed from the project, the corresponding variables remain in the table and can be used for further programming.

"Address overview" editor

If you want to use variables in HMI images, activate the *'Visu'* option. You can then copy (synchronise) this variable into the variable table of the HMI project. *Schapter 9.4 "Standard variables table" editor (on page 292)*

'1st column' - Selection area

'Group' - Component name

'Operand' - Address of the variables

'Variable' - Name of the variable (symbolic address)

'Data type' – Data type of the variables & Chapter 8.5.4 'Assigning data types' on page 203

'Visualisation' – Use variable in HMI images & Chapter 9.4 '"Standard variables table" editor editor editor on page 292.

'Comment' – Any comment e.g. remark or explanation

'Type' – Operand area of the variables, e.g. Input, output

8.14 "Address overview" editor

The input and output addresses (I/O addresses) of all projected devices and components assigned to a control are illustrated in a table in the 'Address overview' editor. You can change the I/O addresses of individual components.

If a project is opened and a control is included, you can open the 'Address overview'. Select one of the following options to this end:

- **Project tree:** Click on 'Address overview' in the control.
- "Devices and networking" editor :: Right-click with the mouse button on the desired control and select 'Address overview'.

"Address overview" editor

I,	/O Ad	dresses					
	Input a	ddresses					
	Start ad	dress: 0					
	End add	ress: 1					
	Filter:	Inputs Outputs			-	_	
	No.	Device	Component	Slot	I-Adress	O-Adress	OrderNo.
	1	PLC_01 [CPU 315-4EC12 315SN/EC]	DI 16xDC24V	4	0 - 1		6ES7 321-1BH00-0AA0
	2	DP_Slave_001 [SLIO 053-1DP00]	DI4xDC24V	1	2		021-1BD00
	3	EC_Slave_001 [SLIO 053-1EC00]	IM 053EC	0	6 - 13		053-1EC00
	4	PLC_01 [CPU 315-4EC12 3155N/EC]	CP 343-1 Industrial Ethernet	6	736 - 751		CP343
	5	PLC_01 [CPU 315-4EC12 3155N/EC]	CP 342 Profibus DP	7	752 - 767		CP342
	6	DP_Slave_001 [SLIO 053-1DP00]	IM 053DP	0	8188*		053-1DP00
	7	PLC_01 [CPU 315-4EC12 3155N/EC]	MPI Schnittstelle	2	8189*		315-4EC12
	8	PLC_01 [CPU 315-4EC12 3155N/EC]	EC-Mastersystem	2	8190*		315-4EC12
	9	PLC_01 [CPU 315-4EC12 3155N/EC]	DP-Mastersystem	2	8191*		315-4EC12
	10	DP_Slave_001 [SLIO 053-1DP00]	DO4xDC24V 0,5A	3		0	022-1BD00
	11	DP_Slave_001 [SLIO 053-1DP00]	DO4xDC24V 0,5A	2		1	022-1BD00
	12	PLC_01 [CPU 315-4EC12 315SN/EC]	DO 32xDC24V	5		4 - 7	322-1BL00

Fig. 172: Address overview

The table includes all local and decentralised components of the control. The input components (I addresses) and further below the output components (O addresses) are listed at the top of the table.

'No.' - Consecutive number

'Device' - Device name [order number of the device]

'Component' - Component name

'Slot' - Slot number within the rack

- 'I-Address' Configured input address (byte address) of an input component
- 'O-Address' Configured output address (byte address) of an output component

'Order number' - Order number of the device or component

Byte addresses	Depending on the number of channels, a component occupies a different number of byte addresses. This is an example on the basis of Fig. 172:
	No. 1: The input component "DI16xDC24V" occupies the two consecutive input bytes 0 and 1.
	 No. 2: The input component "DI4xDC24V" occupies the first four bits of input byte 2. The remaining bits of input byte 2 cannot be used.
	No. 4: The communication processor "CP343" of the control occupies the 16 con- secutive input bytes 736 to 751.
	No. 8: The EtherCAT master system of the control occupies input byte 8190 for the exchange of diagnostics data.

Changing I/O addresses

- **1.** In the table, highlight the line with the component of which you want to change the address.
- 2. Enter the new address in the 'Start address' field.

If this address is already occupied, a note pops up prompting you to enter a different address.

- **3.** Confirm your input with *[Enter]*.
 - ⇒ The address is changed. If the component occupies several byte addresses, the 'End Address' is automatically calculated and the complete address range is assigned to the component.

8.15 Cross-reference list

The cross-reference list offers an overview over all operands used in the user program. The cross-reference list is helpful in error search, e.g. in order to determine which operand should is processed in which program block with which command.

Cross-references can be displayed for the following block types:

- Organisation blocks (OB)
- Function blocks (FB)
- Functions (FC)

The following operand types can be displayed:

- Inputs
- Outputs
- memory
- Timers
- Counter
- Periphery inputs
- Periphery outputs
- Data blocks (DB)
- Instance data block (DI)
- indirect addressing

You can filter those blocks and operand areas which should be displayed. Furthermore, you can jump to the references in the user program.

Cross-reference list

If a project is opened and a control is included, you can open the 'Cross-reference list'.

In the project tree within a control, click on 'Cross-Reference list' under 'PLC program'.

In addition, you can open the cross-reference list directly from the assignment list. % 'Switch to the cross-reference list' on page 243

Fig. 173: Open cross-reference list

18 ; ()			
Filter Settings			
Block Selection: 2	Operand areas:	6	Settings:
Block Type Number	✓ Inputs 0 - 65535	✓ Outputs 0 - 65535	Apply filter changes immediately
	Marker 0 - 65535	☑ Timers 0 - 65535	🔲 Hide Single Use
	☑ Counter 0 - 65535		
		☑ DBs 0 - 65535	
	☑ DIs 0 - 65535	☑ Indirect addressing	
All blocks	All Operand Ranges		
Result			
Operand Type 🔺 Operand 🔺	•	•	
▼ Marker: (2)			
▼ MW20: (2)			
Operand Typ Operand	d △ Symbol Block	Network Line Code Syntax	RW Code
1 Marker MW20	FB1	1 1 IL	R L MW 20
2 Marker MW20	FB1	1 3 IL	W T MW 20

Fig. 174: Cross-reference list

- (1) Toolbar
- (2) Block selection
- (3) Operand areas (= Address areas)
- (4) Configurations
- (5) Cross-reference list

Show/hide filter configura- You can show or hide the area above the cross-reference list:

tions

- Shows/opens the area
- Hides/closes the area

(1) Toolbar

Refresh: All changed configurations, changed operand areas and selected blocks are refreshed in the cross-reference list.

Cross-reference list

(2) Block selection	
	Here, you can select blocks for which cross-references should be displayed.
	1. Activate I 'All blocks' or the desired blocks, e.g. 'OB0'.
	2. Click on ' <i>Refresh'</i> 2 or activate 1 ' <i>Apply filter changes immediately</i> ', in order to refresh the configuration in the cross-references.
(3) Operand areas	
	Here, you can select the operand types and address areas which should be displayed in the cross-reference list.
	1. Activate 📝 'All Operand Areas' or the desired operand type, e.g. 'Inputs'.
	2. Enter the Start and End byte addresses in the two fields next to each other, e.g. 0 to 65535.
	3. Click on <i>'Refresh'</i> 3 or activate 1 <i>'Apply filter changes immediately'</i> , in order to refresh the configuration in the cross-reference list.
(4) Configurations	The configurations for the cross-reference list can be made here.
	'Apply filter changes immediately' – If this option is enabled, changed operand areas or overlaps in the cross-reference list are refreshed automatically. If this option is not enabled, changes in the cross-reference list are only refreshed when you click on ' <i>Refresh'</i> 2.
	<i>'Hide Single Use'</i> – If this option is enabled, the cross-reference list shows only those operands where the address areas overlap. \Leftrightarrow <i>'Overlaps' on page 241</i> Click on <i>'Refresh'</i> or activate \checkmark <i>'Apply filter changes immediately'</i> , in order to refresh the display in the cross-reference list.

(5) Cross-reference list

Result												
Opera	nd Type	e 🔺 Operand 4										
▼ Ma	arker: (2)										
-	MW	20: (2)										
		Operand Typ △	Operand	Symbol	Block	Network		Line	Code Syntax	RW	Code	
	1	Marker	MW20		FB1		1	1	IL	R	L MW	20
	2	Marker	MW20		FB1		1	3	IL	W	T MW	20

The cross-reference list shows the references for each operand in the applicable program block.

'Operand Type' - Type of the selected operand

'Operand' - Address of the operand

'Symbol' - Symbolic address of the operand

'Block' - Program block, in which an operand is accessed

'Network' – Number of the network in the program block, in which an operand is accessed

 ${}^{\prime}\!\textit{Line'}-\textit{Number}$ of the program line in the network in which the access is programmed

'Code Syntax' – Programming language

 $^{\prime}RW^{\prime}$ – Reading/Writing access of an operand: R = reading, W = writing

'Code' – IL program code of the access point

Assignment list

Jump to reference

Op	eranc	і Туре	Operand		
•	Mar	ker: (2	2)		
	•	MW	20: (2)		
			Operand Typ 🗅	Operand	
		▶ 1	Marker	MW20	
		2	GoTo refere		
			🗄 Expand all	12	
			}∃ Collapse all		

Changing the sort sequence

 No
 time stamp
 description

 1
 4/15/2014 8:11:55 AM.264
 MSSE transition

 2
 4/15/2014 8:11:55 AM.247
 Automatic res

You can open the program block and jump to the reference of the operand.

- Right-click with the mouse button on the desired line in the cross-reference list and select 'GoTo reference'.
 - ⇒ The applicable program block will open and the cursor is set to the reference in the program code.

When calling the cross-reference list for the first time, the lines are sorted by operand types. You can also sort the data in a different order and by other criteria.

- In the title line of the table, click on the term according to which you would like to sort the cross-reference list, e.g. 'Block'.
 - ⇒ The table entries are sorted in alphabetical or numerical order:
 - In ascending order
 - ✓ In descending order

Grouping operands

For a better overview, you can sort table entries by groups.

Opera	nd Type	 Operand 			© 🔨
▼ M	arker: (1 MD0	0) ; (2)			Block 2
		Operand Typ □	Operand	Symbol	Block

- (1) Select column (hold left mouse button down)
- (2) Drag the column
- (3) Drop column in the field (release mouse button)

1. Drag the desired column title into the field above the table.

- ⇒ The contents of the column will be grouped. The number of lines is shown for each group.
- 2. Click on **•** to open the group. Click on **•** to close the group.
- **3.** You can repeat steps 1 to 2 in order to structure the group into further sub-groups.
- **4.** In order to cancel a grouping, click on the close icon next to the group name.

8.16 Assignment list

Operand Typ 🔊 Operand

Operand 🔺

In the assignment list, all operand are displayed which are used in the user program. The assignment list is helpful in error search, e.g. in order to localise multiple access to the same address (overlaps). The following operand types are displayed:

- Inputs
- Outputs

Operand Type 💌

Marker: (10)

-

Assignment list

- memory
- Timers
- Counter
- Periphery inputs
- Periphery outputs

You can filter the operand areas which should be displayed. The references can be displayed in the user program and you can localise overlaps of operands. Furthermore, you can open the cross-reference list or the variable table for each operand.

If a project is open and a control is included, you can open the 'Assignment list'.

▶ In the project tree within a control, click on 'Assignment list' in 'PLC program'.



Fig. 175: Open assignment list

8.0													
 Filter settings 	& help												
Operand areas:								0	Settings:	6	Help:		4
Inputs	0	- 778	ℤ c	utputs	0	-	65535		Appl	/ filter changes im	В	Byte	
Marker	0	- 65535	, I III т	imers	0		65535		Shov	only overlapping:	w	Word	
Counter	0	- 65535		Innuts	0		65535		Shov	references	D	DWord	
	0	65535]	mpue	-						0	Read-only	access
i - Outputs	<u> </u>	- 05555]								• 🗸	Write-only	access
											V •	Read-/writ	e-acces
All Operand Rar	iges 🤊	Reset settings											
Result													
7 6	5 4	3 2 1	0 B	W	[D	Varia	ole		Comment			
EB 2	0	\circ \circ \circ	0				E2.0	x_DI_2	2_0_20 + E	2.0 - DI16xDC24	4V [Device	e: PLC_01,	Slot:
AB 4			0				A4.0	x_D	O_4_0_21 A	4.0 - D016xDC24	4V/1A [Dev	vice: PLC_0	1, Slo
MB 1													
MB 20		($\overline{}$					6					
MB 21													
MB 22													
T1													
Т2													
									Ŧ				
References													
Operand Type	Operand	Variable	Block	Network	Line	RW	Code					^	
Outputs	A4.0	x_DO_4_0_21	FB2	1	3	W	S	A 6	4.0	11	Motor sta	art	
Outputs	A4.0	x_DO_4_0_21	FB2	1	7	W	R	Α	4.0	//	Motor st	op 🗸	

Fig. 176: Assignment list

- (1) Toolbar
- (2) Operand areas (= Address areas)
- (3) Configurations

- (4) Help (meaning of icons)
- (5) Assignment list
- (6) References

Creating, transferring and testing the user program

Assignment list	
Show/hide filter configura- tions and help	You can show or hide the area above the assignment list:
\$	Shows/opens the area
-	Hides/closes the area
(1) Toolbar 😂	Refresh: All saved configurations and changed operand areas are refreshed in the assignment list.
(2) Operand areas	
	Here, you can select the operand types and address areas which should be displayed in the assignment list.
	1. ▶ Activate 📝 'All Operand Areas' or the desired operand type, e.g. 'Inputs'.
	2. Enter the Start and End byte addresses in the two fields next to each other, e.g. 0 to 65535.
	3. Click on 'Refresh' 😂 or activate 📝 'Apply filter changes immediately' in order to refresh the changes in the assignment list.
	<i>'Reset configurations'</i> – Activates all operand types and sets the maximum address area.
(3) Configurations	Here you can make general configurations for the assignment list.
	<i>Apply filter changes immediately'</i> – If this option is enabled, changed operand areas or overlaps in the assignment list are refreshed automatically. If this option is not enabled, changes in the assignment list are only refreshed when you click on <i>Refresh'</i> 2 .
	<i>'Only show overlappings'</i> – If this option is enabled, the assignment list shows only those operands where the address areas overlap. \bigotimes <i>'Overlaps' on page 241</i> Click on <i>'Refresh'</i> are or activate <i>(I) (Apply filter changes immediately'</i> , in order to refresh the display in the assignment list.
	'Show references' – Show/hide display of the references & '(6) References' on page 242
(4) Help	The different symbols and tags in the assignment list are explained here.
(5) Assignment list	The operands are displayed in the assignment list as follows:
	 Inputs, outputs, memories, periphery inputs and periphery outputs: Each table line corresponds to a byte, e.g. "EB2", "MB20". Timers and counters: Each table line corresponds to a word, e.g. "T1", "Z5".
	Non assigned address areas (free address gaps) in the table line are marked with "".
	$'7 \dots 0'$ – In these table columns, the bit access for the individual bits 7 to 0 of the operand are displayed. The following tags are possible:

Assignment list

7 0	Meaning
empty row	Address is not assigned in the user program (free bit address)
•	Address is assigned; read access, e.g. input bit
•	Address is assigned; write access, e.g. output bit
•	Address is assigned; read and write access, e.g. memory bit
0	Currently selected variable, see column "variable"
white dot	
dark grey back- ground	Address is assigned; byte, word or double word access, see column "B", "W" or "D"

'B, W, D' – These table columns display the byte, word and double word access of the operand. Example: Any tag of the column 'W' means that the address in the user program is used by a word access. The following tags are possible:

B, W, D	Meaning
	Address is assigned; read access, e.g. input
V	Address is assigned; write access, e.g. output
V	Address is assigned; read and write access, e.g. memory, timer, counter.
	Currently selected variable, see column "variable"
white dot	

'Variable' – Symbolic address of the operand: If several variable names are present for one operand (e.g. for bit operands), you can select the desired variable in a drop down list. The selected variable is tagged in the columns '7 ... 0' or 'B, W, D' with a white dot.

'Comment' – Shows the comment of the current variable

Overlaps

Filter overlaps

If you select 'Only show overlappings' in 'Configurations', the assignment list shows only those address areas, where the operand areas overlap, see .

You can localise overlaps (multiple accesses on one address area) in the assignment list.

Assignment list

	7	6	5	4	3	2	1	0	В	W	D	Variable
MB 20							А	0				
MB 21												
MB 22								В				
										С		

Fig. 177: Example for overlaps

The example shows a number of overlaps occurring in the memories 20 to 22:

- (A) Multiple access via bit and word address (horizontal reading direction): At memory 20, reading access to memory bit M20.0 and reading and writing access to memory word MW20 occurs.
- (B) Multiple access via byte and word address (horizontal reading direction): At memory 22, reading and writing access to memory byte MB22 and reading and writing access to memory word MW21 occurs.
- (C) Multiple access via two word addresses (vertical reading direction): At memory 20 to 22, reading and writing access to memory byte M20 and reading and writing access to memory word MW21 occurs.



If you activate the option 'Show references' in 'Configurations' and click on a operand line in the assignment list, all references of the operand are displayed.

(6) References

This table shows the points in the user program, where the operands are accessed.

- **1.** Activate the option 'Show references' in 'Configurations'.
 - \Rightarrow Below the assignment list, the table with the references is shown.
- **2.** Click in the assignment list onto a operand line.
 - \Rightarrow All references of the operand are displayed.

References

Operand Type	Operand	Variable	Block	Network	Line	RW	Со	de		^
Outputs	A4.0	x_DO_4_0_21	FB2	1	3	W	s	А	4.0	// Motor start
Outputs	A4.0	x_DO_4_0_21	FB2	1	7	W	R	А	4.0	// Motor stop 🧹

Fig. 178: References in the assignment list

'Operand Type' – Type of the selected operand

'Operand' - Address of the operand

'Symbol' – Symbolic address of the operand

'Block' - Program block, in which an operand is accessed

'Network' – Number of the network in the program block, in which an operand is accessed

Check and restore consistency

- 'Line' Number of the program line in the network in which the access is programmed
- *'RW'* Reading/Writing access of an operand: R = reading, W = writing
- 'Code' IL program code of the access point

Jump to reference

Resu	Result									
	7 6 5 4 3 2						2	1	0	
EB	EB 2				0	0	0	0	0	
-	Go to cross-reference list									
v	Go to variable table									
	Grouped list view									

Grouping operands

 Result

 7
 6
 5
 4
 3
 2
 1
 0

 EB 2
 O
 O
 O
 O
 O
 O
 O
 O
 O
 O
 O
 O
 O
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You can open the program block and jump to the reference of the operand.

- ▶ Right-click with the mouse button on the desired operand line in the table with the references and select *GoTo reference*.
 - ⇒ The applicable program block will open and the cursor is set to the reference in the program code.

For a better overview, you can display table entries sorted by groups.

- **1.** Right-click with the mouse button on any operand line in the assignment list and select '*Grouped list view*'.
 - ⇒ The operands are grouped depending on the type. The number of operand lines is shown for each group.
- **2.** \blacktriangleright Click on \blacktriangleright to open the group. Click on \checkmark to close the group.

Switch to the cross-reference list

You can open the cross-reference list for an operand.

- Right-click with the mouse button on the desired operand line in the assignment list and select 'Go to cross-reference list'.
 - ⇒ The cross-reference list will open and the relevant operands are shown.

Switch to the variable table

You can open the variable table for an operand if the operand has been defined in it.

- Right-click with the mouse button on the desired operand line in the assignment list and select 'Go to variable table'.
 - ⇒ The corresponding variable table (e.g. system hardware configuration) will open.

8.17 Check and restore consistency 🗊

If you edit blocks, inconsistencies can arise, e.g. interface conflicts between two blocks. If you transfer inconsistent blocks into the control, this can lead to processing errors in the user program.

You can check the user program for inconsistencies. In a further processing step, you can remove existing inconsistencies.

Check and restore consistency

Check consistency

▶ To check the consistency, select one of the following options:

- **Consistency messages:** In the output range of the consistency messages, click on 🔯. 🔄 Chapter 4.13.5 'Consistency messages 🔜' on page 41
- Menu bar: Check 'Project → Check/correct consistency'.
- Toolbar: Click on 🔯.
- The consistency is checked and the result is shown in a dialogue window. ⇒

Show consistency messages

Consistence	y chec	k / repair		×
Consistency r	esolv	ing		
Import ar Area filter	nd Sele	ection of consister	ncy messages	
Consisten	cy me	ssages:		
		Source	Path	
	3	OB1 (Main) Der Bausteir	temp.PLC_01.0B1 (Main) n OB1 enthält Änderungen die eine Neukompilierung notwendig machen. 2	
	consist	ency warnings		
			I Back Next X Cancel	

Fig. 179: Dialogue window with consistency messages

- (1) Filter consistency messages
- (2) Consistency messages
- (3) Select individual blocks for the correction
- (4) Select several blocks for the correction
- ▶ You can filter the consistency messages shown. Use the 'area filter' (1) to select the consistency messages that are to be shown:
 - All consistency messages of the user programs of all CPUs are shown.
 - CPU... Only the consistency messages of the user program of the selected CPU are shown.
 - ⇒ The filtered consistency messages are shown (2). If all blocks are consistent, the 'Consistency messages' field is empty.

Restore consistency

- **1.** Select the blocks for which you want to restore consistency in the next step:
 - Individual blocks: Highlight v the desired consistency messages or blocks (3).
 - Consistency errors, e.g. interface conflicts: Select fall consistency errors' (4). All blocks with consistency errors are highlighted.
 - Consistency messages, e.g. changed, non-compiled blocks: Select if 'All consistency messages' (4). All blocks with consistency messages are high-lighted.
- 2. Click on 'Next'.
 - ⇒ The consistency of the selected blocks is restored. In this process, block dependencies are checked, corrected if necessary and all selected blocks are compiled. The individual steps and results are shown in the dialogue window.

If the consistency cannot be restored, you must correct the affected blocks manually in the Block editor.

3. Click on *'Done'* to close the dialogue window.

8.18 Compile user program

A user program consists of blocks. A user program must be compiled into error-free machine code so that it can be executed by the CPU. If you have changed blocks, you must compile the block or the user program.

The compilation involves the following processes:

- Syntax test: The user program is searched for syntax errors.
 If blocks contain syntax errors, the compilation process is stopped and an error message is shown.
- Consistency test: The calling-interface between blocks is reviewed.
 If blocks have errors at the calling-interface, the compilation process is stopped and an error message is shown.
- Compilation: The user program is compiled into machine code (translated) that can be processed by the CPU.
 - All compilation errors are listed in the *'Programming errors'* output range. \Leftrightarrow *Chapter* 4.13.2 *'Programming events* \square on page 40

To compile the user program, you have various possibilities:

🔳 'Compile' 🌄

Only the blocks that were changed after the last compilation are compiled.

- or -

Individual blocks can be selected and compiled.

- or -

The block opened in the editor can be compiled.

🗞 Chapter 8.18.1 'Compile 🏹' on page 246

'Compile all'

All blocks of the user program are compiled.

♦ Chapter 8.18.2 'Compile all , on page 246

- Compile changed blocks directly before transferring the user program:
 - 🛛 🏷 Chapter 8.20.2 'Transfer user program 🔙' on page 249

8.18.1 Compile 🗋

You can compile all the blocks that have been changed since the last compilation of the user program or select and compile individual blocks.

Compile changed blocks	
	Select one of the following options:
	 Menu bar: Select 'Project → Compile'. Toolbar: Click on
	*Compile'.
	All changed blocks are compiled. The result of the compilation process is shown in the output range.
Compile block opened in the editor	
	Click on S Chapter 8.2 "Device overview" editor (PLC) (10) on page 192 in the block editor.
	\Rightarrow The block opened in the editor is compiled.
Compile individual blocks	In the <i>'Device overview'</i> editor of the control, you can select and compile individual blocks. <i>S Chapter 8.2 "Device overview" editor (PLC)</i> (1) on page 192
8.18.2 Compile all 🕁	
	You can compile all blocks of the user program.
	Select one of the following options:
	■ Menu bar: Select 'Project → Compile all'.
	Toolbar: Click on 2.
	 Project tree: Right-click with the mouse button on the project name and select 'Compile all'.

All blocks are compiled. The result of the compilation process is shown in the output range.

8.19 Simulate user program B

With the PLC simulation, you can test the user program on the PC before loading it into the control.

If you want to simulate a user program, you must proceed as follows:

- **1.** Compile the user program. Chapter 8.18 'Compile user program' on page 245
- **2.** Under 'Active PC interface', select the virtual interface 'Simulation'. 6.18.2 'Communication settings (PLC)' on page 109
- 3. Open the *'PLC simulation configurations'* dialogue window and create configurations for the simulation, if necessary. *Schapter 8.19.1 'PLC simulation configurations* on page 247

Simulate user program > PLC simulation configurations

- **4.** Start the simulation. Select one of the following options to this end:
 - Menu bar: Select 'Simulation → Start PLC simulation'.
 - Toolbar: Click on .
 - "PLC simulation configurations " dialogue window: Click on 'Start'.
 - \Rightarrow The PLC simulation is started.
- **5.** Test the user program, e.g. in the Block editor or in the *'Watch table'* editor. You can observe e.g. values of variables or signal states. You can overwrite variables with values so as to simulate certain situations for program execution.
- **6. •** End the simulation. Select one of the following options to this end:
 - Menu bar: Select 'Simulation → End PLC simulation'.
 - Toolbar: Click on
 - "PLC simulation configurations " dialogue window: Click on 'Stop'.

8.19.1 PLC simulation configurations 🌆

Here you can create configurations that influence the PLC simulation. You can also start and end the simulation.

To open the *'PLC simulation configurations'* dialogue window, select one of the following options:

- Menu bar: Select 'Simulation → PLC simulation configurations'.
- **Toolbar:** Click on **b**.

nent Line		×
PLC simulation settings		
Cycle time (current/min/max):	10 30 30	
Sleep time (ms):	10 🗕 🕂 🕂	
👿 Ignore non existing SFB/SFC		
Communication settings		
Network interface card:	Loopback Adapter	*
IP address:	127.0.0.1	-
Port:	7777	
	simulation	
7777		
bereit.		
	🗸 0	K
	PLC simulation settings Cycle time (current/min/max): Sleep time (ms): Ignore non existing SFB/SFC Communication settings Network interface card: IP address: Port: 77777 bereit.	PLC simulation settings Cycle time (current/min/max): 10 30 30 Sleep time (ms): 10 - • • Ignore non existing SFB/SFC Communication settings Network interface card: Loopback Adapter IP address: 127.0.0.1 Port: 7777 \$ Image: Image: Im

Fig. 180: PLC simulation configurations

'PLC simulation status' – Display of the operating mode of the simulated CPU *'Start/Stop'* – Start/stop simulation

Transfer the hardware configuration and user program to the control > Transfer hardware configuration

Cycle Time' – Display of the current, the minimum and the maximum cycle time for the program processing

'Rest period' - Waiting period between two program processing cycles

' *Ignore non-existing SFB/SFCs*' – The simulation supports not all or none SFB/SFC. Activate this option in order to keep the simulation further in operating mode RUN, even if the SFB/SFC cannot be processed by the simulation.

'Network interface card' – Network adapter for the virtual communication connection: If you select "Loopback Adapter", the simulation is run on the PC without using the network adapter.

'IP address' – IP address for the virtual communication connection: If an IP address is already configured in the network adapter, it is shown here. For "Loopback Adapter" the IP address is always "127.0.0.1".

'Port' – If port "7777" of the network adapter is already being used by another function or application, enter another port number.

If you change the 'Communication settings', click on 'reinitialize simulation' afterwards.

8.20 Transfer the hardware configuration and user program to the control

To transfer the hardware configuration and the user program to the control, you have various possibilities:

- 'Transfer hardware configuration' 1
 Only the device configuration is transferred to the control.
 Chapter 8.20.1 'Transfer hardware configuration 1
 on page 248
- 'Transfer user program'
 Only the user program is transferred to the control.
 Chapter 8.20.2 'Transfer user program
 'on page 249
- 'Transfer all' I transfer all' Chapter 8.20.3 'Transfer all ' on page 250
- 'Load block into device '
 Transfer only block opened in the editor to the control.
 Chapter 8.5.5 'Instruction section' on page 203

8.20.1 Transfer hardware configuration

You can transfer the device configuration created in the project to the control as system data blocks (SDB). Blocks of the user program are not transferred.

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Transfer hardware configuration'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Transfer hardware configuration'.
 - "Device configuration" editor s: Click on s.
 - ⇒ The 'Transfer the configuration' dialogue window will open.
- **2.** In the table at the top section, click on the desired interface connection, e.g. *'Ethernet interface'*.

If you choose the serial interface, select the desired 'MPI-Destination', if required.

Transfer the hardware configuration and user program to the control > Transfer user program

- **3.** If you want to check whether the programming device is connected to the control, click on *'Test connection'*.
 - ⇒ SPEED7 Studio attempts to create a connection to the control via the selected interface. The individual steps and results are displayed in the dialogue window.
- **4.** If you want to check whether your programming device is connected with the correct control, you can retrieve information from the connected control and select the desired control. Click on *'Accessible partners'*.
 - ⇒ The 'Search for accessible partners' dialogue window will open, 6.19 'Search for accessible partners' on page 112

If no connection can be established, check if the connection cables are connected correctly.

- 5. Click on 'Transfer'.
 - ⇒ If the control is not in operating mode STOP, a dialogue window will open in which you can switch the control into operating mode STOP. After having carried out a transfer, a dialogue window will open in which you can switch the control into operating mode RUN again.

The hardware configuration is transferred to the control. The individual steps and results are displayed in the dialogue window. At the same time, it is displayed whether the transfer has been successful or if an error occurred.

Searching for accessible partners. Load Details of Ip Address: 192.168.10.100. Loading the details of device with IP 192.168.10.100 was successful. Cancel searching for accessible partners.

Fig. 181: Example of an transfer error

If the process was completed successfully, the device configuration in the project harmonises with the configuration in the control.

8.20.2 Transfer user program 属

If you have changed blocks in the project, you can compile them and then transfer them to the control as a user program (PLC program). The hardware configuration is not transferred to the control.

Transfer single program block To transfer the program block opened in the block editor, click on a in the

block editor. S Chapter 8.2 "Device overview" editor (PLC) () on page 192

1. Select one of the following options:

- Menu bar: Select 'Device → Transfer user program'.
- Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Transfer user program'.
- ⇒ The '*Transfer the software*' dialogue window will open.
- **2.** If you select the option 'Overwrite existing blocks', all the blocks of the user program are transferred to the control. If you deactivate this option, only the blocks that have been newly added in the user program are transferred.

Transfer the hardware configuration and user program to the control > Transfer all

- **3.** If you select the option *'Automatic compression'*, all the blocks of the user program are compressed.
- **4.** In the table at the top section, click on the desired interface connection, e.g. *'Ethernet interface'*.

If you choose the serial interface, select the desired 'MPI-Destination', if required.

- **5.** If you want to check whether the programming device is connected to the control, click on *'Test connection'*.
 - ⇒ SPEED7 Studio attempts to create a connection to the control via the selected interface. The individual steps and results are displayed in the dialogue window.
- **6.** If you want to check whether your programming device is connected with the correct control, you can retrieve information from the connected control and select the desired control. Click on '*Accessible partners*'.
 - ⇒ The 'Search for accessible partners' dialogue window will open. 6.19 'Search for accessible partners' on page 112

If no connection can be established, check if the connection cables are connected correctly.

- **7.** Click on 'Transfer'.
 - ⇒ The user program is transferred to the control. The individual steps and results are displayed in the dialogue window. At the same time, it is displayed whether the transfer has been successful or if an error occurred.

	Compile changed blocks If you have not yet compiled changed blocks, they are listed. You can compile these blocks before transferring. Click on 'Compile' for this purpose. The changed blocks are compiled Click on 'Transfer' again.	1.					
Searching	g for accessible partners.						
Load Details of Ip Address: 192.168.10.100.							
Loading the details of device with IP 192.168.10.100 was successful.							
Cancel se	earching for accessible partners.						

Fig. 182: Example of an transfer error

8.20.3 Transfer all

If you have changed the device configuration and blocks of the user program in the project, you can transfer both to the control together.

- **1.** Select one of the following options:
 - Menu bar: Select 'Device → Transfer all'.
 - Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Transfer user program'.
 - ⇒ The 'Transfer all...' dialogue window will open.
- **2.** If you select the option *'Overwrite existing blocks,'* all the blocks of the user program are transferred to the control. If you deactivate this option, only the blocks that have been newly added in the user program are transferred.

- **3.** If you select the option *'Automatic compression'*, all the blocks of the user program are compressed.
- **4.** In the table at the top section, click on the desired interface connection, e.g. *'Ethernet interface'*.

If you choose the serial interface, select the desired 'MPI-Destination', if required.

- **5.** If you want to check whether the programming device is connected to the control, click on *'Test connection'*.
 - ⇒ SPEED7 Studio attempts to create a connection to the control via the selected interface. The individual steps and results are displayed in the dialogue window.
- **6.** If you want to check whether your programming device is connected with the correct control, you can retrieve information from the connected control and select the desired control. Click on *'Accessible partners'*.
 - ⇒ The 'Search for accessible partners' dialogue window will open. 6.19 'Search for accessible partners' on page 112

If no connection can be established, check if the connection cables are connected correctly.

- **7.** Click on 'Transfer'.
 - ⇒ If the control is not in operating mode STOP, a dialogue window will open in which you can switch the control into operating mode STOP. After having carried out a transfer, a dialogue window will open in which you can switch the control into operating mode RUN again.

The hardware configuration and the user program are transferred to the control. The individual steps and results are displayed in the dialogue window. At the same time, it is displayed whether the transfer has been successful or if an error occurred.

Compile changed blocks

If you have not yet compiled changed blocks, they are listed. You can compile these blocks before transferring. Click on 'Compile' for this purpose. The changed blocks are compiled. Click on 'Transfer' again.

Searching for accessible partners.	
Load Details of Ip Address: 192.168.10.100.	
Loading the details of device with IP 192.168.10.100 was successful.	
Cancel searching for accessible partners.	

Fig. 183: Example of an transfer error

8.21 Load blocks from the device **R**

With this function, you can transfer blocks from the control to the project. The following block types can be transferred:

- Organisation blocks (OB)
- Function blocks (FB)
- Functions (FC)
- Data blocks (DB)
- Instance data block (DI)

Load blocks from the device

- System function blocks (SFB)
- System functions (SFC)

You need to create a communication connection to the control. \Leftrightarrow Chapter 6.18.2 'Communication settings (PLC)' on page 109

1. Select one of the following options:

- Menu bar: Select 'Device → Load blocks from the device'.
- Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Load blocks from the device'.
- ⇒ The dialogue window 'Importing online block from control' will open.

SPEED7 Studio attempts to create a connection to the control. The result is displayed in the dialogue window under 'Communication status'.

If no connection can be established, you cannot load the blocks from the device. Check if the connection cables are connected correctly. If required, check the communication settings. \Leftrightarrow *Chapter 6.18.2 'Communication settings (PLC)' on page 109*

- 2. Click on 'Next'.
 - ⇒ The blocks in the control are compared to the blocks in the project and displayed in a list. The block list will show which blocks are present in the project and can be overwritten or which blocks are not present in the project and can be added.

🤩 s	SPEED7 Studio Development Line										×
Import of online project											
Import of block list from PLC Blocks											
			Block Type		Number						*
	•	1	ОВ		1						
			Block	Info							
		1	OB1	Bloc	k exists in the	project and ca	an be overwritten.				
	•		FB		3						
			Block Info								
			FB1	Block	k exists in the	project and ca	an be overwritten.				
			FB100 Block exists in the project and can be overwritten.								
			FB101	Block	k exists in the	project and ca	an be overwritten.				
	►		FC		5						
	►		DB		9						-
		All b	locks								
	Request of the block list completed successfully										
							Back		i> Next	🔀 Car	ncel

Fig. 184: Load blocks from the device: Block list

3. Click on ▶ in the block list to show all blocks of one block type. Click on to hide blocks.

Select 📝 the blocks you want to load from the device into the project.

Activate 'All blocks', if you want to load all listed blocks.
Load blocks from the device

- 4. Click on 'Next'.
 - ⇒ The program code of the selected blocks is read and disassembled from the control, i.e. compiled from binary coded machine language in readable program code.

🥖 s	PEED7	7 Stu	dio Devel	opme	nt Line				×
ıpo	rt of	onl	ine proj	ject					
	Disass	emb	oling and	Testir	ig				
	Block	5							
			Block T	ype	Number				
	•	1	ОВ		1				
			Block	IL co	ode length	MC7 code length	Error message		
		1	OB1	1181		182			
			FB		1				
			Block	IL co	ode length	MC7 code length	Error message		
		1	FB1	731		98			
_	1	Ove	rwrite exis	ting b	locks				
					Disas	sembly of the blocks	completed succes	sfully.	
							🖨 Back	i> Next	🔀 Cancel

Fig. 185: Load blocks from the device: Disassembled blocks

In the block list, the size of the IL code and the MC7 machine code is shown in kByte for each compiled block.

If a block cannot be read or compiled, an error message is displayed and the applicable block is not loaded.

Compare blocks

- **5.** Click on *'Next'*.
 - ⇒ The blocks are transferred from the control to the project. Present blocks will be overwritten in this process. The result is displayed in a table.

						v
V	SPEED7 Stu	idio De	velopment Line			~
Impo	ort of on	line p	roject			
	Import ar	nd com	plete			
	Output:					
			Import	Status		
		2	Import block FB1	Block imported and overwritten successfully.		
		1	Import block OB1	Block imported and overwritten successfully.		
_				Number of blocks 2 to 2		
•				Import successful.		
				C Back	✔ Done 🛛 🗙 Ca	ancel

Fig. 186: Load blocks from the device: Result

8.22 Compare blocks 4

With this function, you can compare blocks in the control (online) with blocks in the projects (offline). The following block types can be compared:

- Organisation blocks (OB)
- Function blocks (FB)
- Functions (FC)
- Data blocks (DB)
- Instance data block (DI)

You need to create a communication connection to the control. \Leftrightarrow Chapter 6.18.2 'Communication settings (PLC)' on page 109

1. Select one of the following options:

- Menu bar: Select 'Device → Compare blocks'.
- Project tree: Right-click with the mouse button on the desired control (PLC) and select 'Compare blocks'.
- ⇒ The dialogue window 'Determine the blocks of the control' will open.

SPEED7 Studio attempts to create a connection to the control. The result is displayed in the dialogue window under *'Communication status'*.

If no connection can be established, you cannot compare the blocks. Check if the connection cables are connected correctly. If required, check the communication settings. *Chapter 6.18.2 Communication settings (PLC)* on page 109

Compare blocks

2. Click on 'Next'.

⇒ The first step of the block comparison is carried out. The blocks in the control are compared to the blocks in the project and displayed in a list. The block list displays differences in the number of blocks with the block numbers.

S	SPEED	7 Stu	dio Devel	opmei	nt Line						×
Com	paris	ion (of online	e and	offline bl	ocks					
	Impo	ort of	block list	from	PLC						
	Block	(5									
			Block T	ype	Number						
	►	1	ОВ		1	-					
			FB		3						
			Block	Info							
		1	FB1	Block	exists in the	project and o	n the control				
			FB100	Block	only exists o	on the control					
			FB101	Block	only exists o	on the control					
	►		FC		5						
	►	1	DB		9						
		All Ł	olocks								
					Req	uest of the blo	ck list compl	eted succe	ssfully		
							R	ack	Nev	+	X Cancel
								0.515			Concer

- Fig. 187: Compare blocks: Block list
- 3. ► Click on ► in the block list to show all blocks of one block type. Click on ◄ to hide blocks.

Select $\boxed{\mathbf{v}}$ the blocks you want to compare. You can only compare the blocks which are both present in the project and in the control.

Activate 'All blocks' if you want to compare all listed blocks.

Compare blocks

- 4. Click on 'Next'.
 - ⇒ The second step of the block comparison is carried out. The program code of the selected blocks is read and disassembled from the control, i.e. compiled from binary coded machine language in readable program code.

🤩 s	PEED	7 Studio Deve	lopment Line				×
Comp	paris	on of onlin	e and offline l	olocks			
	Disas	sembling and	l Testing				
	Block	s					
		Block Type	Number				
	►	ОВ	1				
		FB	1				
		Block IV	IC7 code length	Error message			
		FB1 98					
	►	DB	1				
			Dis	assembly of the bl	ocks completed su	ccessfully.	
					Back	Next	X Cancel

Fig. 188: Compare blocks: Disassembled blocks

In the block list, the size of the MC7 machine code is shown in kByte for each compiled block.

If a block cannot be read or compiled, an error message is displayed and the comparison cannot be continued.

- 5. Click on 'Next'.
 - ⇒ The content of the selected blocks is compared. The result is displayed in a table.

Watch block

Result of block comparison

4	SPEE	D7 Si	tudio Dev	/elopment	Line	2							×
Con	npari	ison	of onl	ine and (offli	ne blocks							
	Res	ult o	f block o	ompariso	n								
	Dra	ig a	column h	neader in t	his fi	eld to group the	conten	t of the colu	mn.				
			BI	ock		Code	/ Data			Inte	rface		Error
			Туре	Name		Time stamp	Size	Content		Time stamp	Size	Definition	Error
	1	۲	ОВ	OB1	۲	Ξ	Ξ	=	۲	Ξ	Ξ	=	
	2	0	FB	FB1	0	¥	¥	¥	Θ	Ξ	Ξ.	=	
	3	۲	DB	DB1	۲	Ξ	Ξ.		Θ	Ξ	≡	=	
	Ξ	= Co	nsistent	≠	= Dif	fering							
						Fin	ished co	omparing blo	ocks				
							[🗘 Back	c	🗸 D	one	Xc	ancel

Fig. 189: Compare blocks: Result of block comparison

The table shows which properties of a block match \equiv or differ \neq .

'Type' – Block type

'Name' - Block number

'Time stamp (Code/Data)' – Date and time of the last change in the program code (instruction section)

'Size (Code/Data)' – Length of the program code (OB, FB, FC) or size of the data range (DB, DI)

'Content' – Program code (instruction section)

'Time stamp (interface)' - Date and time of the last variable change (declaration section)

'Size (interface)' - Size of the declaration section, number of the variables

'Definition' - Variable declaration (declaration section)

'Error' – Error message, e.g. if it wasn't possible to compile the block

8.23 Watch block 🔜

With this function, you can watch the variables of the current block in the block editor (monitoring).

Switch block watch On/Off

The block to be watched must be present in the control.

Watch block

You need to create a communication connection to the control. & Chapter 6.18.2 'Communication settings (PLC)' on page 109

- **1.** Open the block (OB, FB, FC, DB) in the block editor.
- 2. Click on 🖳
 - ⇒ The variable values are cyclically read from the control and displayed. In monitoring mode, you cannot change the block.
- **3.** Click on **E** again.
 - ⇒ The monitoring mode is terminated.

Instruction list (IL) On the right-hand side next to each IL row, the current result of logical operation (RLO), status bit (STA) and values of the accu and status word register are displayed.

		VKE	STA	Accu 1	Status word
1	UN M 1.0	1	0	0050	00000000 00000011
2	L S5T#300MS	1	0	0030	00000000 00000011
3	SE T 1	1	0	T#000.0	00000000 00000010
4	NOP Ø	1	0	0030	00000000 00000010
5	NOP Ø	1	0	0030	00000000 00000010
6	NOP Ø	1	0	0030	00000000 00000010
7	U T 1	1	1	T#000.0	00000000 00000111
8	L S5T#200MS	1	1	0020	00000000 00000111
9	SE T 2	1	1	T#017.0	00000000 00000110

Fig. 190: Watch block in IL

You can change the display of the number values for the current block as follows:

Right-click with the mouse button on a table column and select the desired display format.

The display of binary states in the columns RLO and STA cannot be changed.

You can also apply the display to the entire project. Schapter 8.24 'Status configurations for blocks' on page 260

Function block diagram (FBD)

If you want to watch certain areas, you can highlight networks or elements.



Fig. 191: Watch block in FBD

Watch block

Group	Presentation	Meaning
element	Green	Element is run through: State TRUE
	Grey	Element is run through: State FALSE
		- or -
		Determination of the state not pos- sible
	Shaded grey	The buffer memory size is not suffi- cient to be able to display the ele- ment.
Variable value	Blue background	Variable value at the input of the ele- ment or on the right-hand side of the element

Structured Control Language (SCL)

The variable values are displayed via the variables.



Fig. 192: Watch block in SCL

Presentation	Meaning
Green	The value comes from the current cycle.
Grey	The value comes from a previous cycle.
"No data"	No value can be read from the control, e.g. if the instruc- tion has not yet been run through.

Data block (DB)

The current values are displayed in the column 'Actual value (Online)'.

Address	Name	Data type	Default value	Actual value (Offline)	Actual value (Online)
0.0	IN	BOOL	FALSE	FALSE	😵 - TRUE
2.0	PT	TIME	T#0MS	T#0MS	😵 - T#50S
6.0	Q	BOOL	FALSE	FALSE	😁 - FALSE
8.0	ET	TIME	T#0MS	T#0MS	🐑 - T#19S944MS
12.0	STATE	BYTE	B#16#00	B#16#00	S#16#01
14.0	STIME	ТІМЕ	T#0MS	T#0MS	S + T#14D21H26M54S597MS
18.0	ATIME	TIME	T#0MS	T#0MS	S - T#14D21H27M14S541MS

Fig. 193: Watch data block

Status configurations for blocks

Presentation	Meaning
Green	Data type BOOL: The current value is TRUE
Red	Current value
	- or -
	Data type BOOL: The current value is FALSE

8.24 Status configurations for blocks

Here, you can select variables for the *'Watch block'* function and set the display of the variables. You can carry out these configurations for the current block or the entire project.

Configurations for the entire project

4	PLC_01 [CPU 315-2AG13 315SB/DPM] Device overview	In the project tree, right-click with the mouse button in the desired control at 'PLC program' on 'Status configurations for blocks'.
	 Device properties Device configuration Address overview 	A dialogue window will open; see below. All configurations will be applied to the entire project.
Þ	DLC program	
Þ	Transfer user program	
	Export ASCII Sources	
	Import ASCII Sources Cross-Reference list	
	Assignment list	
	Status configurations for blocks	
	Print Preview	

Configurations for the current block or the entire project

- Click on the solution in the toolbar of the block editor.
 - A dialogue window will open; see below. In this dialogue window you can choose if the configurations are applied to the current block or the entire project.

Add watch table

Colun	nn selection –		
	Column	Remark	Display format
~	RLO	Result of logical operation	
✓	STA	Status bit	
✓	Indirect	Indirect address register	
✓	Accu 1	Default register (Accu 1)	Hexadecimal
~	Accu 2	Accumulator 2	Hexadecimal
	A-Reg. 1	Address register 1	Hexadecimal
	A-Reg. 2	Address register 2	Hexadecimal
	DB-Reg. 1	Register 1 of data block	Decimal
	DB-Reg. 2	Register 2 of data block	Decimal
~	Status word	Status word of line	Binary

Fig. 194: Status configurations for blocks

- 1. Only if called from the block editor: Select by means of *'Use project configurations'* or *'Use local configurations'* if you want to edit the project configurations or the configurations of the current block.
- **2.** Highlight \blacksquare the condition and status registers that you want to watch using the "Watch block" function.
- **3.** Select the desired *'Display format'*, if required.

If you activate the 'Save as project setting' option, configurations of the current block are applied to the entire project.

8.25 Add watch table 🖪

Variables can be watched (read) and controlled (write) in the watch table. You can set which variables of a CPU you want to read and control. If necessary, you can create several watch tables.

Add watch table

4	PLC_01 [CPU 315-2AG13 315SB/DPM]
	🕡 Device overview
	🔯 Device properties
	Device configuration
	Address overview
4	💷 PLC program
	Programmbausteine
	PLC Variablen
	 Monitoring tables
	Add watch table
	🕷 Watch table

Fig. 195: Add watch table

If a project is open and a control is included, you can add and edit watch tables.

- 1. In the project tree within a control, click on *PLC program* on *Watch tables* → Add watch table.
 - ⇒ The dialogue window 'Add watch table' will open.
- **2.** *Name'*: Enter a different name, if required.
- 3. 'Comment': Enter a comment, if required, e.g. remark or explanation
- 4. Click on 'OK'.



If you select the 'Open edit window' option and click on 'OK', the "Watch table" editor opens. Chapter 8.26 "Watch table" editor on page 262

 \Rightarrow The watch table is added and displayed in the project tree.

8.26 "Watch table" editor

Variables can be watched (read) and controlled (write) in the watch table. You can set which variables of a CPU you want to read and control.

If a project is open and a control is included, you can add watch tables. Chapter 8.25 'Add watch table **\boxed{}**' on page 261

To watch or control variables, you must create a communication connection to the control. & Chapter 6.18.2 'Communication settings (PLC)' on page 109

To open an existing watch table, in the project tree within a control double click on the desired watch table in the 'PLC program' at 'Watch tables'.

F												
•	Watch table 🖉 🖹 😢											
Ν	lame	Watch ta	able									
	Group	△ «	Operand	Alias 🗸	Format	Status value	Watch 🗌	Control Value «	Control 🗌 🔍	Data type 🛛 🖇	Туре «	Comment
÷						🛞 🕶 False		False		BOOL	Unknown	
Facility 1 MD 4 NoName		Hexadecimal	📎 - DW#16#83E54FE0	✓ DW#16#00000000			DWORD	flag				
			MD 8	NoName	Hexadecimal	♡ - DW#16#0CB8DA90	V	DW#16#0000000		DWORD	flag	
	Ungruppiert		MD 12	NoName	Real	₩ 4.917296E-12		10	V	DWORD	flag	
MD 20		MD 20	NoName	Hexadecimal	⊗ - DW#16#00D40000	1	DW#16#00000000		DWORD	flag		
			MD 20	NoName	Binary	<pre> % * 2#0000_0000_1101_0100_0000_000 </pre>	V	2#0000_0000_0000_0000		DWORD	flag	
	4											
Syste	em administrat	or - 4/15/	/2014 9:13 AM		/s7p2	20140225/PLC_01/CPU/Plc programming//V	Vatch table	une	changed 🔘 Run	ning $\Theta - \overline{V}$		- + 100%

Fig. 196: "Watch table" editor

- (1) Toolbar
- (2) Information on and configurations of the watch table
- (3) Edit watch table
- (4) Information bar

Showing/hiding input areas

You can show or hide the input areas:

- Shows/opens the input area
- Hides/closes the input area
- Hide slave objects
- Show slave objects

(1) Toolbar

- **List group / ungroup:** Presentation of the watch table grouped or ungrouped & 'Change presentation of the watch table' on page 267
- **Graphic display of the status values:** The development of the status value is shown in a time diagram in the 'Status value' column.
- **Call status value(s) on a one-time basis:** The status values are read from the control on a one-time basis and are shown in the *'Status value'* column.
- **Call status value(s) cyclic:** The status values are read from the control cyclically and are shown in the *'Status value'* column.

D	4	N	GE	R	

Danger in writing control values!

Changing variables with control values during ongoing plant operations can lead to malfunctions or programming errors that can cause serious material and personal damage!

- Ensure that no dangerous conditions can occur before you write the control values.
- Writing control value(s) on a one-time basis: The control values of the selected variables are transferred to the control on a one-time basis.
- Writing control value(s) cyclically: The control values of the selected variables are transferred to the control with each PLC cycle.

(2) Information on and configurations of the watch table

:=

Here you can change the name of the watch table, enter a comment and set the refresh rate.

Comment field: Here you can show or hide the comment field.

Refresh rate: Here you can show or hide the input field for the refresh rate. You can enter the time interval in milliseconds for the cyclical display of the status values in the *'Refresh rate'* input field.

(3) Edit watch table

In the table, you can set which variables of the CPU you want to read and control.

'1st column' - Selection area

'Group' – Sort and display table entries by group & 'Grouping variables' on page 264

'Operand' - Address of the variables

'Alias' – Symbolic address of the variables

'Format' - Display/input format of the status and control value

'Watch' - The status values are shown for the variables selected here.

'Control Value' – Value to be written in the control 😓 'Control variables' on page 267

Control' – In the control, the variables selected here are overwritten with the control value.

'Data type' – Data type of the variables & Chapter 8.5.4 'Assigning data types' on page 203

'*Type*' – Operand area of the variables, e.g. input, output, memory

Comment' – Any comment e.g. remark or explanation

Add variable

	Operand	Alias	~	Format	Status value
¢	MW40			Please select 💌	💮 🕈 False

Fig. 197: Add variable

You can perform inputs in the first line of the table. You can recognise this row by the icon \oplus .

1. Click on the input field of the 'Operand' column and enter the operand, e.g.MW 40.

- or -

If you want to use a variable from a variable table (\Leftrightarrow Chapter 8.12 "Variable table" and "Standard project configuration" editor a 'on page 229), click on the input field of the 'Alias' column and enter the alias name.

- **2.** Click on the *'Format'* column in the adjacent field and select the desired display/ input format for the status and control value, e.g. "Decimal".
- **3.** Highlight the *Watch*' column if the status value for this variable is to be shown.
- **4.** If you want to enter a comment on the variables, click on the *'Comment'* field and enter the comment.
- **5.** If you want to allocate the variable to a group, select the desired group in the *'Group'* column or enter a new group name into the input field.
- 6. Confirm your input with [Enter].
 - ⇒ The new variable is inserted into the table. If you have allocated the variable to a group, the variable is inserted within this group.

Grouping variables

You can have the table entries sorted and displayed by group.

You can create a new group along with a new variable. & 'Add variable' on page 264

You can allocate variables to a group subsequently:

- **1.** Click on the '*Group*' column and select the desired group or enter a new group name into the input field.
- **2.** Confirm your input with [Enter].
 - \Rightarrow The variable is inserted within the group.

Changing variables

You can change existing variables in the table.

Click on the input field which you want to edit. Changes can be entered directly. For some fields, changes can be made via a selection list.



Fields highlighted in grey cannot be changed.

Deleting variables



Fig. 198: (1) First column

Move variable with "Drag & drop" **1.** In the first column, highlight the variable line which you want to delete.

2. Press [Del].

A dialogue window will open, where you can select whether you want to delete the variable.

- \Rightarrow The variable is deleted and removed from the table.
- **1.** In the first column, highlight the variable line which you want to move.
- 2. Press and hold the mouse button while dragging the line to the desired position.
 - \Rightarrow The variable line is inserted.

Copy variable with "Drag & drop"

- **1.** In the first column, highlight the variable line which you want to copy.
- **2.** Press and hold the mouse button and the key *[Ctrl]* while dragging the line to the desired position.
 - ⇒ The variable line is copied and inserted. The new variable has the same properties as the initial variable. The operand is adopted and numbered consecutively.

Move several variables with "Drag & drop"

- **1.** Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the first column.
 - or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- **2.** Press and hold the mouse button while dragging the lines to the desired position.
 - \Rightarrow The variable lines are inserted.

Copy several variables with "Drag & drop"

1. Press and hold the key *[Ctrl]* while highlighting all desired variable lines in the first column.

- or -

In order to highlight a row of variable lines, press and hold the key [shift] and click on the second column of the first and the last line.

- **2.** Press and hold the mouse button and the key *[Ctrl]* while dragging the lines to the desired position.
 - ⇒ The variable lines are copied and inserted. The new variables have the same properties as the initial variables. the operands are adopted and numbered consecutively.



Inputs can be watched but not controlled. Outputs can be controlled but not watched.

Watch variables

Status value	Watch	
😵 🕶 False		
- DW#16#FB2D5DCA	\checkmark	
- DW#16#0018B153	1	

Variables can be watched (read) in the watch table. For this, a communication connection must be created with the control.

1. In the 'Watch' column, highlight variables you want to watch.

If you highlight with the title row of the 'Watch' column, all variables in the table are watched.

2. Click on **mathemath** the data from the control on a one-time basis.

- or -

Click on botto read the data from the control cyclically.

⇒ The data are shown in the 'Status value' column.

Presentation	Meaning
Green	Trend display: The value increases
Red	Trend display: The value decreases



If you activate the graphical display of the status values key, the development of the status value is shown in a time diagram.

Control variables

Variables can be controlled (written) in the watch table. For this, a communication connection must be created with the control.

DANGER!



Danger in writing control values!

Changing variables with control values during ongoing plant operations can lead to malfunctions or programming errors that can cause serious material and personal damage!

- Ensure that no dangerous conditions can occur before you write the control values.
- **1.** In the 'Control' column, highlight **v** all the variables you want to control.

If you highlight with title row of the 'Control' column, all variables in the table are watched.

- **2.** Enter the desired control value for all the highlighted variables in the input field of the *'Control Value'* column.
- 3. Click on so to write all the control values in the control on a one-time basis.

- or -

Click on sto write all the control values in the control with each PLC cycle.

⇒ The data are shown in the 'Status value' column.



Before control values are transferred to the control and are written there, a security notice will open and you can stop the process. If you activate the option "Don't show message again", this security notice does not open anymore and control values are written in the control immediately without enquiry.

Change presentation of the watch table

You can present the watch table grouped or ungrouped:

Click on solution.

In the grouped presentation, you can show or hide entire groups:

- Hide slave group
- Show slave group

8.27 Logic analysis 👷

8.27.1 Overview



This function is only included in the license SPEED7 Studio PRO and not in the license SPEED7 Studio BASIC.

With the logic analysis, you can record the signals of a control for each cycle.

Logic analysis > Overview



Fig. 199: Logic analysis

- (1) Control and block
- (2) Toolbar
- (3) Records
- (4) Cursors

- (5) Information about the record
- (6) Point in time/period of the record
- (7) Zoom-bar
- (8) Operand table

(1) **Control and block** Here, you can select the control and the program block for the logic analysis.

(2) Toolbar

- Commands you need for executing the logic analysis, are provided in the toolbar.
- Start recording: Starts recording the signal states.
- Stop recording: Terminates recording the signal states.
- **Configurations:** Opens the dialogue window configuration for the logic analysis.
- **Show main cursor:** Shows/hides the cursor to read a point in time.
- **Show the secondary cursor:** Shows/hides the cursor for time measurements.
- Live display: The display will automatically create an afterimage during recording as soon as the recorded signals exceed the visible area.
- Show all nodes: Scales the visible area in a way that all recorded signals are visible.
- Delete all nodes: Deletes all recorded signals.

Logic analysis > Carry out logic analysis

۵ <u>۹</u>	Load recording: Opens a stored record. & Chapter 8.27.10 'Saving and opening a record: 🍇 🙀 on page 276
	Save recording: Saves the last record onto a data carrier. & Chapter 8.27.10 'Saving and opening a record: 🍇 🙀 ' on page 276
	Delete all (reset): Deletes the operand table and all recorded signals.
0	Show additional information: Shows/hides information about the record.
(3) Records	In the upper record area, all operands are recorded which are bigger than one bit) e.g. BYTE; WORD). The records are shown as line diagrams.
	In the lower record area, all bit operands are recorded (e.g. single inputs/outputs).
(4) Cursors	You can show two cursors within the recorded diagrams. You can move the cursors in order to read the point in time or to measure the time.
	🏷 Chapter 8.27.6 'Show time 🂵' on page 272
	🌣 Chapter 8.27.7 'Measure a period of time 🎚 ' on page 273
(5) Information about the record	Displays information about the status, the number of signals and time and duration of the current record.
(6) Point in time/period of the record	Displays time of day from the control at the moment of the record.
(7) Zoom-bar	With the zoom-bar, you can change the section from the record.
	& Chapter 8.27.8 'Change section' on page 274
(8) Operand table	You can determine operands to be recorded.
-	& Chapter 8.27.3 'Edit operand table' on page 270

8.27.2 Carry out logic analysis

In order to carry out a logic analysis, proceed as follows:

- **1.** Create and compile the user program. *Chapter 8.18 'Compile user program'* on page 245
- **2.** Transfer the hardware configuration and the user program to the control. Schapter 8.20 'Transfer the hardware configuration and user program to the control' on page 248
- 3. ▶ Open the logic analysis via 'View → Logic analysis'.
- **4.** Select the control and the program block for the logic analysis. (4) *Control and block' on page 268*
- 5. Add operands. & Chapter 8.27.3 'Edit operand table' on page 270
- 6. Make configurations on the logic analysis, if required, e.g. adapting the ring buffer size. & Chapter 8.27.11 'Make configurations 'on page 276
- 7. Start recording. & Chapter 8.27.4 'Start recording 3' on page 271
 - ⇒ Signals are read from the control in each program cycle and are displayed as diagram.

Logic analysis > Edit operand table

- 8. Terminate recording. & Chapter 8.27.5 'Stop recording 3' on page 272
- **9.** If required, determine the point or period of time for a record.
 - 🖏 Chapter 8.27.6 'Show time 🂵' on page 272
 - ♦ Chapter 8.27.7 'Measure a period of time 1.27' on page 273

8.27.3 Edit operand table

In the operand table, you can determine operands to be recorded. The following operand areas can be recorded:

- Inputs (E)
- Outputs (A)
- Memory (M)
- Data ranges (D)
- Timers (T)
- Counter (Z)

⊿	Visible	Address	Туре	Symbol	Value	Unit	Min	Max	Average	Colour	Width
•	J	MW20 🗎	INT		196		0	255		#FFA500 🔻	
•	1	тз 🔒	INT		49		49	50		#6B8E23 •	—
	1	A4.0 🔒	BOOL		FALSE		FALSE	TRUE		#87CEFA •	

Fig. 200: Operand table

💊 – Move operands, change order 🏷 'Move operands, change order' on page 271

'Visible' - Show/hide recorded diagram

'Address' – Address of the operand

'Type' - Data type of the operand

'Value' 'Symbol' - Symbolic name of the operand

 Current value of the operand during a record or value of the operand at the current cursor position (not editable)

'Unit' - Any measuring unit, e.g. volt, litre, metre, etc.

'Min.' - Smallest value of the operand within the record (not editable)

'Max.' – Biggest value of the operand within the record (not editable)

'Average' - Average value of the operand within the record (not editable)

'Colour' - Colour of the operand in the diagram of the record

'Width' - Line width of the operand in the diagram of the record

Add operands

Each line in the operand table can contain one operand.



1. Double-click on the empty input field in the 'Address' column.

- or -

Highlight the input field and press [F2] in order to edit the field.

2. Enter an operand, e.g. A4.0, EB8, MW20, T1.

3. Press [Enter].

⇒ The operand and the matching data type are entered into the table line. In the column *'Colour'*, the colour for the diagram of the record is determined.

Logic analysis > Start recording

- **4.** If required, you can change further configurations, e.g. change colour or line width.
- 5. Finish your input with [Enter].
 - \Rightarrow A new (empty) line will be added to the operand table.

	 If recording is active or if data has already been recorded, you cannot edit, delete of move operands. In the input field 'Address', the symbol a is displayed. In order to be able to edit, delete or move operands, finish the record with and delete all recorded data with a. % '(2) Toolbar' on page 268
Deleting operands	1. Click into the operand line you want to delete.
	 2. ▶ Press [Del]. ⇒ The operand line is removed from the table.
Deleting all operands	Click on the button. ఈ '(2) Toolbar' on page 268 ⇒ The operands are removed from the table.
Move operands, change order	
	Click in the operand line you want to move onto the symbol button pressed down.
	2. Move the operand line upwards or downwards to the desired position.
	3. Release the mouse button.
	⇒ The operand line is moved. The order of the operand in the recording area is changed.
Show/hide operands	You can show or hide operands. & Chapter 8.27.9 'Show/hide operands' on page 276
8.27.4 Start recording	8
	To record signals, you must create a communication connection to the control. <i>Chapter</i> 6.18.2 <i>Communication settings (PLC) on page 109</i>
	Click on the 🍇 button.
	Additional program blocks are transferred to the control. With these blocks, the recorded values are entered into a ring buffer and read.
	The record is started. Signals are read from the control in each program cycle and are displayed in a diagram.
Memory overflow	If values are written faster than they are read, the ring buffer will flow over. Overflows are highlighted in red in the diagram and the zoom-bar.

Logic analysis > Show time



Fig. 201: Overflow of the ring buffer

To prevent memory overflows, increase the *'cyclic device time'* or the *'size of the ring buffer'*. *Chapter 8.27.11 'Make configurations* 'on page 276



In case of time-critical applications, not all overflows are highlighted in red in the diagram and the zoom-bar.

8.27.5 Stop recording 😹

Click on the Solution.

 \Rightarrow The record is stopped.

The original user program – without additional program blocks for the ring buffer – is restored in the control.

8.27.6 Show time 🕒



Fig. 202: Show and move cursor

Logic analysis > Measure a period of time

In order to show a point in time within a record, use the cursor.

- **1.** Click on one of the two buttons **1**.
 - \Rightarrow A cursor is shown.
- **2.** Drag & drop the cursor to the left or right to the desired position.
 - At the lower end, date and time from the control of the current cursor position is shown.

In the record and in the column *'value'* in the operand table, values of the current cursor position are shown for each operand.



8.27.7 Measure a period of time 🎚



Fig. 203: Show and move cursors

In order to measure the time within a record, you can use both cursors.

- 1. Click on the left libutton.
- **2.** Click on the right **button**.
 - \Rightarrow Both cursors are shown.
- **3.** Drag & drop the cursors to the left or right to the desired position.
 - ⇒ At the lower end, date and time from the control of the current cursor position is shown.

In addition, *'Diff:'* shows the time difference between both cursors. *'Frequency:'*, shows the frequency in hertz.

Logic analysis > Change section



8.27.8 Change section

With the zoom-bar, you can change the visible area (y-axis) in the record.



Fig. 204: Zoom-bar

- (1) Visible area for the record
- (2) Not visible area for the record
- (3) Slider left
- (4) Slider right
- (5) Cursors (measure a period of time)

Move visible area



Fig. 205: Move visible area

- **1.** Right-click with the mouse in the recorded diagram hold the mouse button pressed down.
- **2.** Drag the mouse to the left or right to the desired position.
- **3.** Release the mouse button.

- or -

- **1.** Click in the zoom-bar into the visible area (light grey) and hold the mouse button pressed down.
- **2.** Drag the area to the left or right into the desired position.
- **3.** Release the mouse button.

- or -

Right-click with the mouse button in the zoom-bar on the desired position.

Change size of the section (resolution)

Rotate the mouse wheel in the recorded diagram upwards, in order to extend the visible area.

Rotate the mouse wheel in the recorded diagram downwards, in order to compress the visible area.





Fig. 206: Change size of the section

- **1.** Click to the desired position in the recorded diagram and hold the mouse button pressed down.
- **2.** Drag the mouse to the left or right until the desired section size is reached.
 - \Rightarrow The section is marked in grey.
- **3.** Release the mouse button.
 - \Rightarrow The visible area is stretched.

- or -

- **1.** Click in the zoom-bar on one of both sliders and hold the mouse button pressed down.
- **2.** Drag the slider to the left or right.
- **3.** Release the mouse button.
 - \Rightarrow The visible area is compressed or stretched.

Show the entire record

Double-click on the recorded diagram.

 \Rightarrow The diagrams are compressed to the length of the record.

Logic analysis > Make configurations

Change the height of the diagrams



You can change the height of the diagrams (y-axis) of the upper recording area.

Fig. 207: Change the height of the diagrams

- **1.** Click on the line between both recording areas and hold down the mouse button.
- **2.** Drag the line upwards or downwards.
- **3.** Release the mouse button.
 - ⇒ The diagrams are compressed or stretched.



You can change sections already during recording. You should switch off the live display function for this purpose. \Leftrightarrow '(2) Toolbar' on page 268

8.27.9 Show/hide operands



Click in the upper recording area or in the operand table in the column *'visible'* on or .

 \Rightarrow The diagram of the recorded operand is hidden or shown.

8.27.10 Saving and opening a record: 🍇 🝇

A record will remain only until the project is closed or *SPEED7 Studio* is closed. If you want to use the recorded logic analysis even afterwards, save it and reopen it.

____ Click on the 🙀 button in order to save the active record.

Click on the M button in order to open a saved record.

8.27.11 Make configurations 📷

Before starting a recording, you can configure the logic analysis.

- ____ Click on the 🐜 button.
 - \Rightarrow The dialogue window for configuration will open.

General configurations 'Active device' – Shows the selected control for the logic analysis (4) (1) Control and block' on page 268

Logic analysis > Make configurations

'Recording task (OB)' - Organisation block for recording the logic analysis



Danger when changing the cyclic device time!

Changing the cyclic device time will lead to longer program processing times and might cause malfunctions or program errors that can cause serious material and personal damage!

 Ensure that no dangerous conditions can occur before you set the cyclic device time bigger than 0 ms.

'Cyclic device time' – Cycle time of the control in milliseconds: Increase the cyclic device time when memory overflows occur during recording.

Size of the ring buffer' – Size of the ring buffer for records in byte: Increase the ring buffer when memory overflows occur during recording.

'Evaluate signals at least once per second' – If the signal state of an operand does not change during the record, the diagram draws no line for this signal. Activate this option if you want to draw a line nevertheless.

Trigger configurations You can define the start and duration of the record with a defined event (trigger signal). (*trigger definition' on page 277*)

'Activate trigger' - Enable/disable trigger function:

- On: Recording starts when the defined event occurs after you have clicked on the button.
- Off: Recording starts immediately, when you have clicked on the Statts button.

'Activate pre-trigger' – Record and show the progression of the signals before the trigger event

'Number of PLC cycles' – Number of PC cycles which should be recorded and shown before the trigger event

'Activate post-trigger' – Record and show the progression of the signals after the trigger event

'Number of PLC cycles' – Number of PC cycles which should be recorded and shown after the trigger event

Trigger definition

You can define the event for the trigger signal here. You can enter logical operations. The record is started if the result of the logical operation (RLO) is 1 (TRUE). The record is stopped if the result of the logical operation (RLO) is 0 (FALSE).

- 1. Under 'operation', select the linking operation "And" or "Or".
- **2.** In order to negate the logical operation, activate the option 'negate'.
- **3.** Under *'trigger source'*, select the desired operand for the logical operation.
 - \Rightarrow The logical operation is shown under 'Step7 command'.
- **4.** If you want to enter further conditions click on the '+' button.
 - \Rightarrow A new line for further logical operations is added.

If you disable the 'Active' option in a logical operation line, this line is not analysed.

8.28 Import an S7 program 🛼

With this function, you can import Siemens STEP[®]7-Programs or WinPLC7 projects. Only the program blocks are imported but not the hardware configuration.

If you want to import an S7 program, a project must be open and a control must be contained in the project.

- **1.** In the project tree, right-click with the mouse button in the desired control at *'PLC program'* on *'Import S7 program'*.
 - ⇒ The dialogue window '*Import S7 program*' will open.
- **2.** Under *'Project path'*, select the directory and the project (S7P file) or the library (S7L file). Click on *'Next'*.
- 3. Select the station if necessary and click on 'Next'.
- **4.** Choose blocks to import. If existing blocks in your project are to be replaced by imported blocks, select the option *'Overwrite existing blocks'*. Click on *'Next'*.
 - ⇒ The import process is started and the program blocks are imported. The individual steps and results are shown in the dialogue window.
- 5. Click on 'Done'.

8.29 Export ASCII sources 📑

You can export the user program in ASCII format in order to e.g. edit it with any text editor. You can save the blocks and the variable table of the user program in an export file in ASC or SEQ format.

If you want to export a user program, a project must be open and a control must be contained in the project.

- **1.** In the project tree, right-click with the mouse button in the desired control at *'PLC program'* on *'Export ASCII sources'*.
 - \Rightarrow A dialogue window will open.



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Export ASCII Sources	×
PLC_01 [CPU 315-2AG13 315SB/DPM] - Export of the block IL sources	
Export path selection	
Choose export path:	
C:\Users\Public\Documents	A
Operand export mode Absolute Symbolic summarize export Write all IL sources to single file Enter the file name: AWL Export the symbolic tables	
🖓 Back 💫 Next 🎽	Cancel

Fig. 208: Export ASCII sources: Export path and further options

2. Under 'Choose export path', select the directory where the files should be exported to.

3. Select further options, if required:

'Operand export mode' – The operands can be exported as absolute address or with the symbol name.

If you want to export all blocks into one file, enable the option *'Write all IL sources to single file'* and determine a file name. If you want to export the blocks into several files, don't enable this option. The file name of the export files is a combination of the block name and the block number.

If you enable the option 'Export the symbolic tables', the variable tables are exported into a file.

- 🗞 8.13 "System hardware configuration" editor 📷
- § 8.12 "Variable table" and "Standard project configuration" editor m.
- 4. Click on 'Next'.
 - ⇒ If you have enabled the option 'Export the symbolic tables', the variable tables are read and displayed.
 ♦ 'Import and select symbol tables' on page 280

If you have not enabled the option *'Export the symbolic tables'*, the block files are read and displayed. *'Import and select block sources' on page 281*

Import and select symbol tables

V	Export ASCII Sources								×	
PLC_(01 [C	PU 3	15-3	2AG13 3155	B/D	PM] - E	хро	orto	of the block IL sources	
	Impo	rt the	sym	bol tables						
	LIST OT	symi	DOITZ	ables:		NI 1		~		~
			-	Name		Numbe	er	Cor	mment	
	•	1	~	Hardware symb	ools	42		List	of Hardware symbols	
				Symbolic	Ор	erand	Тур	e	Comment	
			✓	x_DO_0_0_539	A 0.	0	вос	DL	A 0.0 - DO8xDC24V 0,5A [Device: DP_Slave_001, Slot: 2, Rack: 0]	
			✓	x_DO_0_1_539	A 0.	1	вос	DL	A 0.1 - DO8xDC24V 0,5A [Device: DP_Slave_001, Slot: 2, Rack: 0]	
			✓	x_DO_0_2_539	A 0.	2	вос	DL	A 0.2 - DO8xDC24V 0,5A [Device: DP_Slave_001, Slot: 2, Rack: 0]	
			✓	x_DO_0_3_539	A 0.	3	вос	DL	A 0.3 - DO8xDC24V 0,5A [Device: DP_Slave_001, Slot: 2, Rack: 0]	
			✓	x_DO_0_4_539	A 0.4	4	вос	DL	A 0.4 - DO8xDC24V 0,5A [Device: DP_Slave_001, Slot: 2, Rack: 0]	
	L					-	P.0/		A.G.C. DOB-DC2484.0 EA (Devices DD Claus 201 Clash 2 Device 01	\sim
	1	Select	t all s	ources						
		Overv	vrite	existing files						
	Name	of ex	port	file:	Sym	bols			ASC -	
										_
							mpo	rt co	ompleted successfully	
									Gancel	

Fig. 209: Export ASCII sources: Import and select symbol tables

1. Click in the list of the symbol tables on ▶, in order to display all symbols of one area. Click on to hide symbols.

Select I the symbols you want to export.

Activate 'Select all sources' if you want to export all listed symbols.

If you enable the option 'Overwrite existing files', already present export files are overwritten. If you don't enable this option, present files remain unchanged – the symbol tables are not exported.

- **2.** Enter a file name for the export file of the symbols. If required, select the file type 'ASC' or 'SEQ'.
- 3. Click on 'Next'.
 - \Rightarrow The block files are read and displayed.

Import and select block sources	Export A	SCII Sources X
	PLC_01 [CP	U 315-2AG13 315SB/DPM] - Export of the block IL sources
	Import	of block sources
	List of b	lock sources:
		Type Number
	•	/ V OB 1
		Source Symbolic Size IL
		✓ OB1 Main 1158
	•	✓ FB 1
	•	✓ DB 1
	I Se	elect all sources
	0	verwrite existing files
		Import completed successfully
		Cancel
L		

Fig. 210: Export ASCII sources: Import and select block sources

1. Click in the list of the block sources on ▶, in order to display all blocks of one area. Click on to hide blocks.

Select 📝 the blocks you want to export.

Activate 'Select all sources' if you want to export all listed blocks.

If you enable the option 'Overwrite existing files', already present export files are overwritten. If you don't enable this option, present files remain unchanged – the block sources are not exported.

Know-how-protected blocks cannot be selected and exported.

Message Status 4 Export of source DB1 Successfully completed 3 Export of source CB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	wport ASCII Sources I [CPU 315-2AG13 315SB/DPM] - Export of the block IL sources xport and completion Nutput: 0/utput: 4 Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of source OB1 Successfully completed 1 Export of source OB1			
ICPU 315-2AG13 315SB/DPM] - Export of the block IL sources sport and completion atribut: atribut: 4 Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	I [CPU 315-2AG13 315SB/DPM] - Export of the block IL sources xport and completion Dutput: Value 4 Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	xport ASC	SCII Sources	
sport and completion utput: utput: Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	Apport and completion utput: utput: 4 Export of source DB1 4 Export of source DB1 3 Export of source FB1 2 Export of source OB1 1 Export of symbol tables 1 Export of symbol tables	I [CPU	U 315-2AG13 315SB/DPM] - Export of the block IL sources	
Appendix and completion at point of source DB1 Status 4 Export of source DB1 Successfully completed 3 Export of source DB1 Successfully completed 2 Appendix for source OB1 Successfully completed 1 Export of source OB1 Export source Specific Completed	weight completion automatical completion Automatical complete Message Status Image: Automatical completed Successfully completed Successfully completed Image: Automatical completed Successfully completed Successfully completed			
utput: Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	Dutput: Message Status Image: Image: Status	xport an	and completion	
Message Status 4 Export of source DB1 Successfully completed 3 Export of source OB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	Message Status 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed.	Output:		
 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed. 	 4 Export of source DB1 Successfully completed 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed. 		Message Status	
 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed. 	 3 Export of source FB1 Successfully completed 2 Export of source OB1 Successfully completed 1 Export of symbol tables Export successfully completed. 		4 Export of source DB1 Successfully completed	
 Export of source OB1 Successfully completed Export of symbol tables Export successfully completed. 	 Export of source OB1 Successfully completed Export of symbol tables Export successfully completed. 		3 Export of source FB1 Successfully completed	
1 Export of symbol tables Export successfully completed.	1 Export of symbol tables Export successfully completed.		2 Export of source OB1 Successfully completed	
			1 Export of symbol tables Export successfully completed.	
Export source 3 of 3	Export source 3 of 3		Export source 3 of 3	

Fig. 211: Export ASCII sources: Exported symbol tables and blocks

2. Click on 'Next'.

- ⇒ The export process is started and the symbol tables and block sources are exported. The individual steps and results are shown in the dialogue window.
- 3. Click on 'Done' to close the dialogue window.

8.30 Import ASCII sources 📑

You can import blocks and variable tables of the user program that have been created in ASC or SEQ format, into the project.

If you want to import a user program, a project must be open and a control must be contained in the project.

- **1.** In the project tree, right-click with the mouse button in the desired control at *PLC program*' on *'Import ASCII sources*'.
 - ⇒ A dialogue window will open.



Import ASCII Sources	×
PLC_01 [CPU 315-2AG13 315SB/DPM] - Import of external IL sources	
Selection import nath	
Selection import path	
Choose import path:	
C:\Users\Public\Documents	A
Import symbol source	
Choose import path: C:\Users\Public\Documents ASC - 🕅	
Gack Next	Cancel

Fig. 212: Import ASCII sources: Import path and further options

- **2.** Under 'Choose import path', select the directory where the ASCII files are stored.
- **3.** Enable *'Importing symbols'* if you want to import variable tables on top of the program blocks. If required, select another directory and the file type *'ASC'* or *'SEQ'*.
- 4. Click on 'Next'.
 - ⇒ If you have enabled the option 'Importing symbols', the variable tables are read and displayed.
 ♦ 'Import and select symbol tables' on page 284

If you have not enabled the option *'Importing symbols'*, only the block files are read and displayed. \Leftrightarrow *'Import and select block sources' on page 285*

Import and select symbol tables

Impo List o	rt the f syml	e sym bol ta	bol tables ables:								
			Name			Number	Comment				
•	1	✓	Symbols.ASC -	Program symt	ools 4	7	List of Prog	ram symbols			
			Symbolic	Operand	Туре	Comn	nent				
		✓	x_DO_0_0_539	A 0.0	BOOI	A 0.0 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		✓	x_DO_0_1_539	A 0.1	BOOI	A 0.1 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		✓	x_DO_0_2_539	A 0.2	BOOI	A 0.2 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		✓	x_DO_0_3_539	A 0.3	BOOI	A 0.3 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		✓	x_DO_0_4_539	A 0.4	BOOI	A 0.4 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		✓	x_DO_0_5_539	A 0.5	BOOI	A 0.5 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
		~	x_DO_0_6_539	A 0.6	BOOI	A 0.6 -	DO8xDC24V	0,5A [Device:	DP_Slave_001,	Slot: 2, Rack: 0]	
1	Selec Over	t all s write	ources all symbols								
					mport	complete	d successful	ly			

Fig. 213: Import ASCII sources: Import and select symbol tables

1. Click in the list of the symbol tables on ▶, in order to display all symbols of one area. Click on to hide symbols.

Select ve the symbols you want to import.

Enable 'Select all sources' if you want to import all listed symbols.

If you enable the option 'Overwrite existing files', already present variable tables in the project are overwritten. If you don't enable this option, present symbols remain unchanged – the symbol tables are not imported.

If the symbol names are already allocated in the project, an error message is displayed. In this case, continue as follows:

- Disable the symbols already allocated in the project and continue with the import procedure. The disabled operands are not imported.
 - or -
 - Abort the import procedure. Manually change all symbol names in the project which have already been allocated. Then restart the import procedure. All operands are imported.

2. Click on 'Next'.

 \Rightarrow The block files are read and displayed.

Import	and	sel	ect	bl	oc	k
source	S					

1	Import ASCII Sources							×	
PLC_(PLC_01 [CPU 315-2AG13 315SB/DPM] - Import of external IL sources								
	Import of block sources								
	List of block sources:								
			•	Туре	Number				
	•		v	ОВ	1	_			
			4	Source	Version	Size IL	File path		
		ŀ	v	DB1	1.0	1104	C:\Users\Public\Documents\OB1.AWL	L	
	•		₹.F	В	1				
			1	Source	Version	Size IL	File path		
		•	✔ F	·B1	0.0	216	C:\Users\Public\Documents\FB1.AWL		
	•	6		рв	1				
				Source	Version	Size IL	File path		
		•		DB1	1.0	102	C:\Users\Public\Documents\DB1.AWL		
	1	Select a Overwr	ill sou	urces disting fi	les				
						Impo	ort completed successfully		
							Gack 🖨	Next X Canc	el

Fig. 214: Import ASCII sources: Import and select block sources

1. Click in the list of the block sources on ▶, in order to display all blocks of one area. Click on to hide blocks.

Select 📝 the blocks you want to import.

Enable 'Select all sources' if you want to import all listed blocks.

If you enable the option 'Overwrite existing files', already present program blocks in the project are overwritten. If you don't enable this option, present blocks remain unchanged – the block sources are not imported.

\supset	Know-how-protected blocks cannot be selected and imported.

Install block library

Import ASC	II Sou	irces		×
1 [CPU :	315-	2AG13 315SB/DP	M] - Import of external IL sources	
mport an	d con	nplete		
Output:				
		Message	Status	
	3	Import block FB1	Block imported and overwritten successfully.	
	2	Import block OB1	Block imported and overwritten successfully.	
	1	Import block DB1	Block imported and overwritten successfully.	
			Number of blocks 3 to 3	
			Import successful.	1
			Back 📃	Done X Cancel
			1- book	v concer

Fig. 215: Import ASCII sources: Imported symbol tables and blocks

2. Click on 'Next'.

- ⇒ The import process is started and the block sources and symbol tables are imported into the project. The individual steps and results are shown in the dialogue window.
- **3.** Click on *'Done'* to close the dialogue window.

8.31 Install block library 🔛

You can install blocks from libraries and add them to the catalog. You can then use these blocks in your projects.

Install block library

If you want to install libraries, a project must be opened.

- **1.** ▶ Select in the menu bar '*Extras* → *Install block library*'.
 - ⇒ The 'Installing libraries' dialogue window will open.
- **2.** Under *'Project path'*, select the directory and the library (S7L file) or a Simatic project (S7P file). Click on *'Next'*.
 - \Rightarrow The packages and/or stations available in the library are displayed.
- **3.** Select the desired package and/or the desired station. If symbolic identifiers from the library are to be adopted into the project, select the option *'Install symbols'*. Click on *'Next'*.
 - \Rightarrow If symbol tables are entered into the library, these are displayed.
- 4. If necessary, select the symbols you want to install. Click on 'Next'.

Install block library

- 5. If necessary, select the blocks you want to install. Click on 'Next'.
 - ⇒ The import process is started and the libraries are imported. The individual steps and results are shown in the dialogue window.
- 6. Click on 'Done'.
 - ⇒ The libraries are installed in the SPEED7 Studio catalog.

Use installed blocks

X Catalog	↓ ‡	×	
Components	Blocks	•	•
i= := .			
A SearchText			×
Building Con	trol Library [1.0]		
👂 📆 VIPA Standar	rd Library [1.0]		
▷ 🎛 CP240_HTB_	FB [1.0]		
MicroPLC [1.	0]		
WLD [1.0]			

- **1.** Open the desired block group in the '*Blocks*' register of the catalog.
- **2.** Drag the desired block into the '*Program blocks*' section of the project tree.
 - \Rightarrow The block is added to the current project.

"Device overview" editor (HMI device)

9 Creating a visualisation

9.1 HMI, WebVisu and Movicon projects

	In HMI or <i>WebVisu</i> projects, you can edit images using a graphic editor. Ready-made ele- ments provided in a library allow for very easy design. You can also create elements or import graphics and manage them in the library. All texts in the images can be translated into multiple languages.
	Alternatively, you can create an HMI device with the Movicon functionality. A Movicon project can be edited in an external Movicon application.
HMI projects	In an HMI project, you can create and edit the visualisations for HMI devices.
	Before you create a visualisation, you need to add an HMI device to the project, create configuration settings and edit the variable table. For this, please see the following chapters:
	 Chapter 6.4 'Add new device (HMI)' on page 79 Chapter 9.3 "Device properties" editor (HMI device) a' on page 289 Chapter 9.4 "Standard variables table" editor a' on page 292
<i>WebVisu</i> projects	You can create and edit <i>WebVisu</i> projects if the control has an integrated web server for web visualisation.
	Before you create a visualisation, you need to create configuration settings and edit the variable table. For this, please see the following chapters:
	 Chapter 6.18.3 'WebVisu Configuration (PLC)' on page 111 Chapter 9.4 ''Standard variables table" editor an page 292
Movicon projects	You can create an HMI device with the Movicon functionality. For this, please see the fol- lowing chapters:
	 Ghapter 6.4 'Add new device (HMI)' on page 79 Chapter 6.4.1 'Movicon project configurations' on page 82
	If you want to edit the Movicon project subsequently, please see the following chapters:
	 Chapter 9.14 'Movicon projects' on page 312 Chapter 9.4 '"Standard variables table" editor and a page 292

9.2 "Device overview" editor (HMI device) @

This editor is only available for HMI devices.

In the *'Device overview'* editor, images of the HMI device are displayed in a table. Here you can change the name, the image title and the image description of the image.

If a project is opened and an HMI device is included, you can open the *'Device overview'*:

Project tree: Click on 'Device overview' in the HMI.
"Device properties" editor (HMI device)

1 н	MI_01 [TP 6	52M-JEE0]-De	evice overview	
Name 🛆	Image title	Width (Pixel)	Height (Pixel)	Image description
Diagnosis	Diagnosis	800	600	Diagnosis and errors
Facility	Facility	800	600	Production overview
Main	Main	800	600	Start screen
Status	Status	800	600	Production screen

Fig. 216: Device overview of an HMI device

Name' – Image name: With this name, the image is displayed in the project tree.

Click on the image name for change.

'Image title'

Click on the image title for change.

'Width (Pixel)' and *'Height (Pixel)'* – The image size depends on the screen resolution of the HMI device and cannot be changed.

'Image description' - Any comment e.g. remark or explanation

____ Click on the image description for change.

Changing the sort sequence

Г				_	
	Name	N	Image title		Width (Pixel
	Facility	S	Main		800
	Diagnosi	s	Diagnosis		800

You can sort the images in the device overview in alphabetical order according to image names or image titles.

- ▶ Click on the 'Name' or 'Image title' field in the title row of the table.
 - \Rightarrow The table entries are sorted in alphabetical order:
 - Alphabetically in ascending order
 - Alphabetically in descending order

9.3 "Device properties" editor (HMI device) 场

This editor is only available for HMI devices.

General information on and configurations of the HMI device are displayed in the 'Device properties' editor. Here you can change the device name and the comment as well as make communication settings and further configurations.

If a project is opened and an HMI device is included, you can open the 'Device properties':

- **Project tree:** Click on *'Device properties'* in the HMI.
- "Devices and networking" editor :: Right-click with the mouse button on the HMI device and select 'Device properties'.

"Device properties" editor (HMI device) > Communication settings



The 'Device properties' editor is divided into three sections.

9.3.1 General device properties

To display or change the device properties of the HMI device, you must proceed as follows:

You have accessed the *'General'* section in the *'Device properties'* editor of the HMI device. \Leftrightarrow Chapter 9.3 "Device properties" editor (HMI device) **'** on page 289

	Device type:	TP 62M-JID0-CX	
UIN	Name:	HMI_01	
	Author:	Admin	
omment:			

Fig. 217: Device properties of an HMI device

'Device type' - Name of the HMI device

'Name' - Device name: The name is displayed in the project tree.

'Author' - Name of the responsible person who created the block

'Comment' - Any comment e.g. remark or explanation

Click on the input field and enter any comment, e.g. an annotation or explanation. With the *[Enter]* key, you can add a new line to the input field.

9.3.2 Communication settings

The communication settings are used to configure the interface for the data exchange between the programming device and the HMI device.

For communication settings, you must proceed as follows:

"Device properties" editor (HMI device) > Configurations

You have accessed the 'Communication' section in the 'Device properties' editor of the HMI device. Schapter 9.3 "Device properties" editor (HMI device) on page 289

Communication co	nfigurations	
Active pc interfac	Ethernet interface	* 🕹 Verify connection
Properties of eth	ernet interface	
PC interface:	VMware Virtual Ethernet Adapter for VMne	et1 *
	192.168.88.1	
HMI interface:	IP address	Subnet mask
	192.168.0.1	255.255.255.0

Fig. 218: Communication settings

- **1.** *Active PC interface*': interface for the data exchange between the programming device and the HMI device
- **2.** *PC interface*': Select the network adapter for the communication connection from the list.
 - ⇒ If an IP address is already configured in the network adapter, it is shown under the input field.
- 3. 'HMI interface': Select the desired interface of the HMI device from the list.
 - ⇒ If an IP address is already configured in the HMI device, it is shown under the input field.
- **4.** In order to check whether a connection between the programming device and the HMI device can be established with the selected communication setting, click on *'Verify connection'*.
 - ⇒ You can see in the status line, whether the connection could be established successfully.

9.3.3 Configurations

Here you can change further properties of the HMI device. For configurations, you must proceed as follows:

You have accessed the 'Configurations' section in the 'Device properties' editor of the HMI device. Chapter 9.3 "Device properties" editor (HMI device) in page 289 "Standard variables table" editor

HMI configura		
Currently connected PLC	Ŧ	4 Close connection
Panel - user management		
Login:	wince	
Password:	•••••	Clear password
Current start display	Main •	
FTP rootpath	/SDMMC Card/WebMi/	

Fig. 219: HMI configurations

- **1.** *Currently connected PLC* ': Select from the list the control you would like to connect to the HMI device via the Ethernet interface.
 - ⇒ The selected control is marked as "in use". If you want to reset the connection, click on *'Remove connection'*.
- 2. *Panel user management*': Enter a user name and a password if necessary to protect access to the visualisation in the HMI device. Select the *'Clear view'* option to show the password in the edit field.
- **3.** *Current Start display*': Select from a list the desired image with which the HMI device is to be started.

9.4 "Standard variables table" editor maintain

Via the standard variables table, you can use the variables belonging to the CPU in images:

- You can use the already declared variables of the system hardware configuration or of the standard project configuration (synchronise variable table).
- If necessary, you can add further variables (e.g. from data blocks) for use in images.



Before you can use control variables in images, these must be entered in the standard variables table.

In the project tree within a visualisation project under 'Variables', double-click on 'Standard variables table'.

"Standard variables table" editor

Iter se Presele	ction: All	2	•		11	-2]	YASKAWA
ilter:	System Ha	rdwarekonfiguration	· 8	PLC_01 [CPU 31]	5-2AG12 315SB/	/DPM]	HMI_0	1 [TP 62M-JID0
	Name	Туре	Comment	PLC variable	Address	Data type	Source	Comment
¢		Boolean						
	x_DI_0_0_20	Boolean	8	x_DI_0_0_20	E 0.0	BOOL	Input	Slot: 4, Rack: 0]
	x_DI_0_7_20	Boolean		x_DI_0_7_20	E 0.7	BOOL	Input	Slot: 4, Rack: 0]
	x_DI_4_0_21	Boolean		x_DI_4_0_21	E 4.0	BOOL	Input	Slot: 5, Rack: 0]
	x_DI_4_1_21	Boolean		x_DI_4_1_21	E 4.1	BOOL	Input	Slot: 5, Rack: 0]
	Temperature	Numeric		Temperature	MW 40	WORD	Memory	

Fig. 220: "Standard variables table" editor

- (1) Toolbar
- (2) Filter settings
- (3) Variable table

(1) Toolbar

Synchronise variable table:

You can transfer the variables declared in the CPU to the variable table. All variables marked $\boxed{\mathbf{v}}$ in the system hardware configuration, the standard project configuration and the data blocks in the '*Visu*' column are transferred from there.

____ Click on 🔁.

 \Rightarrow The variables are copied into the variable table.



Changes to the system hardware configuration, the standard project configuration or the data blocks are not automatically adopted into the variable table. You need to synchronise the variable table in order to adopt the changes into the HMI project.

Print variable table The dialogue window "Print" will open.

(2) Filter settings

With the filter settings, you can always select specifically which variables shall be transferred to the variable table. All variables marked $\boxed{}$ in the system hardware configuration, the standard project configuration and the data blocks in the *'Visu'* column are transferred from there.

- **1.** Select the area to be transferred under *'Preselection'*, e.g. data blocks.
- **2.** Select the table or block from which the variables shall be transferred under *'Filter'*, e.g. DB1.

HMI elements

3. Click on **2**.

⇒ The variables from the selected table or the selected data block are copied to the variable table.

Add new variable	
------------------	--

- **1.** Under *'Current variable table'*, select the section from which you want to use control variables, e.g. "Data blocks" for variables from a data block.
- 2. You can perform inputs in the first line of the table. You can recognise these rows by the icon ⊕.

Click on the input field of the *'Name'* column and enter a name (symbolic address) for the control variable in the HMI project.

- **3.** \triangleright Click on the adjacent field in the '*Type*' column and select the desired data type.
- **4.** If you want to enter a comment on the variables, click on the *'Comment'* field and enter the comment.
- **5.** Click on the *'PLC variable'* column in the adjacent field and select the desired control variable from the list.

Only the variables marked \boxed{w} in the system hardware configuration and the standard project configuration in the '*Visu*' column are displayed from there.

- 6. Confirm your input with [Enter].
 - \Rightarrow The new variable is inserted into the table.

(3) Variable table *(Name' –* Name of the control variable (symbolic address) for use in HMI images.

'Type' – Data type for the use in images

'Comment' - Any comment e.g. remark or explanation

'PLC variable' – Name of the control variables (symbolic address), as declared in the system hardware configuration, the standard project configuration or in the data block. The name cannot be changed.

'Address' - Address of the variables

'Data type' - Data type of the variables

'Source' - Operand area of the variables, e.g. input, output, memory, DB

'Comment' – Comment from the system hardware configuration, the standard project configuration or the data block. The comment cannot be changed.

9.5 HMI elements 🟢

HMI elements are, for example, graphics or visual controls that you can use in images. The HMI elements are available in file format SVG (Scalable Vector Graphics) and can be enlarged or made smaller without losses.

Using HMI elements in an image

Ready-made HMI elements can be found in the catalog (\Leftrightarrow Chapter 4.9 'Catalog \gtrsim ' on page 30) under the 'HMI elements' register.

- **1.** Under 'HMI elements', open an element group, e.g. 'Controls'.
- **2.** Drag the desired element from the catalog to any place in the drawing field.
 - \Rightarrow The element is inserted in the image.

9.6 HMI library

You can create HMI elements and manage them in the HMI library to use them in images. In addition, you can import graphics in file format SVG (Scalable Vector Graphics) into the HMI library and use them in images.

9.6.1 Create, edit and use new element

Create new element

- **1.** In the catalog under *'HMI library'*, *'Catalog'*, right-click with the mouse button and select *'Create new element'*.
 - \Rightarrow A dialogue window will open.
- 2. Enter a name for the element and select the desired size of the element.
- 3. Click on 'OK'.
 - ⇒ The element is inserted under 'Catalog'.

Edit element

- **1.** Under *'Catalog'*, double-click on the desired element.
 - \Rightarrow The editor for editing HMI elements will open.
- 2. ► Edit the element in the editor. The editing functions, shapes and graphical elements of the editor for images are available to you. Schapter 9.9 "Image" editor on page 297
- 3. Save the project.

Using element in an image

You can use the element in images.

Drag the element from the HMI library to the desired location in the image (drag & drop).

9.6.2 Importing and using resources

Resources are, for example, graphics or visual controls that you can use in images. Resources can exist in different graphic file formats. Resources in file format SVG (Scalable Vector Graphics, Version Tiny 1.2) can be enlarged or made smaller without losses. Add new sub display > Configurations

Import resource

- **1.** In the catalog under *'HMI library'*, *'Catalog'*, right-click with the mouse button on *'Import resource'*.
 - \Rightarrow A dialogue window will open allowing you to select a graphic file.
- **2.** Select a graphic file and click on 'Open'.
 - \Rightarrow The file is inserted as an element under 'Catalog'.

Using resource in an image

You can use the element in images.

Drag the element from the HMI library to the desired location in the image (drag & drop).

9.6.3 Delete element 📴

You can delete an element from the HMI library.

- **1.** In the catalog under *'HMI library'*, *'Catalog'*, right-click with the mouse button on the desired element and select *'Delete element'*.
 - A dialogue window will open, where you can select whether you want to delete the element.
- 2. Click on 'Yes'.
 - ⇒ The element is removed from the HMI library and from the images in which it is used.

9.7 Add new sub display 🙀

You can add a new image to the project. Each new image is added in the project tree as a so-called sub display underneath an image.



- **1.** In the project tree, within the visualisation project, under *'Images'*, click on *'Add new sub display'*.
 - ⇒ A dialogue window with image configurations will open.
- **2.** Create configurations, if necessary, and click on 'OK'.
 - \Rightarrow The image is added and displayed in the project tree.

9.7.1 Configurations

Here you can make the configurations for the image.

'Image name' - With this name, the image is displayed in the project tree.

'Image title'

'Image description' - Any comment e.g. remark or explanation

'Image size' - The image size depends on the screen resolution and cannot be changed.

9.7.2 Background	
	Here you can set the background for the image. You can select a graphic file as the back- ground image or you can select a background colour.
	If you click on ' <i>Reset</i> ', the background colour is set to white.
9.8 Delete image 🚘	
0 —	You can delete an image from the project.
	1. In the project tree, within the visualisation project, under <i>'Images'</i> , right-click with the mouse button on the image and select <i>'Delete image'</i> .
	A dialogue window will open, where you can select whether you want to delete the image.
	2. Click on 'Yes'.
	\Rightarrow The image is deleted and removed from the project tree.

9.9 "Image" editor 📷

Individual images can be edited for the visualisation in the *'Image'* editor. Different shapes and graphical elements are available to you to illustrate processes of your machine or system.

Create a new image ($\$ Chapter 9.7 'Add new sub display \mathbb{R} ' on page 296) or select an image for editing.

Creating a visualisation

"Image" editor > Drawing a shape



Fig. 221: "Image" editor

- (1) Toolbar
- (2) Drawing field
- (3) Image
- (4) Information bar

9.9.1 Drawing a shape

You can insert shapes directly at the desired position and in the desired size in the drawing field.

Then you can change the shape:

- ♦ Chapter 9.9.4 'Edit object' on page 300
- Schapter 9.9.5 'Edit object properties' on page 302

"Image" editor > Inserting elements from the catalog



- 1. In the toolbar, click on the desired shape under 'Shapes'.
- **2. Draw line:** Click on the position in the drawing field where you want the line to start. Drag the line and click again to set the end point of the line.
 - Draw rectangle: Click on the position in the drawing field where you want the shape to start. Press and hold the mouse button. Drag the mouse until the shape has the desired size and then let go of the mouse button. When you press and hold the [Ctrl] button while drawing the shape, a square is drawn.
 - Draw ellipse or circle: Click on the position in the drawing field where you want the shape to have its centre point. Press and hold the mouse button. Drag the mouse until the shape has the desired size and then let go of the mouse button.
 - Draw polygon or polyline: Click on the position in the drawing field where you want the shape to start. Drag the line and click several times to set the individual points. Double-click with the mouse button to set the last point.
 - Draw Bézier curve: Click on the position in the drawing field where you want the shape to start. Drag the line and click several times to set the individual points. Press and hold the mouse button to define the curvature. Double-click with the mouse button to set the last point.
 - Add text box: Click on the position in the drawing field where you want the shape to start. Enter your text.
 - Add image: A dialogue window will open allowing you to select a graphic file. Select a graphic file and click on 'Open'. The graphic is inserted at position x: 0, y: 0.

9.9.2 Inserting elements from the catalog

You can insert elements from the catalog directly at the desired position in the drawing field. You can use ready-made or self-created HMI elements:

- Chapter 9.5 'HMI elements iii' on page 294
- Chapter 9.6 'HMI library '' on page 295

Then, you can change the element and assign control variables:

- 🗉 🌣 Chapter 9.9.4 'Edit object' on page 300
- Schapter 9.9.5 'Edit object properties' on page 302
- In the catalog under 'HMI elements', open an element group, e.g. 'Visual Controls → Controls → Sliders'.

If the properties are displayed instead of the catalog, you must click on 'Catalog' at the lower screen edge.

- 2. Drag the desired element from the catalog to any place in the drawing field.
 - ⇒ The element is added to the image and is saved in the project tree as a graphic file under '*Resources*'.



"Image" editor > Edit object

9.9.3 Align and arrange objects

You can align and arrange objects you have inserted in an image.

Align



1. Select the desired object.

2. In the toolbar under 'Align', click on a button to align the object at the top, at the bottom, vertically centred, left-hand, right-hand or horizontally centred.

Arrange

When the objects are inserted in the image, they are positioned on top of each other in the order in which they are created. You can change this order and move the objects to the front or to the back.

In addition, you can group several objects in order to apply changes to all objects included in this group.



- **1.** Select the desired object.
- 2. In the toolbar under 'Arrange', click on a button to arrange the object:
 - Bring forward: Moving object by one position to the front
 - Send backward: Moving object by one position to the back
 - Bring to front: Move object to the foremost position
 - Send to back Move object to the rearmost position
 - Group: Group several selected objects to an object group
 - Ungroup: Disband object group
 - Horizontally distributed: Distribute several selected objects horizontally in the image
 - Vertical distributed: Distribute several selected objects vertically in the image

9.9.4 Edit object

You can subsequently edit and change any inserted objects.

Change size (scale)





- 2. Click on one of the green squares and hold down the mouse button.
- Drag the mouse until the object has the desired size and then let go of the mouse 3. button.

If the option 'Catch on grid' is enabled, the object size is aligned to the grid.

When you press and hold the [Ctrl] button while drawing the square, the object size is changed proportionately.



Change edges, segments and points

•

- **1.** Double-click on the desired shape.
 - ⇒ Handles are shown as red squares.
- 2. Click on a square and hold down the mouse button.
- 3. Drag the mouse until the object or the object section has the desired shape and then let go of the mouse button.



If the option 'Catch on grid' is enabled, the shape is changed step by step based on the grid.

Rotate



- **1.** Select the desired shape or the desired element.
- 2. If necessary, you can move the reference point (yellow square) to change the centre of rotation.
- **3.** Click on a button in the toolbar under '*Rotate*'. You can rotate the object by 90° , 180°, 270° or by a value selected with the slider.
 - \Rightarrow The object is rotated around the reference point.



"Image" editor > Edit object properties

Change lines and contours

· 3 • 2 · ·				
= = = F F F				
Line				

- **1.** Select the desired shape.
- **2.** In the toolbar under *'Lines'*, click in a selection field or on a button to change the line or the contour:
 - Line type: Solid lines or broken lines
 - Line width: Line width in pixels
 - Outline: Line colour
 - Line end: Flat, round or square
 - Connection: Angular, rounded or bevelled

Use a template

You can apply pre-defined layouts to a shape.



- **1.** Click on 'Format templates' in the toolbar.
- 2. Select the desired layout.

Transfer formatting

- **1.** In the toolbar, under 'Shapes', click on 'Transfer formatting'.
- **2.** Click on the shape to which you want to transfer the formatting.

9.9.5 Edit object properties

Properties of an Element

You can edit the properties of objects in images to change the presentation. You can assign control variables to certain pre-defined elements.

"Image" editor > Edit object properties



Fig. 222: Properties of a marked element

	Properties	<u>≁</u> ᡎ ×
	*	
	Property General	Value
	ID	id_5
Line Shapes	 Appeareance Fill colour 	Colour gradient
· · · · · · · · · · · · · · · · · · ·	Stroke	#FF595959
0 0 0	Stroke width	6
	Presentation	
	RefPX	814.283
	RefPY	219.724

Fig. 223: Properties of a marked shape

"Image" editor > Edit object properties

- Select the desired object in the image.
 - \Rightarrow The properties of the object are displayed.

If the properties are not displayed, select 'View → Properties' or press [Ctrl]+ [Shift]+[M].

If the catalog is displayed instead of the properties, you must click on *'Properties'* at the lower screen edge.

Edit properties

Different properties are presented depending on the shape or element type, e. g.:

- 'General' Assign control variable (not for shapes) & 'Assign control variable' on page 304
- *'Format'* Position, size and rotation
- Composition' Colours
- 'Text formatting' Formatting of text
- *'Limits'* Limit values

Assign control variable

4 General						
ID	ID id_0					
Variable	Value					
label	label Actual value					

- **1.** To assign a control variable to the element, under '*General*', click on the '...' button next to the input field '*Variable*'.
 - ⇒ A dialogue window for assigning control variables to the HMI element will open.

- **2.** Select the desired variable from the list and click on 'OK'.
 - \Rightarrow The variable is entered in the input field.

If you open the "Typed variable display" window, all variables are listed therein. & Chapter 4.15 'Typed variable display' on page 45

Insert control variables as an element You can use the mouse to insert control variables in the image using the "Typed variable display" window, thereby creating a new element. Support Chapter 4.15 'Typed variable display' on page 45

Change colours

Property	Value		
 Appeareance 			
post decimal positions	1		
limit very low colour	#FF0000 #FFFF00 #FFFF00		
limit low colour			
limit high colour			
	#FF0000		

For certain objects, you can define different colours, e.g. for the background, contour and filling of an object, for the font or the presentation of limit values.

- ▶ To change a colour, enter the hexadecimal value in the input field as follows:
 - RGB value without transparency: #rrggbb, e.g. #0080FF

RGB value with transparency (Alpha channel): #aarrggbb, e.g. #C00080FF

- or -

Next to the input field, click on the colour field to open the dialogue window for the colour selection.

Edit dynamic samplings

You can dynamise elements so as to stimulate process flows in images. *Edit dynamic samplings* – "Simple dynamics" on page 305

9.9.6 Edit dynamic samplings – "Simple dynamics"

You can dynamise elements so as to stimulate process flows in images. The 'Simple dynamics' dialogue window contains pre-defined animations that you can assign to an element in the image.

You can define several dynamic samplings per element. If, for example, you want to stimulate the level of a container, you can "Scale" the dynamic sampling for the visualisation of the level and additionally you can use dynamic sampling "Colour" to present limit values.

9.9.6.1 Add dynamic sampling 🕂

If you want to dynamise an element, you must proceed as follows:

- **1.** Highlight the desired element in the image.
- 4 × Properties = := Property Value Svg-properti ▲ General ID id_0 Color Position Size Rotation Event Action Add ð Edit... h Copy Ctrl+C Ctrl+V Paste Delete Del X Catalog 📄 Properties

2. Right-click with the mouse button on the lower section of the *'Properties'* and select *'Add'*.

If the properties are not displayed, select '*View* \rightarrow *Properties*' or press [*Ctrl*]+[*Shift*]+ [*M*].

If the catalog is displayed instead of the properties, you must click on 'Properties' at the lower screen edge.

⇒ The 'Simple dynamics' dialogue window will open.

"Image" editor > Edit dynamic samplings – "Simple dynamics"

Simple dynamics	22				
🔒 0. RIGHT	check right				
🏴 1. EVENT	IIII Condition Node Change Event				
	All following conditions must be met:				
	Address Value				
	R bSignal (35438a01-72 value ▼ B ▼ == ▼ false ▼				
Display // User Input					
	Add Before Add After Delete				
VZ. RESULI					
3. ACTION	🛟 Change colour				
C Rotate	Select type: O Discrete				
Scale Skew	Discrete value ranges				
Colour Opacity	© Value range				
Visibility Mage	Value Attribute Colour				
Widget En/Disable					
Window Q Zoom					
🗣 acknowledge 峰 Sound					
AA Text/Value Script					
Set Node 🛛 🔟 Trigger					
	Add Befrre				
	OK Cancel Help				

Fig. 224: "Simple dynamics" dialogue window

You must create the following configurations for the dynamic sampling of an element:

- Event that triggers the dynamic sampling, e.g. the value of a variable, a click of the mouse, timer
- Action to be executed when the event takes place, e.g. colour, size of position of the element

Define event

- **1.** To assign an event to the element, click in section *'1. event'* on the desired event that triggers the dynamic sampling, e.g. *'Condition'*.
- **2.** Create further configurations to narrow down the event further, e.g. select control variable.

Example: Select control variable	
R bSignal (c5457fcd-3d34-4(1. Select the event <i>'Node'</i> (change of a certain attribute of a variable) or <i>'Condition'</i> (value of a variable).
	2. Click on the '' button.
	⇒ A dialogue window for selecting control variables will open.
	If no control variables are shown here (empty list), you must first edit the 'Standard variables table'.
	3. Select the desired variable from the list and click on 'OK'.
	\Rightarrow The variable and an ID number are entered in the input field.

Define action

- **1.** To stimulate the element, click in section '3. *action*' on the desired action, e.g. '*Colour*'.
- 2. Create further configurations to adapt the action, e.g. select control variable.
- 3. Close the dialogue window 'Simple dynamics'.
 - ⇒ The dynamic sampling is added to the 'Properties'.



9.9.6.2 Edit dynamic sampling 🖑

To display or change the dynamic sampling of an element, you must proceed as follows:

- Event Action Condition Colou S ÷ Add Edit.. P Ctrl+C Copy lìh 1 Paste Ctrl+V Delete Del
- **1.** Highlight the desired element in the image.
- **2.** In the lower section of the *'Properties'*, right-click with the mouse button on the desired dynamic sampling and select *'Edit'*.
 - ⇒ The 'Simple dynamics' dialogue window will open.
- 3. Change the configurations of the dynamic sampling, if necessary.
- 4. Close the dialogue window 'Simple dynamics'.

9.9.6.3 Copying and pasting dynamic sampling

You can copy the dynamic sampling of an element and add it to another element:



- 1. Highlight the desired element in the image.
- **2.** In the lower section of the *'Properties'*, right-click with the mouse button on the desired dynamic sampling and select *'Copy'*.
- 3. Highlight the element in the image that is to receive the same dynamic sampling.

Edit and use enumeration

- **4.** Right-click with the mouse button on the lower section of the *'Properties'* and select *'Paste'*.
 - ⇒ The marked element receives the same dynamic sampling as the first selected element.

9.9.6.4 Delete dynamic sampling -



- To delete the dynamic sampling of an element, you must proceed as follows:
- **1.** Highlight the desired element in the image.
- **2.** In the lower section of the *'Properties'*, right-click with the mouse button on the desired dynamic sampling and select *'Delete'*.
 - A dialogue window will open where you can select whether you want to delete the dynamic sampling.
- 3. Click on 'Yes'.
 - ⇒ The dynamic sampling is removed from the element.

9.10 Add new enumeration

An enumeration is a list of texts that can be displayed, instead of values, in HMI elements. You can use enumerations in certain HMI elements.

- **1.** In the project tree within the visualisation project, under *'Enumerations'*, click on *'Add new enumeration'*.
 - ⇒ A dialogue window will open.
- **2.** Enter a name for the enumeration.
- **3.** Select the type of enumeration:
 - BOOL for two texts instead of the two states TRUE and FALSE
 - NUMERIC for texts instead of numerical values
 - STRING for character strings instead of values
- 4. Click on 'OK'.
 - ⇒ The enumeration is added to the project tree, and the editor to edit the enumeration is opened.

9.11 Edit and use enumeration

- In the project tree within a visualisation project under *'Enumerations'*, double-click on the desired enumeration.
 - \Rightarrow The enumeration is opened in the editor.

Enumeration of the BOOL type

____ Enter the desired text for the values TRUE and FALSE in the 'Text' input fields.

Enumeration of the NUMERIC type					
	1. Enter the desired text in the first line of the table in the ' <i>Text</i> ' input field.				
	2. Enter a numerical value in the 'Value' input field.				
	3. Confirm your input with <i>[Enter]</i> .				
	\Rightarrow The enumeration element is inserted in the table.				
	4. You can add further enumeration elements.				
Enumeration of the STRING type					
	1. Enter the desired text in the first line of the table in the <i>'Text'</i> input field.				
	2. Enter a value in the 'Value' input field.				
	3. Confirm your input with <i>[Enter]</i> .				
	\Rightarrow The enumeration element is inserted in the table.				
	4. You can add further enumeration elements.				
Using an enumeration in an image	You can use the enumeration in certain HMI elements. During run-time, the filed texts instead of the values are displayed in the HMI elements.				
	1. Highlight the desired element in the image.				
	⇒ The properties of the element are displayed. Schapter 9.9.5 'Edit object properties' on page 302				
	2. Under 'General', select the 'Mode' "Enumeration".				
	If the property 'Mode' is not displayed, the enumeration cannot be applied to this HMI element.				
	3. Under ' <i>General</i> ', ' <i>Enum list</i> ', select the desired enumeration.				

9.12 Translations

You can translate all texts in the images into as many languages as desired.

- ____ Click on '*Translations*' in the project tree within a visualisation project.
 - ⇒ The 'Translations' editor will open.

Translations

	German	English	
÷			
	Temperatur	Temperature	
	🕂 Start		
	\land Stopp		
	lstwert	Actual value	



(1) Toolbar

(2) Editor for translations (translation table)

(1) Toolbar

+	Add language: Add new language column 'Add language' on page 310
	Import: Import translation table into the HMI project & <i>'Import translation table'</i> on page 311
	Export: Export translation table to a translation file \mathcal{G} <i>'Export translation table'</i> on page 311
(2) Editor for translations (translation table)	The first column of the translation table contains the texts of the standard language. This column displays all texts that are contained in the text boxes of images. You can add a new column for each desired language and edit the texts.
Add language	
	1. Dick on the 🕂 button.
	⇒ A dialogue window will open.
	2. Enter the desired language.
	⇒ The new language is inserted into the table. The text boxes for this language are empty.
Change language columns	
	You can rename, delete as well as show and hide individual language columns.
	Right-click with the mouse button on the desired language column in the header and select the desired function.
Edit texts	
	Double-click in the desired table line and edit the text.
	As long as a text box has not been edited, the symbol ${\color{red} {f \Lambda}}$ is displayed.

User management

Delete text lines

You can delete individual lines.

- **1.** Highlight the table line which you want to delete.
- 2. Press [Del].

- or -

Right-click with the mouse button on the line and select 'Delete highlighted line...'.

Export translation table

You can export the translation table in XML format (VTR file) in order to e.g. edit it with any editor.

- **1.** Click on the hotton.
 - \Rightarrow A dialogue window will open.
- **2.** Select a directory and enter a file name.
 - \Rightarrow The translation table is exported.

Import translation table

You can import translation tables into the HMI project.

- **1.** Click on the 📑 button.
 - \Rightarrow A dialogue window will open.
- **2.** Select the desired VTR file.
 - ⇒ The translation table is imported into the HMI project.

9.13 User management

The user management allows you to create a user list. For each user, you can define a password and write permission.

User pr	roperties			
Nam Arth	ie nur C. Clarke	Password	Re-enter password	Apply
User lis	s t Name aac Asimov	Password set	Writing permission	
A	rthur C. Clarke	4		

Fig. 226: User management

Simulate HMI visualisation

Adding a user

- 1. Click on 🖶.
- 2. Enter the desired user name in the input field 'Name'.
- **3.** Enter the password in the input field *'Password'* and repeat the input under *'Re-enter password'*.
- 4. Click on 'Apply'.
 - \Rightarrow The user will be entered in the user list.
- 5. To allow the user to modify HMI images, activate I the option 'Writing permission'.

Removing a user

Right-click with the mouse button on the user line and select 'Delete user'.

- or -

- Left-click with the mouse button on the user line and then press [Del].
- A dialogue window will open, where you can select whether the user should be deleted or not.

9.14 Movicon projects

You can create an HMI device with the Movicon functionality. You can thus use the HMI device in a SCADA (Supervisory Control and Data Acquisition) system. For this, please see *Chapter 6.4.1 'Movicon project configurations' on page 82*.

You can open an existing Movicon project and change the project path.

9.14.1 Opening a Movicon project

____ Click on 'Open Movicon project' within the HMI at 'HMI Movicon project'.

⇒ The external Movicon application will be started (if available) and the Movicon project will be opened.

9.14.2 Changing the project path

- Right-click with the mouse button on 'HMI Movicon project' within the HMI and select 'Change project path'.
 - \Rightarrow A dialogue window will open where you can reassign the project path.

9.15 Simulate HMI visualisation

With the HMI simulation, you can test the images in the web browser of your PC before you load the project into the visualisation device or into the control.

If you want to simulate the HMI visualisation, you must proceed as follows:

- **1.** Create and save all images in your HMI project.



- 3. In the toolbar, select the web browser in which the HMI simulation is to be executed.
- **4.** Start the HMI simulation. Select one of the following options to this end:
 - Toolbar: Click on S.
 - Project tree: In the HMI project, right-click with the mouse button on 'Images' and select 'Dynamic Simulation'.
 - Image editor: Click on the 'Preview' button.
 - \Rightarrow The start image is opened in the web browser.
- **5.** Test the HMI visualisation. For example, you can test whether dynamic samplings work correctly.
- **6.** If you want to reload the HMI simulation into the web browser with the start image, click on
- 7. End the HMI simulation. To this end, click on 🚮.
- 8. If you have executed the PLC simulation, end it.

Functions of Motion Control

10 Motion Control

10.1 Functions of Motion Control

Functions of Motion Control are supported by VIPA controls of the series *SLIO CPU iMC7* (e.g. SLIO-CPU 015-CEFNR00). The control communicates via the communication protocol EtherCAT with the drive modules.

- You can choose drive modules from the catalog and configure them.
- You can call up further tools, such as YASKAWA SigmaWin+ or YASKAWA DriveWizard.
- You can add and configure axes.
- With the Motion Control library, you can program machine functionalities.

10.2 Add drive

Functions of Motion Control are supported by VIPA controls of the series *SLIO CPU iMC7* (e.g. SLIO-CPU 015-CEFNR00). The control communicates via the communication protocol EtherCAT with the drive modules.



Fig. 227: Adding slave via "Catalog"

- (1) Select drive module (hold left mouse button down)
- (2) Drag drive module
- (3) Drop the drive module at a suitable place (release the mouse button)
- (4) The drive module is added

1. Select one of the following options if you want to add a drive module:

- Catalog: Drag the desired drive module from the 'Device templates' register of the catalog (Schapter 4.9 'Catalog 's' on page 30) to the connecting line of the EtherCAT bus system in the 'Devices and networking' editor. Fig. 60 The drive module is directly added and displayed in the project tree.
- Project tree: Within the PLC under 'Decentralised periphery', 'EC master system', click on 'Add new device'. Fig. 61
- Editor "Devices and networking ": Right-click with the mouse button on the connecting line of EC master system and select 'Add new device'.

Start SigmaWin+ or DriveWizard

SPEED7 Studio	Development Line	×
SLIO Drives	Add new device Device name: EC_Slave_001 Number: 1 Chose a device template Device advice	
	🖌 ок 🔰	🕻 Cancel

Fig. 228: "Add new device" (drive) dialogue window (drive)

- 2. Select 'Drives'.
- **3.** Select the desired device template from the list.
- **4.** *'Device name'*: Enter a device name, if required.
- 5. Click on 'OK'.
 - \Rightarrow The drive module is added and displayed in the project tree.



If you enter a value in the 'Number' box, several structurally identical drive modules are added.

10.3 Start SigmaWin+ or DriveWizard

If you have installed tools for the configuration of YASKAWA drives on your PC, you can call up the tools via the drive modules.

- In the editor "Devices and networking "" right-click with the mouse button on the drive module and select the desired tool, e.g. 'Start SigmaWin+' for servo drives or 'Start DriveWizard' for frequency converters.
 - \Rightarrow The configuration tool is started for the drive module.

Tools which have not been installed are highlighted in grey and cannot be called up.

10.4 Editor "Motion Control Overview" 3.

In the editor *'Motion Control Overview'*, you can change the configurations of the Motion Control functions.

If a project is open and a control is included which supports Motion Control functionalities, you can open the *'Motion Control Overview'* editor:

Project tree: Within the PLC under 'Motion Control', click on 'Motion Control Overview'.

The 'Motion Control Overview' editor is divided into three sections.

S Motion Contr	ol
🌯 General settings	
Axes overview	
Diagnostic	2

10.4.1 General settings 🗞

General settings		
Motion control application		
Motion control enabled	1	
Cycle Time IO-sy	stem	
1000 EC-N	/lastersystem [100] 😤 B	Bus system properties
Motion control library		
All Motion Control FBs		
Administrative FBs	Single Axis FBs	Multiple Axes FBs
📴 🗹 MC_Power	🖳 🗷 MC_Home	📴 🔲 MC_CamIn
📴 🗹 MC_Reset	🖳 🗹 MC_Stop	📴 🔲 MC_CamOut
🖳 🗹 MC_ReadStatus	🖳 🗹 MC_Halt	📴 🔲 MC_GearIn
🖳 🗌 MC_ReadAxisError	🖳 🗷 MC_MoveRelative	🖺 🔲 MC_GearOut
📴 🗌 MC_ReadParameter	🖳 🗷 MC_MoveVelocity	🖺 🔲 MC_PhasingAbsolute
📴 🗹 MC_WriteParameter	🖳 🔲 MC_MoveAbsolute	📴 🔲 MC_PhasingRelative
🖳 🗌 MC_ReadBoolParame	eter 🛛 🖳 MC_MoveSuperimpo	osed
📴 🔲 MC_WriteBoolParam	eter	
VMC_ReadDWordPar	rameter	Add Blocks

Fig. 229: Motion Control General Settings

Editor "Motion Control Overview" > Axis overview

Activate Motion Control

- ▶ Activate under Motion Control application the option 'Motion control enabled'.
 - ⇒ By activating Motion Control, the following directories and blocks are created by SPEED7 Studio in the project tree under 'program blocks':
 - Directory *MC_APP*' with data blocks for the Motion Control user program
 - Directory 'MC_SYSTEM' with system blocks for the Motion Control user program
 - Organisation blocks for Motion Control, e.g. OB1, OB60 and OB61, including precall and postcall of the motion control system and synchronisation settings in the OB61.

Moreover, a synchronisation-enabled bus system (e.g. EtherCAT master system) is entered in the *'IO-system'* field.

Cycle time' – Cycle time in microseconds, adjustable in the configurator of the IO system

'IO-system' - Used IO system

'Bus system properties' – Open the dialogue window for the properties of the used IO system

Select Motion Control functions

All available Motion Control functions are grouped and listed under the 'Motion Control library'.

- **1.** Activate the Motion Control groups or individual functions you want to use in the Motion Control user program, e.g. *'MC_Power'*.
- 2. Click on 'Add blocks'.

By activating Motion Control functions, *SPEED7 Studio* creates the directory '*MC_LIB*' and within the function block, matching the activated Motion Control function, in the project tree under '*Program blocks*', e.g. "MC_Power [FB700]".

If you delete the function block of an activated Motion Control function from the directory *'MC_LIB'*, this function block is added automatically when you compile the user program the next time.

10.4.2 Axis overview 3

In the axis overview, all configured axes are listed in a table. For each axis, the table lists the input and output parameters of the cyclic communication, the user units and limit values.

Detailed information on the parameters is available at:

- Schapter 10.6.1 'Basic settings 'on page 322'
- ♦ Chapter 10.6.2 'User units 🔣' on page 323
- Chapter 10.6.3 'Limit values (2)' on page 326

In the 'Expert View', more details are shown than in the 'Smart View', e.g. further parameters and calculated values.

Γ

Editor "Motion Control Overview" > Diagnostics

Smart View Expert View	i i			
Basic settings	MC_Axis_01	MC_Axis_02		
Name of axis	MC_Axis_01	MC_Axis_02		
Axis type Encoder type Encoder resolution	Virtual axis	Positionierungsachse incremental 20 bit		
User units	MC_Axis_01	MC_Axis_02		
Machine cycle				
Type of software	modulo	📃 modulo		
The or solution	📃 limited	limited		
minimum	-1000.00	-1000.00		
maximum	1000.00	1000.00		
Gear ratio				
Motor revolutions	1	1		
Revolutions drive	1	1		
Mechanics	L			
Revolutions drive	1	1		
User units	1.00	1.00		
Limits	MC_Axis_01	MC_Axis_02		
Dynamics				
Max. velocity	0	٠		
Max. acceleration	0	•		
Max. deceleration	0	•		
Max. jerk		•		
Positioning	L			
Monitoring minimum position				
Min. position	0.00			
Monitoring maximum position		-		
Max. position	0.00			

Fig. 230: Motion Control Axis Overview

10.4.3 Diagnostics %

With the Motion Control diagnostics, you can check OB callings, execution and cycle times and see information on the axes during operation.

Editor "Motion Control Overview" > Diagnostics

Diagnostics						
Stop diagnostic						
Overview	OB61					
Diagnostics: Running CPU: Running OB61: 2 Running OB60: Running OB1: Running Number of MC axes: 3	Cyc Max: 7 Min: 4 ø: 5 Currently: 5	le Time 03 μs 55 μs 80 μs 97 μs	Execution tin 418 273 337 347	ne Cycle T μs μs μs μs μs	Fime Execution time 4000	cycle Time details 4000 400
Motion Control Axes McAxis_01 [DB8184] McAxis_02 [DB8183] McAxis_03 [DB8182]	Configuration Axis type Encoder resolution: Encoder type: Type of software:	SIGMA 7 20 Bit Increment Modulo av	al encoder is		Device profile: Profile version: PDO Mapping:	0007 EtherCAT Standard Default Mapping
	Drive status: Status word: Control word: PLCopen state: Operating mode: Encoder position: Velocity: Torque:	0x1237 0x0 Continuou Cyclically s 16336599 0 16	s motion synchronous po [0xF946D7]	sition mode	Following error: Error: Ready: Communication: Communication statu Switched on: Referenced:	39210 [0x992A]
	Motion status Invalid position: Constant velocity: Accelerated: Decelerated:	•			Positive direction of Negative direction of Min. SW limit active: Max. SW limit active:	rotation:

Fig. 231: Motion Control Diagnostics

- (1) Switch on/off diagnostics
- (2) OB callings and number of axes
- (3) Run time behaviour of the OB61 and Motion Control cycle
- (4) Information on the axis

(1) Switch on/off diagnos-

tics

In order to start the Motion Control diagnostics, you must proceed as follows:

- **1.** Configure all axes. & Chapter 10.5 'Add new axis ¹/₄' on page 321
- 2. Create and compile the user program. Schapter 8.18 'Compile user program' on page 245
- 3. Transfer the hardware configuration and the user program to the control. 8.20 'Transfer the hardware configuration and user program to the control' on page 248
- 4. Click on 'Start diagnostics'.
 - ⇒ Motion Control diagnostics will be started.
- 5. End the Motion Control diagnostics. Click on 'Stop diagnostics' for this purpose.

(2) Diagnostics display, OB callings and number of axes	s shows whether the diagnostics is running and the organisation blocks OB1, OB60 OB61 are run through. Moreover, the number of the configured axes is shown here.		
(3) Run time behaviour of the OB61 and Motion Con- trol cycle	 The following information relating to the cycle time and execution time of the OB61 is shown in tables and as bar diagrams: Max. measured time since the start of the Motion Control diagnostics Min. measured time since the start of the Motion Control diagnostics Average value since the start of the Motion Control diagnostics Currently measured time The pie chart displays the entire Motion Control cycle time in micro seconds. The individual pie sections display the current execution duration of the program processing of the OB61: Start OB61 – Internal CPU time for the preparation of the program processing Read PAE – Inputs reading Execution time – Processing user program Write PAA – Outputs writing Terminate OB61 – Internal CPU time for terminating the program processing 		
(4) Information on the axis	Click left on the desired axis. ⇒ Configured data (set values) and current states (actual values) are displayed for the selected axis.		
10.5 Add new axis	You can add new axes to a control with the Motion Control functionality axes. In the user		
	program, you can control axes and thus move the drive.		
	In order to be able to add axes, a control which supports Motion Control functions must already be present in the project. S Chapter 10.1 'Functions of Motion Control' on page 314		
	"Motion Control" must already be activated in the "Motion Control overview". Schapter 10.4.1 'General settings on page 317		
 PLC_01 [CPU 015-CEFNR00] Device overview 	1. In the project tree within the control under <i>'Motion Control'</i> , <i>'Motion Control axes'</i> , click on <i>'Add new axis'</i> .		
Device properties	A dialogue window will open.		
Device configuration Address overview	2. <i>Name of axis</i> ': Enter an axis name, if required. You can reference the axis in the user program with this name.		
Motion Control overview	3. Click on 'OK'.		
Motion Control Axes Add new axis MC_Axis_01 [EC_Slave_001] Fig. 232: Add new axis	If you select the option 'Open Motion Control configuration' and click on 'OK', "Motion Control axis" editor will open.		
	The axis is added and displayed in the project tree. Additionally, SPEED7 Studio creates a data block with the same name under 'Program Blocks', 'MC_APP'.		

Editor "Motion Control axis" > Basic settings

10.6 Editor "Motion Control axis" %

In the *'Motion Control axis'* editor, you can make configurations at an axis of the drive.

In order to open the editor of a Motion Control axis, proceed as follows:

Project tree: In the control under 'Motion Control', 'Motion Control axes', double click on the desired axis.



The 'Motion Control axis' editor is divided into three sections.

10.6.1 Basic settings 😓

	Axis type		
MC_Axis_02	Positionierungsachse *		
Output device			
EC_Slave_002 [Sigma-7]	SIGMA 7 Servopack (SGD7S-===A=)		
Motor type	Encoder resolution		
SGM70-0007000 (24 bit) absolute	• 24 bit •		
SGM/D-DDD/DDD (24 bit) absolute	24 Dit		

Fig. 233: Motion Control axis: Basic settings

Depending on the axis type, different setting possibilities are displayed.

'Name of axis' - Is displayed in the project tree and used in the user program

'Axis type' – Virtual axis, position or speed controlled axis, axis on external sensor/ encoder

'Output device' - Assign the axis to a drive module e.g. EtherCAT drive module

'Motor type' (only for axis type "positioning axis")– Select motor according to the type designation or select "User defined" and set corresponding sensor resolution

'Sensor resolution' (only for axis type "positioning axis") – resolution of the encoder: The suitable resolution is set automatically depending on the motor type. If you select "User defined" as motor type, you have to set the resolution manually.

'absolute' / 'incremental' - Encoder type: Absolute encoder or incremental encoder

'Number of bits for revolution' (only for axis type "External encoderExternal encoder") – Resolution of the used encoder per motor revolution

'Number of bits for multi turns' (only for axis type "External encoder") – Number of available bits, if the encoder is ready for multi turn. If the encoder is not ready for multi turn, enter value 0.

1. First, select the 'Axis type'.

2. If you have selected a real axis or an external encoder, assign an 'Output device'.

3. If an I/O allocation of the drive module does not match the used axis type, a dialogue window will open where you can choose whether *SPEED7 Studio* should correct the I/O allocation (IO mapping) automatically.

If this dialogue window will open, click on 'Yes'.

4. Select the used motor with the *'Motor type'*. If no suitable motor is listed, select *'User defined'*, the *'Sensor resolution'* and *'absolute'* or *'incremental'*.

Details

- **1.** Click on 'Details' in order to display the parameters for the cyclic communication.
- **2.** If required, change the configuration for the cyclic reading and writhing access of the axis.

10.6.2 User units

Here you can determine the areas and units of the axis. You can change the transmission ratio of the axis. The selected unit will be used for the input and output parameters of the Motion Control function blocks.

Editor "Motion Control axis" > User units

₩₩₩ ₩ ₩							
Unit							
Axis type Machine cycle							
modulo Maximum finite mm Minimum							
Scaling							
Motor resolution							
Increments	Revolutions motor						
Gear ratio							
Revolutions motor	Revolutions output						
Mechanics							
Revolutions output 1	User units •						
Machine cycle							
Range	Cvcle	Overflow	Error numerator	Error denominator			
2000 mm	4194304000 inc	4194303999 inc	0 inc	0 inc			
	Cycle Hi	Overflow Hi	Error numerator Hi	Error denominator Hi			
	0 inc	0 inc	0 inc	0 inc			
	Cycle Lo	Overflow Lo	Error numerator Lo	Error denominator Lo			
Details	-100663296 inc	-100663297 inc	0 inc	0 inc			
Position	Velocity Factor	Acceleration Factor	Jerk Factor				
2097152	•	•	•				
Offset							
-1000 mm							

Fig. 234: Motion Control axis: User units

'Unit' – Unit for displays, e.g. in the motion diagram of the cam editor: The unit has no influence on the calculation of motions.

Axis type

'Modulo':

- For endless positioning in positive direction (exceeding "maximum") or negative direction (exceeding "minimum")
- The maximum value (e.g. 360 degrees) corresponds to the minimum value (e.g. 0 degrees).
| | <i>'Limited'</i>: For positioning within the limits "Minimum" and "Maximum" If the axis is driven across the limits, the position will be set to invalid. The maximum value (e.g. 360 degrees) doesn't correspond to the minimum value (e.g. 0 degrees). |
|------------------|---|
| Machine cycle | Traversing range of the axis: The values can be used for the calculation of a motion,
examples see below.
<i>'Maximum'</i> – Upper limit value for the traversing range
<i>'Minimum'</i> – Lower limit value for the traversing range |
| | CAUTION! The axis can run out of control! A limited axis is not stopped, even if the configured traversing range is left! Program the Motion Control function blocks (e.g.MC_MoveVelocity, MC_GearIn, etc.) in a way that the configured traversing range is not exceeded! Use the monitoring function of the positioning and the function block MC_ReadAxisInfo for that purpose. |
| Motor resolution | <i>'Increments'</i> , <i>'Motor revolution'</i> – Resolution of a motor revolution: The value displays the number of increments per motor revolution of the used drive. The motor resolution can be set via the motor type and the sensor resolution. <i>S Chapter 10.6.1 'Basic settings 's' on page 322</i> |
| Gear ratio | Transmission ration of the gear: The number of motor revolutions corresponds to the number of revolutions of the output (on the load side, e.g. on the drive output), see example below.
<i>'Motor revolutions'</i> – Number of motor revolutions: The value is used for the transmission ratio of a motion.
<i>'Revolutions drive'</i> – Number of revolutions of the output side: The value is used for the calculation of a motion.
If no drive is used on the axis (transmission ratio 1:1), select "Motor revolutions = 1" and "Revolutions drive = 1". |
| Mechanics | Relation between the mechanics and the user units: The number of the <i>'Revolutions drive'</i> , corresponds to the value of <i>'User units'</i> , see example below. |

Editor "Motion Control axis" > Limit values

Example for the axis con- figuration	The total motion (working travelling distance) of a linear axis should be max. 2,000 mm in an area between -1,000 mm and +1,000 mm. A drive with a transmission ratio of 2:1 is used. For three revolutions on the load side (output) a distance of 100 mm is travelled.
	Select the following configurations for this example:
	Unit: mm
	Axis type: limited
	Machine cycle – Maximum: 1,000, Minimum: -1,000
	Gear ratio – Motor revolutions: 2, revolutions output: 1
	Mechanics – revolutions output: 3, User units: 100

Details

Click on *'Details'* in order to display an overview over the calculated values, e.g. velocity, acceleration and jerk.

10.6.3 Limit values (3)

🥙 Limits								
Operating se	ettings							
Max. velocity								
100,14	t mm/s							
Max. accelerat	ion Max. decele	eration						
476,84	mm/s ² 476,84	🗘 m	m/s²					
Max. jerk								
953675,22	↓ mm/s ³							
	Limits							
	Max. velocity		Max. acceleration		Max. deceleration		Max. jerk	
	210000	inc/cycle	1000	inc/cycle ²	1000	inc/cycle ²	2000	inc/cycle ³
	Positioning							
	Min. position		Max. position					
Details	0	inc	0	inc				
	Min. position Hi		Max. position Hi					
	0	inc	0	inc				
	Min. position Lo		Max. position Lo					
	0	inc	0	inc				

Fig. 235: Motion Control axis: Limit values

Operation settings

Here, you can enter the maximum limit values of the axis for velocity, acceleration, delay and jerk. The values are used for the input and output parameters of the Motion Control function blocks.

Positioning

You can monitor the traversing range of a limited axis. "Software limit switches" can be programmed via the user program.

- **1.** Enable the option 'Monitoring minimum position' or 'Monitoring maximum position'.
- 2. ► Enter the limit values into the input fields 'Min. position' or 'Max. position'. The values must be within the configured traversing range. So 'Machine cycle' on page 325
 - ⇒ Motion Control function block MC_ReadAxisInfo displays if a limit value has been exceeded via the parameters LimitSwitchNeg or LimitSwitchPos.



CAUTION!

The axis can run out of control!

A limited axis is not stopped, even if the configured traversing range is left!

Program the Motion Control function blocks (e.g.MC_MoveVelocity, MC_GearIn, etc.) in a way that the configured traversing range is not exceeded! Use the monitoring function of the positioning and the function block MC_ReadAxisInfo for that purpose.

Details

Click on 'Details' in order to display an overview over the calculated values.

10.7 Create cams

10.7.1 The "Electronic cam"

Irregular motions can be created with mechanical cam gears. If a change of a motion sequence is required, the system must be retooled and the cam must be exchanged. "Electronic cams" have the advantage that motion sequences can be changed in a real short time, even during operation, without the necessity to retool the system.

Electronic servo drives will assume the function of the "Electronic cam". Those drives can carry out very complex motions. Information on the motion can be found in a "data point table". You can set the data points with the cam editor and reproduce and develop mechanical cams. The data points are stored in a data block and are transferred from the control to the drive via the function block "MC_CamIn".

10.7.2 Add new cam 🗛

You can add new cams to a control with the Motion Control functionality and edit them in the cam editor.

In order to be able to add cams, a control which supports Motion Control functions must already be present in the project; see \Leftrightarrow *Chapter 10 'Motion Control' on page 314*.

Create cams > Cam editor

4	" PLC_01 [CPU 015-CEFNR00]
	🔞 Device overview
	🚺 Device properties
	Device configuration
	Address overview
	Motion Control
	🔺 💷 PLC program
	률 Cross-References
	📳 Assignment list
	 Cam profiles
	Add new cam profile
	🛕 Cam_profile_01

Fig. 236: Add new cam

In addition, at least two axes must be present in the project; see \bigcirc Chapter 10.5 'Add new axis ' on page 321.

1. In the project tree within the control under *'PLC program'*, *'Cams'*, click on *'Add new cam'*.

 \Rightarrow A dialogue window opens.

- 2. Name': Enter a cam name, if required.
- **3.** *Master axis*': Select the desired master axis (or leading axis, reference axis). You can use virtual or real axes.
- **4.** *Slave axis*': Select the desired slave axis (or following axis). You can use virtual or real axes.
- 5. Click on 'OK'.
 - ⇒ The cam is added and displayed in the project tree. Additionally, SPEED7 Studio creates a data block with the same name under 'Program Blocks', 'MC_APP'.

You can change the master axis and following axis afterwards; see Chapter 10.7.3.9 'Properties of the cam (profile properties)' on page 339.

10.7.3 Cam editor \Lambda

In the cam editor, you can set the data points of the "Electronic cam".

In order to open the cam editor, proceed as follows:

Project tree: Within a control, double click on the desired cam under 'PLC program', 'cams'.

Create cams > Cam editor



Fig. 237: Cam editor

- (1) Toolbar
- (2) Motion diagram
- (3) Motion characteristics

- (4) Properties of a motion segment
- (5) Overview over motion segments
- (6) Properties of the cam

(1) Toolbar

- Editing mode: Edit highlighted motion segment, see & 'Select/highlight segment' on page 331
- Create new curve: The data points are recalculated and stored in the data block.
- M Have the motion function inserted automatically; see ♦ Chapter 10.7.3.5 Auto-complete the curve A on page 335

In order to insert and draw motion functions, see \Leftrightarrow Chapter 10.7.3.4 'Draw segments' on page 333.

For an overview over the motion functions, see *Chapter 10.7.4 'Motion functions' on page 341*

- Insert motion function "Straight line"
- N Insert motion function "Polynomial 5. grade"
- Insert motion function "Inclined sine"
- Insert motion function "Modified acceleration trapezium (PP)"

Δ	Insert motion function "Modified acceleration trapezium (PR)"
Δ	Insert motion function "Modified acceleration trapezium (RP)"
	Insert motion function "Modified sine (VV)"
2	Insert motion function "Modified sine (VR)"
2	Insert motion function "Modified sine (RV)"
n_	Insert motion function "Sine-straight-combination"
	Show/hide motion characteristic velocity (v)
	Show/hide motion characteristic acceleration (a)
	Show/hide motion characteristic jolt (j)
No.	Export cam profile: Save all data from the cam profile in a VPCAM file (XML format)
V.	Import cam profile: Load cam profile from a VPCAM file into the cam editor
(2) Motion diagram	In the motion diagram (or motion plan) of the cam editor, you can edit the total motion graphically; see 🖏 Chapter 10.7.3.1 'Motion diagram' on page 330.
(3) Motion characteristics	This diagram shows the development of the velocity, the acceleration and the jolt; see ♦ <i>Chapter 10.7.3.6 'Motion characteristics' on page 336</i> .
(4) Properties of a motion	You can display and edit all data of a motion segment here.
segment	& Chapter 10.7.3.7 'Properties of the motion segment' on page 336
(5) Overview over motion	You can display and edit all data of the motion segment of the cam profile here.
segments	& Chapter 10.7.3.8 'Overview over motion segments (profile overview)' on page 338
(6) Properties of the cam	You can display and edit general data about the cam profile and the selected master and slave axes here.
	\Leftrightarrow Chapter 10.7.3.9 'Properties of the cam (profile properties)' on page 339

10.7.3.1 Motion diagram

In the motion diagram (or motion plan) of the cam editor, you can edit the total motion graphically.

- The total motion (or cam profile) is divided into individual successive motion seg-ments. The motion diagram includes the individual segments of the total motion.
- Individual motion function (or motion laws) can be included into the motion diagram.
- Shockproof and jolt free motions can be guaranteed between the motion segments via matching conditions (or boundary value conditions).



Fig. 238: Motion diagram

- (1) x-axis (master axis)
- (2) y-axis (slave axis)
- (3) free segment (curve is thus not complete)
- (4) 1. Motion segment, here Polynomial 5. grade
- (5) 2. Motion segment, here straight line
- (6) 3. Motion segment (highlighted), here Polynomial 5. grade
- (7) Boundary point/connection point

Select/highlight segment

You can highlight a segment in the motion diagram.

Left-click on the desired motion segment.

⇒ The segment will be displayed highlighted.

The properties of the highlighted motion segment are shown in the tab 'segment'; see \mathcal{G} Chapter 10.7.3.7 'Properties of the motion segment' on page 336.

For inserting and editing of motion segments, see:

- Chapter 10.7.3.2 'Insert segments @' on page 331
- Chapter 10.7.3.4 'Draw segments' on page 333
- ♦ Chapter 10.7.3.8 'Overview over motion segments (profile overview)' on page 338
- ♦ Chapter 10.7.3.5 'Auto-complete the curve 🔥 ' on page 335

10.7.3.2 Insert segments 😪

In the motion diagram of the cam editor, you can insert successive motion segments in order to create the total motion of the cam.

Empty motion diagram

For a newly created cam, no motion segments are available – the motion diagram is empty.

- Right-click with the mouse button on the motion diagram and select 'Insert new segment'.
 - A motion segment with the motion function "Polynomial 5. grade" will be inserted.

In order to change the motion function, see Chapter 10.7.3.7 'Properties of the motion segment' on page 336.

Insert segment in front 👰

You can insert another segment in front of a motion segment.



Fig. 239: Insert segment in front

- (1) highlighted segment
- (2) original, shortened segment
- (3) new segment
- Right-click with the mouse button on the desired motion segment in the motion diagram and select *'Insert segment in front'*.
 - ⇒ The starting point of the highlighted segment will be moved to the centre. A motion segment with the motion function "Polynomial 5. grade" will be inserted at the free position. The boundary points of the two segments are connected in order to create a closed curve.

In order to change the motion function, see *Chapter 10.7.3.7 'Properties of the motion segment' on page 336.*

Insert segment behind 🚭

You can insert another segment behind a motion segment.

Create cams > Cam editor



Fig. 240: Insert segment behind

- (1) highlighted segment
- (2) new segment
- (3) original, shortened segment
- Right-click with the mouse button on the desired motion segment in the motion diagram and select 'Insert segment behind'.
 - ⇒ The end point of the highlighted segment will be moved to the centre. A motion segment with the motion function "Polynomial 5. grade" will be inserted at the free position. The boundary points of the two segments are connected in order to create a closed curve.

In order to change the motion function, see *Chapter 10.7.3.7 'Properties of the motion segment' on page 336.*

10.7.3.3 Delete segment 🔼

Right-click with the mouse button on the desired motion segment in the motion diagram and select 'Delete segment'.

 \Rightarrow The motion segment will be deleted.

Starting and end points of the neighbouring segments are moved into the centre of the deleted segment to avoid a closed curve being interrupted.



Fig. 241: Delete motion segment

- (1) highlighted segment
- (2) neighbouring segments after deletion

10.7.3.4 Draw segments

In the motion diagram of the cam editor, you can insert motion functions and move boundary points.

Insert and draw motion functions

If the cam profile is not complete, i.e. if there are free segments in the motion diagram, you can select motion functions via the toolbar and draw diagrams.



Fig. 242: Insert and draw motion functions

- (1) select motion function
- (2) free motion segment
- (3) draw motion functions
- **1.** Select the desired motion function in the toolbar of the cam editor. For an overview over the motion functions, see \Leftrightarrow *Chapter 10.7.4 'Motion functions' on page 341*.
- **2.** Left-click with the mouse in the free segment of the motion diagram and hold the mouse button pressed down.
 - \Rightarrow The starting point of the motion function will be set.
- **3.** Drag the mouse to the right, e.g. up to the starting point of the following segment, in order to connect both segments.
 - \Rightarrow The endpoint of the motion function will be moved.
- **4.** Release the mouse button.



Auto-complete the curve

Between motion segments which are not connected, you can have the motion function "Polynomial 5. grade" inserted automatically, see ♦ Chapter 10.7.3.5 'Auto-complete the curve \A' on page 335.

Move boundary points

You can move the starting, end, or connection points of a motion function in the motion diagram.



Fig. 243: Boundary points

- (1) Endpoint
- (2) Starting point
- (3) Connection point (starting and endpoint)
- **1.** Highlight the desired motion segment in the motion diagram.
 - \Rightarrow The segment will be displayed highlighted.
- **2.** Left-click with the mouse on the boundary point which you want to move hold the mouse button pressed down.
- 3. Drag the mouse in order to move the boundary point.
- **4.** Then release the mouse button.

Connect and disconnect boundary points

Boundary points are "magnetic":

- If you drag an endpoint onto the starting point of the following segment, both points will be connected.
- If you drag a starting point onto the endpoint of the previous segment, both points will be connected.
- If you drag a connection point slowly, the connection will stay intact.
- If you drag a connection point fast, the connection will be disconnected.

\bigcirc

The increment when moving the points depends on the display size of the motion diagram and the screen resolution. Under 'Properties of the motion segment', you can enter accurate values for the starting points and end points; see & Chapter 10.7.3.7 'Properties of the motion segment' on page 336.

10.7.3.5 Auto-complete the curve \Lambda

Between motion segments which are not connected, you can have the motion function "Polynomial 5. Grade" inserted automatically.

Create cams > Cam editor



Fig. 244: Auto-complete the curve

▶ Select 'Auto-complete the curve' in the toolbar of the cam editor.

On free positions, motion segments with the motion function "Polynomial 5. Grade" will be inserted. The boundary points of all segments are connected in order to create a closed curve.

In order to change the motion function, see *Chapter 10.7.3.7 Properties of the motion segment' on page 336.*

10.7.3.6 Motion characteristics

This diagram of the cam editor shows the development of the velocity, the acceleration and the jolt.

If the desired motion characteristic is not displayed, you have to select it via the toolbar of the cam editor; see \Leftrightarrow '(1) Toolbar' on page 329.



Fig. 245: Motion diagram

- (1) motion characteristic velocity (v)
- (2) motion characteristic acceleration (a)
- (3) motion characteristic jolt (j)
- (4) x- and y-coordinate of the current mouse pointer position
- (5) absolute maximum value of the characteristics
- (6) select scale of the y-axis for a motion characteristic

10.7.3.7 Properties of the motion segment

You can display and edit all data of a motion segment here.

Create cams > Cam editor

			verv	iew F	rofile	properties		
Section 0								
Properties								
Nar	me	[secti	ion 0				
Fur	nction		<u>^</u> s	ine-Line	e-Con	bination	*	
		Startpoir	nt			Endp	point	
x	470.0	0	÷	mm	x	670.00	÷	mm
у	120.0	1	÷	degree	У	120.00	¢	degree
Boundary value conditions								
Startpoi						Endp	point	
v	0.000		$\frac{\pm}{\mp}$		v	0.000	*	
	0.000			degree/s		0.000		degree/s
a	0.000	0	ŧ		а	0.0000	¢	
	-1.92	D		degree/s ²		1.920		degree/s ²
Par	amete	er			_			
λ	0.50		¢		Ų.			
c	0.50		ŧ		,Ų			
Cha	aracte	ristic valu	es					
Cv		1.2220						
Ca		7.6782		Ca*		-7.6782		
Cj		-48.2438		Cj*		-48.2438		
Cm	dyn	9.3831		Cmd	yn*	9.3831		
	Pro Nar Fur x y Boo v Boo v Boo v Boo v C C C C C C C C C C C C C C C C C C	Propertie Name Function x 470.0 y 120.0 Boundary v 0.000 a 0.000 a 0.000 c 0.0000 c 0.000 c 0.0000 c 0.00000 c 0.0000 c 0.0000 c 0.0000 c 0.00000 c 0.00000 c 0.00000 c 0.00000 c 0.00000000 c 0.0000000000	Properties Name Function Startpoir x 470.00 y 120.01 Boundary value constant Startpoir v 0.000 0.000 -1.920 Parameter A 0.50 c 0.50 Characteristic value Cv 1.2220 Ca 7.6782 Cj -48.2438 Cmdyn 9.3831	Properties Name secti Function Secti Function Secti Startpoint 120.01 x 470.00 y 120.01 Boundary value condit Startpoint v 0.000 a 0.0000 -1.920 Parameter A 0.50 c 0.50 Characteristic values Cv 1.2220 Ca 7.6782 Cj -48.2438 Cmdyn 9.3831	Image: Section 0 Name section 0 Function Sine-Line Startpoint Sine-Line x 470.00 mm y 120.01 degree Boundary value conditions Startpoint v 0.000 degree/s a 0.000 degree/s a 0.000 degree/s c 0.50 Image: Startpoint v 0.000 degree/s a 0.000 degree/s c 0.50 Image: Startpoint v 0.50 Image: Startpoint c 0.50 Image: Startpoint c <td< th=""><th>Section 0 Properties Name section 0 Function Sine-Line-Com Startpoint mm x x 470.00 mm x y 120.01 degree y Boundary value conditions Startpoint v 0.000 degree/s a 0.000 degree/s a a o o V 0.000 degree/s a a o o v A 0.50 Image: Conditions Image</th><th>Image: Section 0 Properties Name Section 0 Function Sine-Line-Combination Startpoint Endpoint x 470.00 mm x 670.00 y 120.01 degree y 120.00 Boundary value conditions V 0.000 0.000 o 0.000 degree/s 0.000 a 0.000 degree/s 0.000 a 0.000 degree/s 0.000 a 0.50 Image: Conditions Image: Conditions Characteristic values Cv 1.920 degree/s² 1.920 Parameter A 0.50 Image: Conditions Image: Conditions Image: Conditions Cv 1.2220 degree/s² 1.920 Image: Conditions Cv 1.2220 Image: Conditions Image: Conditions Image: Conditions Cv 1.2220 Image: Conditions Image: Conditions Image: Conditions Ci 0.50 Image: Conditions Image: Conditions Image: Conditions</th><th>Section 0 Properties Name section 0 Function Sine-Line-Combination Startpoint Endpoint x 470.00 mm x 670.00 • y 120.01 degree y 120.00 • Boundary value conditions Endpoint v 0.000 degree/s 0.000 • a 0.000 degree/s 0.000 • • A 0.50 • • • • • A 0.50 •</th></td<>	Section 0 Properties Name section 0 Function Sine-Line-Com Startpoint mm x x 470.00 mm x y 120.01 degree y Boundary value conditions Startpoint v 0.000 degree/s a 0.000 degree/s a a o o V 0.000 degree/s a a o o v A 0.50 Image: Conditions Image	Image: Section 0 Properties Name Section 0 Function Sine-Line-Combination Startpoint Endpoint x 470.00 mm x 670.00 y 120.01 degree y 120.00 Boundary value conditions V 0.000 0.000 o 0.000 degree/s 0.000 a 0.000 degree/s 0.000 a 0.000 degree/s 0.000 a 0.50 Image: Conditions Image: Conditions Characteristic values Cv 1.920 degree/s ² 1.920 Parameter A 0.50 Image: Conditions Image: Conditions Image: Conditions Cv 1.2220 degree/s ² 1.920 Image: Conditions Cv 1.2220 Image: Conditions Image: Conditions Image: Conditions Cv 1.2220 Image: Conditions Image: Conditions Image: Conditions Ci 0.50 Image: Conditions Image: Conditions Image: Conditions	Section 0 Properties Name section 0 Function Sine-Line-Combination Startpoint Endpoint x 470.00 mm x 670.00 • y 120.01 degree y 120.00 • Boundary value conditions Endpoint v 0.000 degree/s 0.000 • a 0.000 degree/s 0.000 • • A 0.50 • • • • • A 0.50 •

Fig. 246: Properties of the motion segment

Select segment		All configurations in this tab correspond to the highlighted motion segment. You can high- light the desired segment in the motion diagram, in the <i>'profile overview'</i> (see <i>S Chapter</i> <i>10.7.3.8 'Overview over motion segments (profile overview)' on page 338</i>) or here, via the two buttons:
	$\langle \rangle$	Select previous motion segment
	\Rightarrow	Select following motion segment
Properties		<i>'Name'</i> – Automatically created name of the motion segment. Change the name of the segment if required.
		<i>'Function'</i> – Motion function of the segment, see <i>Schapter 10.7.4 'Motion functions'</i> on page 341
		'Starting point' - x- and y-coordinates for the starting point of the motion segment
		'Endpoint' – x- and y-coordinates for the endpoint of the motion segment

In the input fields you can set the velocity (v) and the acceleration (a) for starting point and endpoint. The entered value is normed, i.e. it refers to the geometrical conditions. In the display fields below, the calculated physical values are displayed, e.g. "mm/s" or "degree/s" for velocity.
The parameters are not displayed for all motion functions.
$'\lambda'$ – Reversal point for asymmetric motion functions (or inflection point parameter): The entered value is normed, i.e. it refers to the geometrical conditions.
<i>'c'</i> – Synchronous line segment: The entered value is normed, i.e. it refers to the geometrical conditions.
The characteristic values of the motion segment are displayed here. The characteristic values are evaluation criteria for the operational behaviour of a cam gear.
<i>Cv'</i> – Characteristic value for velocity
'Ca' and 'Ca*' – Characteristic values for acceleration
<i>'Cj'</i> and <i>'Cj*'</i> – Characteristic values for jolt
'Cmdyn' and 'Cmdyn*' – Characteristic values for dynamic torque

10.7.3.8 Overview over motion segments (profile overview)

You can display and edit all data of the motion segment of the cam profile here.



Fig. 247: Overview over motion segments

Each line of the profile overview contains the data of a motion segment.

- $\mathbf{\dot{x}'}-\mathbf{x}\text{-coordinate}$ of the starting point of the segment
- 'y' y-coordinate of the starting point of the segment

'Function' – Motion function of the segment, see \Leftrightarrow Chapter 10.7.4 'Motion functions' on page 341

the last line of the profile overview contains the x- and y-coordinates of the endpoint of the last motion segment.

Highlight/select segment

- ▶ Left-click with the mouse in a line of the profile overview.
 - \Rightarrow The segment will be displayed highlighted.

Change boundary points

You can change the starting point, endpoint, or connecting point of a motion segment.

- ▶ Enter the desired x- or y-coordinate into the input field or click on the button ▲/▼.
 - ⇒ The boundary point will be moved. If the starting point is connected to the endpoint of the previous motion segment, this endpoint is set on the same coordinate. The connection between motion segments remains intact.

Insert segment in front 👰

- **1.** Right-click with the mouse in a line of the profile overview and select *'Insert segment in front'*.
 - ⇒ The starting point of the highlighted segment will be moved to the centre. A motion segment with the motion function "Polynomial 5. grade" will be inserted at the free position. The boundary points of the two segments are connected in order to create a closed curve.
- **2.** Change the motion function, if necessary.

Insert segment behind 🚭

- **1.** Right-click with the mouse in a line of the profile overview and select *'Insert segment behind'*.
 - ⇒ The end point of the highlighted segment will be moved to the centre. A motion segment with the motion function "Polynomial 5. grade" will be inserted at the free position. The boundary points of the two segments are connected in order to create a closed curve.
- **2.** Change the motion function, if necessary.
- 10.7.3.9 Properties of the cam (profile properties)

You can display and edit general data about the cam profile and the selected master and slave axes here.

	Sections	Profile o	verview	Profile p	properties		
Δ	Propertie	ties					
	Name		Cam_pro	file_01			
	Vmax [cyc	cles/min]	60]		
	Count of	points	512	*			
3)	Master a	xis					
	MC axis	MC_Mast	er *				
	Min	0		Max	1000		
	Unit	mm					
3	Slave axis						
	MC axis	MC_Axis_	.01 *				
	Min	1		Max	360		
	Unit	degree					

Fig. 248: Properties of the cam

Properties	<i>'Name'</i> – Name of the cam: If you change the name, a dialogue window will open where you can choose if <i>SPEED7 Studio</i> should adapt the name of the corresponding data block and the program code as well.
	<i>'Vmax'</i> – Velocity of the master axis, number of pulses per minute: V _{max} influences the values of the derivatives velocity, acceleration, and jolt and the dynamic characteristic values.
	<i>'Number of data points'</i> – Resolution of the master encoder: Number of data points which are stored in the data block and which are transferred from the control to the drive via the function block "MC_CamIn".
Master axis	In order to add new axes, see <i>Chapter 10.5 'Add new axis</i>
	To determine the measurement and user units of the axes, see & Chapter 10.6.2 'User units II' on page 323.
	'MC axis' – Master axis (or leading axis, reference axis): x-axis in the motion diagram
	<i>'Min'</i> – Minimum value of the x-axis: The value is always 0.
	'Max' – Maximum value of the x-axis
	<i>'Unit'</i> – Unit of the x-axis: The unit has no influence on the calculation of motions.
	'Number of revolutions' – Maximum number of motor revolutions
	'Increments per revolution' – Number of increments per motor revolution
Slave axis	In order to add new axes, see 🏾 Chapter 10.5 'Add new axis 🏊' on page 321.
	To determine the measurement and user units of the axes, see & <i>Chapter 10.6.2 'User units</i> H ' on page 323.
	'MC axis' – Slave axis (or following axis): y-axis in the motion diagram

'Min' – Minimum value of the y-axis: The value is always 0.

'Max' - Maximum value of the y-axis

'Unit' – Unit of the y-axis: The unit has no influence on the calculation of motions.

'Number of revolutions' - Maximum number of motor revolutions

'Increments per revolution' - Number of increments per motor revolution

10.7.4 Motion functions

Motion states

Depending on the velocity (v) and the acceleration (a), the following motion states result:

Characteristic	State	Boundary condition
R	Pause	Velocity $(v) = 0$,
		Acceleration (a) = 0
G	Velocity (constant)	Velocity (v) \neq 0,
		Acceleration (a) = 0
U	Reversal	Velocity $(v) = 0$,
		Acceleration (a) $\neq 0$
В	Motion	Velocity (v) $\neq 0$,
		Acceleration (a) $\neq 0$



Fig. 249: Motion states

- (1) Motion
- (2) Velocity (constant)
- (3) Reversal
- (4) Pause

Motion task

A motion task describes the transition from one motion state to another (or motion transition).

Example: The drive should maintain a constant velocity after the initial acceleration. The motion task is "motion in velocity", abbreviated "(MV)".

Motion tasks and applicable motion functions

Generally, the entire motion of a cam consists of several motion segments. At the segment boundaries (boundary points), several motion functions (or motion laws) can be connected with each other. The following table lists the usable motion functions for different motion tasks. At least one applicable motion function can be used for each possible combination of motion tasks.

Example: The motion task "Velocity in reversal (VR)" can be realised with the motion function "Polynomial 5. grade" or "Modified sine".

	Pause	Velocity	Reversal	Motion
Pause	 Straight line Polynomial grade Inclined sine Modified sine Modified acceleration trapezium 	N Polynomial 5. grade M Modified sine	 Polynomial grade Modified sine Modified acceleration trapezium 	N Polynomial 5. grade
Velocity	 Polynomial grade Modified sine 	 Straight line Polynomial grade Modified sine 	N Polynomial 5. grade N Modified sine	N Polynomial 5. grade
Reversal	 Polynomial grade Modified sine Modified acceleration trapezium 	N Polynomial 5. grade N Modified sine	N Polynomial 5. grade Sine-straight-com- bination	N Polynomial 5. grade
Motion	N Polynomial 5. grade	N Polynomial 5. grade	N Polynomial 5. grade	N Polynomial 5. grade

10.7.4.1 Straight line 🔀

The motion task "Straight line" can be used for synchronous line segments. The following motion tasks can be connected with the motion function "Straight line":

	Pause	Velocity	Reversal	Motion
Pause	•			
Velocity		•		
Reversal				
Motion				

10.7.4.2 Polynomial 5. grade 📐

Motion function "Polynomial 5. grade" can be used for all motion tasks.

Benefits:

■ Low characteristic values C_v, C_a and C_{mdyn} – i.e. low forces and torques





■ The C_i value is higher than for "Inclined sine".



With the motion function "Polynomial 5. grade", all motion tasks can be connected to each other:

	Pause	Velocity	Reversal	Motion
Pause	•	•	•	•
Velocity	•	•	•	•
Reversal	•	•	•	•
Motion	•	•	•	•



Fig. 251: Velocity "Polynomial 5. grade"



Fig. 252: Acceleration "Polynomial 5. grade"



Fig. 253: Jolt "Polynomial 5. grade"

10.7.4.3 Inclined sine 📉

Benefits:

- Very low C_j value
- Low-vibration motion
- Suitable for high speeds

Disadvantages:

Characteristic values C_v, C_a and C_{mdyn} are higher than for "Polynomial 5. grade".

Create cams > Motion functions



Fig. 254: Motion "Inclined sine"

With the motion function "Inclined sine", the following motion tasks can be interconnected:

	Pause	Velocity	Reversal	Motion
Pause	•			
Velocity				
Reversal				
Motion				



Fig. 255: Velocity "Inclined sine"



Fig. 256: Acceleration "Inclined sine"

10.7.4.4 Modified sine 📉

Benefits:

Very low characteristic values C_v, C_a and C_{mdyn} – i.e. very low forces and torques
 Suitable for high speeds

Disadvantages:

■ The C_i value is higher than for "Inclined sine".





With the motion function "Modified sine", the following motion tasks can be interconnected:

Create cams > Motion functions

	Pause	Velocity	Reversal	Motion
Pause	•	•	•	
Velocity	•	•	•	
Reversal	•	•		
Motion				

Velocity in velocity (VV)



Fig. 258: Velocity "Modified sine (VV)"



Fig. 259: Acceleration "Modified sine (VV)"

Velocity in reversal (VR) This motion form is also called "Harmonic combination".



Fig. 260: Motion "Modified sine (VR)"



Fig. 261: Velocity "Modified sine (VR)"



Fig. 262: Acceleration "Modified sine (VR)"

Create cams > Motion functions

Reversal in velocity (RV)



Fig. 263: Motion "Modified sine (RV)"



Fig. 264: Velocity "Modified sine (RV)"



Fig. 265: Acceleration "Modified sine (RV)"

10.7.4.5 Modified acceleration trapezium

Benefits:

- Very low C_a value
- Low inertia forces

Disadvantages:

The C_i value is higher than for "Inclined sine".





With the motion function "Modified acceleration trapezium", the following motion tasks can be interconnected:

	Pause	Velocity	Reversal	Motion
Pause	•		•	
Velocity				

Create cams > Motion functions



Pause in pause



Fig. 267: Velocity "Modified acceleration trapezium (PP)"



Fig. 268: Acceleration "Modified acceleration trapezium (PP)"



Fig. 269: Jolt "Modified acceleration trapezium (PP)"

Pause in reversal (PR)



Fig. 270: Velocity "Modified acceleration trapezium (PR)"



Fig. 271: Acceleration "Modified acceleration trapezium (PR)"



Fig. 272: Jolt "Modified acceleration trapezium (PR)"

Reversal in pause (RP)



Fig. 273: Acceleration "Modified acceleration trapezium (RP)"

10.7.4.6 Sine-straight-combination N

Benefits:

- Very low C_v value
- Low-vibration motion
- Suitable for high speeds

Disadvantages:

■ The C_a value is higher than for "Simple sine".

You will get the motion function "Simple sine" if you use the motion function "Sine-straight-combination" and set the parameter c=1; see \Leftrightarrow Chapter 10.7.3.7 'Properties of the motion segment' on page 336.



Fig. 274: Motion "Sine-straight-combination"

The following motion tasks can be connected with the motion function "Sine-straight-combination":

	Pause	Velocity	Reversal	Motion
Pause				
Velocity				
Reversal			•	
Motion				



Fig. 275: Velocity "Sine-straight-combination"



Fig. 276: Acceleration "Sine-straight-combination"

Overview

11 Deployment SPEED7 EtherCAT Manager

11.1 Overview

Properties

- Serves to configure EtherCAT master.
 - Is called within the SPEED7 Studio.
 - Synchronizes the address areas with the SPEED7 Studio.
 - Saves the configuration in the *SPEED7 Studio* project.
 - Expanded functionality by choose-able *'Expert'* mode.

Functions	 Automatic configuration Manual configuration Diagnosis
Starting the SPEED7 EtherCAT Manager	In SPEED7 Studio you can call via the 'Project tree', 'Field periphery' of the EtherCAT CPU the SPEED7 EtherCAT Manager with 'Bus system properties'.
Exit the SPEED7 EtherCAT Manager	By clicking at [X] in the SPEED7 EtherCAT Manager, the dialog is closed and the configuration is taken to the SPEED7 Studio.
Work environment of the SPEED7 EtherCAT Man- ager	The work environment of the SPEED7 EtherCAT Manager is divided into the following parts:

Automatic configuration of a slave system

SPEED/ EtherCAT Manager - Station config			
Configuration Mode			-
Project Explorer	Device Editor		_
EC-Mastersystem	Master IP Configuration F	Process Image I/O Address Overview	
 Slave_001 (0001) [VIPA 053-1EC00] 			
1 001: Module 1 [021-1BD00]	General		
Slave_002 (0002) [VIPA 053-1EC00]		EC-Mastersystem	
	Cycle Time [us]	32000	•
	Slaves connected to local system		
	Network Adapter	I AN-Verhindung 4 (Intel/B)-820/1000 GT-Decktopadanter)	-
2		Sele	ct
∠		J	
	Slaves connected to remote system	n	
	PG/OP Ethernet	172. 20.120.62	
	EC-Mastersystem	192.168.0.1	
	Custom remote system	172 20 120 62	
	Dert Dert		
		6000	
	Master-Instance	0 Dese	elect
Classic View Hat View			
Messages			₩
Level Time Message			
	_		
	5		
	Ŭ		
		_	
Networks: Naves: 2		Status: 🔍 🔍 Mode: ONFIG	STANDARD
V			
1 Tool bar: Here you can switch be	tween Configuration	5 Here all the messages are listed.	
and <i>Diagnosis</i> .		6 In this section you can find the number of netwo	orks and
2 Project explorer: Here master an	d slave stations of	slave stations.	
your system are listed.		7 Status area: With an online connection the 2 Sta	atus
3 Device editor: Properties dialog of	of a device (parameter)	LEDs flash alternately. At Modus it is shown wh	ether
respectively information area.		you are in operating mode <i>Diagnosis</i> or <i>Configu</i>	iration,
4 Selection of the view: In Classic	View all the subordi-	tollowed by the selected dialog sight Standard f	espec-
subordinate stations are shown indented	the same level		
	at the same level.		
Expert mode' In SPEED7 Studio you can call via the 'Project tree' 'Field periphery' of the EtherCAT			
CPU	the SPEED7 FtherCAT	Manager with 'Bus system properties (Expert)' Whe	en ena-
bled	the properties dialogs a	are extended accordingly. In 'Expert mode' you will have	ave the
full s	cope of the SPEED7 Et	herCAT Manager. Additionally in the status area Expe	ert'is
show	vn.		
Chief			

Input area - numeric
formatSome input fields have [Dec] respectively [Hex] buttons. By selecting the corresponding
button you can select the input format decimal respectively hexadecimal for the input
field.

11.2 Automatic configuration of a slave system

Precondition The automatic configuration assumes that your EtherCAT system is mounted and can be reached on-line.

There are the following possibilities for on-line connection:

- Slaves connected to the local system
 - You are directly connected to a slave station via EtherCAT by means of a separate network adapter. Here the on-line connection is established by specifying the *Network Adapter*.
- Slaves connected to remote system
 - You are connected to the Ethernet PG/OP channel of your CPU and can use this to access the EtherCAT master. The on-line connection is established by specifying *IP Address*, *Port* and *Master Instance*. With VIPA *Port* 6000 and *Master Instance* 0 is to be set.

Proceeding

- 1. Depending on the SPEED7 EtherCAT Manager
- 2. Click in the 'Project Explorer' at 'EC-Mastersystem'
- 3. Set depending on the on-line access in the 'Device Editor > Master' as follows:
 - If you are directly locally connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network adapter* and click at [Select].
 - If you are connected to the Ethernet PG/OP channel of you CPU, please enter IP Address, Port and Master Instance and click at [Select]. With VIPA set Port to 6000 and Master Instance to 0.
 - ⇒ The SPEED7 EtherCAT Manager uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.
 - When called from the SPEED7 Studio the IP address is taken from your project. If you change the IP address you need to adjust this in your project and start the SPEED7 EtherCAT Manager again!
- **4.** Click in the 'Project Explorer' at 'EC-Mastersystem' and select from the context menu 'Scan EtherCAT network'
 - ⇒ You might be asked if you want to delete the existing slaves. Confirm with [Yes].

Then the master is listed with its slaves and the associated PDO configuration in the *'Project Explorer'*, which was found by the network scan. The system can now be configured accordingly.

If there is no connection possible with the local master, the an anti virus software could block the connection. Then disabling the packet filter of the protocols of the network card in the anti virus software could help.

11.3 Manual configuration of a slave system

Precondition With the manual configuration the system need not be built and connected online. The system can freely be configured in the SPEED7 EtherCAT Manager.

Proceeding

- 1. Depending on the SPEED7 EtherCAT Manager.
- 2. Click at the 'Project Explorer' at 'EC-Mastersystem' and select 'Context menu → Append Slave(s)'.
 - ⇒ A dialog opens to insert slave systems

Configuration - EC-Mastersystem > Preparation

- **3.** Select the according slave from the list, enter the number of slaves and confirm with [OK].
 - ⇒ The corresponding slave systems are inserted and can be configured now.

11.4 Configuration - EC-Mastersystem

11.4.1 Preparation

Click in the Toolbar at [Configuration] and select '*EC-Mastersystem*' in the '*Project Explorer*'. As soon you have configured at least one slave station, the following registers are available:

- & Chapter 11.4.2 'Master' on page 359
- & Chapter 11.4.3 'Process Data Image' on page 360
- ♦ Chapter 11.4.4 'Advanced Options (Expert mode)' on page 360
- ♦ Chapter 11.4.5 'Distributed Clocks (Expert mode)' on page 363
- Schapter 11.4.6 'I/O Address Overview' on page 364

11.4.2 Master

Pro	iect E	xplorer	General		
-		EC-Mastersystem	Unit Name	EC-Mastersystem	
 Slave_001 (0001) 001: Module 	.2		Cycle Time [us]	32000	Ŧ
	*	Slave_001 (0001)			
	1 001: Module 1	Slaves connected to local system	l		
			Network Adapter	LAN-Verbindung 4 (Intel(R) PRO/1000 GT-Desktopadapter)	~
					Select
			Slaves connected to remote syste	em	

Slav	slaves connected to remote system					
١	PG/OP Ethernet	192.168.0.1				
0	EC-Mastersystem	192.168.0.1				
0	Custom remote system	192.168.0.1				
	Port	6000				
	Master-Instance	0	Deselect			

Here you can perform master and bus-specific settings.

- General
 - Unit Name: Name of the master
 - Cyclic time: Interval in µs, in which the process data are read and written (PDO cycle time). Here you can choose between different values.
- Slaves connected to the local system
 - You are directly connected to a slave station via EtherCAT by means of a separate network adapter. Here the on-line connection is established by specifying the *Network Adapter*.
- Slaves connected to remote system
 - You are connected to the PG/OP channel of your CPU and can use this to access the EtherCAT master. The on-line connection is established by specifying *IP Address, Port* and *Master Instance*.

IP Address: Enter the IP Address of the PG/OP channel of the remote CPU. Port: Port, over which the communication takes place with the remote CPU. With

VIPA use Port 6000. Master-Instance: Serves for the master instance of the remote system. With VIPA the master instance is 0.

With [Select] the *SPEED7 EtherCAT Manager* uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.

\bigcirc

When called from the SPEED7 Studio the IP address is taken once from your project. If you change the IP address you need to adjust this in your project and then start the SPEED7 EtherCAT Manager again.

Configuration - EC-Mastersystem > Advanced Options (Expert mode)

11.4.3 Process Data Image

Droject Evolerer				I/O addresses													
PIC	Project Explorer				Input addresses				Output addre	Output addresses							
-	1	<u> </u>	EC-Mastersystem	Sta	Start address:		384	1	Start address:		No value 🍦	No value 👘					
	-	1	Slave 001 (0001)	End Address: 391				End Address:									
			1 001: Module 1	Inp	Input addresses assigned (Byte). 9 Output addresses assigned (Byte). 1												
				_													
			1 of the date 1	No.	Bus address	Slave	Module	Slot	S7 Input address	Process Image	S7 Output address	Process Image	EtherCAT input address	EtherCAT output address	Туре	Order number	Cor
				1	1	Slave_001			384 - 391	•		···· · · ·	0 - 7		VIPA 053-1EC00	VIPA 053-1EC00	
				2	1	Slave_001	Module 1	1	392	•		*	8		021-18F00	021-18F00	
				3	1	Slave_001	Module 2	2		*	384	•		0	022-1BF00	022-18F00	

Here you have a list of S7 respectively EtherCAT addresses, which are used by the modules of all the slave stations. The 'S7 address' corresponds to the address in the address area of the CPU. By entering a new 'Start Address' you can adjust the S7 addressing of the input and output areas of the modules accordingly.



Information about the assignment of the in/output area can be found in the manual of your module.

Refresh

The 'I/O Addresses EtherCAT' are only visible in 'Expert mode'! 'I/O Addresses EtherCAT' are the offset addresses, which are used within the EtherCAT process image. You cannot change the address. You can use the addresses e.g. for EtherCAT network analysis.

If you have activated "Isochronous mode" via the feature set *'Motion Control + ... axes'*, you can use the *'Process image'* to place the address area of the corresponding module of a slave station in the OB61 process image. Otherwise, the address area is located in the OB1 process image or in the I/O area.

11.4.4 Advanced Options (Expert mode)

Project Explorer	Master Settings					
	Init Command Retries:	3 💌				
EC-Mastersystem Slave_001 (0001) I 001: Module 1	Properties: Slave Settings Startup Checking	Name Value MasterStateChangeTimeout (ms) 60000		Timeouts		
	Check Verdol 1 Check Product Check Revision	Code Number winber		SDO Access: Init->Pre-Op/Init->Bootstrap: Pre-Op->Safe-Op/Safe-Op->Op: Back to Pre-Op, Init: Op->Safe-Op:	0 (x)(ms) 3000 (x)(ms) 10000 (x)(ms) 5000 (x)(ms) 200 (x)(ms)	
	Identification Check Check Identifica Use Currer Copy Stati	ing ation nt Values on Address -> Identification Valu tification Value -> Station Addre	ue Iss	Mailbox Mode Cyclic State Change	10 📩 [ms]	
	Process Data Mode Disable LRW			Overwrite Mailbox Size Output Size: Input Size:	(bytes]	
	Overwrite Watchdog					
	Set Multiplier (Set PDI Watchd Set SM Watchd	Reg.: 0x400): log (Reg.: 0x410): og (Reg.: 0x420):				
					Apply changes to all slaves	
Configuration - EC-Mastersystem > Advanced Options (Expert mode)

This dialog is only visible in the '*Expert mode*'! In this dialog the parameters of the master system can be adjusted and the default settings for all the slave stations can be defined.

- Master Settings
 - Init Command Retries: Number of retries, beyond which a transmission error is returned. (default: 3)
 - MasterStateChangeTimeout: Here you can define a timeout for the state change of the master and its slave stations (default: 60000ms). If the MasterStateChangeTimeout is too short, the EtherCAT master reports the error message 0xED21.
- Slave Settings
 - In this area default parameters can be applied for all the slave stations. The settings are applied for all slave stations as default setting by clicking on [Apply changes (to all slaves)]. By selecting the slave station in the *'Project Explorer'* you always have the possibility to customize the slave parameters via the register *'Advanced Options'*.

Slave Settings

Start-up checking:

Here you can define the items, the EtherCAT master has to check during the transition *'Init→Pre-Op'* (Vendor ID, Product code, Revision number).

- Revision number can be verified:
 - "==" \rightarrow High word is equal, Low word is equal
 - ">=" \rightarrow High word is equal or greater, Low word is equal or greater
 - "LW ==" \rightarrow Low word is equal
 - "LW ==, HW >=" \rightarrow Low word is equal, High word is equal or greater
 - "HW ==" \rightarrow High word is equal
 - "HW ==, LW >=" \rightarrow High word is equal, Low word is equal or greater
- Identification checking:
 - With these parameters, you determine via which HotConnect address the EtherCAT master should identify the slave station.
 - 'Check identification': When activated, the text box below shows the current Hot-Connect address, which the EtherCAT master has to use to identify the slave station.
 - For identification via the address set on the address switch of the slave station (Explicit Device ID), you have to activate 'Check identification' and enter the corresponding ESC register address for addressing via the address switch at 'Select local address'.
 - For identification via SSI (Configured Station Alias) you have to activate 'Check identification' and enter the corresponding ESC register address for SSI activation at 'Select local address'. In this case, the Configured Station Alias address must be specified via 'EEPROM' of the slave station in diagnostics mode. In addition, you must specify the Configured Station Alias address in your configuration in 'Group' by means 'Identification value'.

♦ Chapter 11.8.4 'EEPROM (Expert mode)' on page 388

Schapter 11.9.3 'Create Hot Connect group' on page 394

For more information about the ESC register addresses, refer to the manual for your slave station.

Configuration - EC-Mastersystem > Advanced Options (Expert mode)

Process Data Mode:

Here you specify the command that should be used for process data access.

- *'LRW activate:'* With one Logical-Read-Logical-Write command inputs are read and also outputs are set. This needs 1 frame.
- *'LRW deactivate:' 'LRD/LWR:'* Read access with Logical-Read command to inputs and write access with Logical-Write command to outputs. This needs 2 frames.
- Overwrite Watchdog:

Writes the configured value in the relevant register of the slave station. Here among others you can set the time of the *'SM Watchdog'* (SyncManager-Watchdog).

- 'Set Multiplier': Writes the configured value to the corresponding slave register: 0x0400
- 'Set PDI Watchdog': Writes the configured value to the corresponding slave register: 0x0410
- 'Set SM Watchdog': Writes the configured value to the corresponding slave register: 0x0420



Please note that even if a watchdog is present, this need not be indicated in the ESI file and this is shown as inactive!

Timeouts:

'SDO Access': Internal master timeout for SDO access

'Init \rightarrow *Pre-Op'*: Internal master timeout for slave state change from *Init* to *Pre-Op 'Pre-Op* \rightarrow *Safe-Op*/*Safe-Op* \rightarrow *Op'*: Internal master timeout for slave state change from *Pre-Op* to *Safe-Op* and then to *Op*.

'Back to Pre-Op, Init': Internal master timeout for slave state change to Pre-Op and Init

'Op →Safe-Op': Internal master timeout for slave state change from Op to Safe-Op ⇔ Chapter 11.10 'EtherCAT State Machine' on page 396

Mailbox Mode:

The *'Mailbox'* is an a-cyclic communication channel. Here mostly *'Emergencies'* messages and *'SDOs'* are buffered. The way of accessing the just unread mailbox data can be specified here.

- 'Cyclic': Interval in ms within which the mailbox is to be read (polling mode). If you want short interrupt response times, you should select the mode 'Cyclic' and set a short time e.g. 1ms.
- 'State change': The mailbox is read only on a state bit change.
- Overwrite Mailbox Size
 - 'Output Size': Overwrites mailbox output size
 - *'Input Size'*: Overwrites mailbox input size
 - When changing the 'Process Data Mode' you have to refresh the addresses in the Register 'Process Image'.
 - If the Process Data Mode 'LRW' is used, the input and the output address of the EtherCAT process image must be identical. Here address leaks can occur between slave stations. If an EtherCAT address exceeds the maximum address area of the CPU, the current configuration gets invalid. You need to reduce the configuration or change to process data mode 'LRD/LWR'.
 - If you use long cycle times (> 100ms) you should always accordingly raise the 'SM Watchdog'. Otherwise your slave station changes after laps of 'SM Watchdog' time to Safe-Op and releases OB 86. From now on you can only manually set the slave to Op!

Configuration - EC-Mastersystem > Distributed Clocks (Expert mode)

11.4.5 Distributed Clocks (Expert mode)

Project Explorer EC-Mastersystem Slave_001 (0001) 1 001: Module 1	Due to the hardware, with local connections the function 'distributed clocks' is not supported.						
	Reference Clock						
	Name	No slave with activated DC in configuration					
	Clock Adjustment Master Shift (EtherCAT Master Time controlled by Reference Clock) Bus Shift (Reference Clock controlled by EtherCAT Master Time) External Mode (Reference Clock controlled by External Sync Device) 						
	Options						
	Continuous Propagation Compensation						
	Sync Window Monitoring						
	Show 64Bit System	Time					

Slaves with active DC

This dialog is only visible in the 'Expert mode'! Here you can adjust the clock functionality accordingly. In EtherCAT "Distributed Clocks" means a logical combination of "clocks", which are located in the EtherCAT devices. With this there is the possibility to locally provide a synchronized time in each bus device. If an EtherCAT device supports the Distributed Clocks functionality, it has its own clock. After PowerON this first locally works, based on an own pulse generator. By selecting an EtherCAT slave station, which has to provide the reference time, the distributed clocks can be synchronized. This reference clock so represents the system time.

- Reference clock: Here you get information about the clock, which provides the reference time.
 - Name: Name of the reference clock. Per default this is always the 1. slave station, which supports the "Distributed Clock (DC)" functionality.
- Clock adjustment
 - Master Shift: The EtherCAT master time is synchronized by the reference clock.
 - Bus Shift: The reference clock is synchronized by the EtherCAT master time.
 - External Mode: The reference clock is controlled by an external master

Configuration - EC-Mastersystem > I/O Address Overview

- Options
 - Continuous Propagation Compensation: A command (datagram) will be inserted in the cyclic frame which allows the EtherCAT master to measure and compensate the propagation delay time by time.
 - Sync Window Monitoring: A command (datagram) will be inserted in the cyclic frame to read the ESC registers 0x092C. If this is selected the master will throw a notification about the state (*sync* respectively *out-of-sync*) of your system.
 - 64bit system time: Master supports slaves with 32bit and 64bit system time register (0x0910). If this is selected he will interpret it as 64bit system time.
- Slaves with active DC
 - Shows a list of all slave stations with active DC

11.4.6 I/O Address Overview

Proj	ect E	cplorer	I/O addres	ses				
-	U	EC-Mastersystem	Input addres	sses	Output a	ddresses		
	*	📕 Slave_001 (0001)	Start address	12	Start addr	ess:		
		1 001: Module 1	End Address:	19	End Addre	ess:		
			Address	Name		Data type	Comment	*
			ED 0	d_HardwareInt	terruptC_0_1	DWORD	ED 0.0 - Slave_001 Hardware Interrupt Counter When Auto-Acknowledge is enabled it in process alarms. Otherwise it shows only that an alarm has occurred. Write on object 0x5000:6 to reset the counter or to acknowledge the alarm respectively. [Device: Slave_001 Slot 0]	
			ED 4	d_DiagnosticIn	terrup_4_1	DWORD	ED 4.0 - Slave_001 Diagnostic Interrupt Counter When Auto-Acknowledge is enabled it ir diagnostic alarms. Otherwise it shows only that an alarm has occurred. Write on object 0x5002:6 to reset the counter or to acknowledge the alarm respectively. [Device: Slave_001 Slot 0]	

Here you have a list of addresses that are used by the I/O components of all the modules in the address area of the CPU. By entering a new *'Start address'* you can adjust the addressing of the input and output areas accordingly. You can edit *'Name'* and *'Comment'* by clicking at the corresponding entry.



Information about the assignment of the in/output area can be found in the manual of your module.

11.5 Configuration - slave station

11.5.1 Preparation

Click in the Toolbar at [Configuration] and select the Slave-Station 'Slave_...' in the 'Project Explorer'. The following registers are available now:

 $\boldsymbol{\mathfrak{G}}$ Chapter 11.5.2 'General' on page 366

Schapter 11.5.3 'Modules' on page 367

Schapter 11.5.4 'PDO Mapping' on page 368

Group - if a group exists for this slave station

Schapter 11.9 'Grouping logic' on page 391

& Chapter 11.5.5 'Advanced Options (Expert mode)' on page 371

♦ Chapter 11.5.6 'Ethernet (EoE)' on page 374

& Chapter 11.5.7 'Distributed Clocks (Expert mode)' on page 375 - if supported

& Chapter 11.5.8 'Init Commands (Expert mode)' on page 376

♦ Chapter 11.5.9 'CoE Object Dictionary (Expert mode)' on page 378

& Chapter 11.5.10 'Process Image' on page 379

Schapter 11.5.11 'I/O Address Overview' on page 379

& Chapter 11.5.12 'Parameter' on page 380

Configuration - slave station > General

11.5.2 General

Proje	ct Explorer	Address		
-	EC-Mastersystem	Station Address		7 💌
	r 📲 Slave_001 (0001) [VI	Information		
	1 001: Module 1	Name		Slave_007
		Description		VIPA 053-1EC00 EtherCAT Fieldbus coupler (MDP)
		Vendor		VIPA GmbH (0x0000AFFE)
		Product Code		0x0531EC00 (87157760)
		Revision Number		0x00010001 (65537)
		ESI File		C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles \Vipa 053-1EC00 MDP.xml
		Identification Value		Not Used
		Ports		
		А		Slave_001 (0001) / Port C [X2 OUT]
		D		Not Connected
		В	۲	Not Connected
		с		Not Connected

Here you can perform slave-specific settings such as assignment of name and address to a station. It is also possible to change the connection to the station.

- Address
 - Station Address: EtherCAT address of the slave station.
- Information
 - Name: Name of the slave station can be assigned accordingly.
 - Description: Description of the slave station.
 - _ Vendor: Name of the vendor.
 - Product Code: Internal product code of the slave station.
 - Revision Number: Internal revision number of the slave station. _
 - ESI File: Path and name of the device file, in which the data of the slave station is stored.
 - Identification Value: Identification Value of the slave station
- Ports
 - Connected Devices: List of connected slave stations. _
 - _ Predecessor Device: Name of the predecessor device.
 - If topology should be changed, please use the 'Edit Topology' dialog.

Configuration - slave station > Modules

11.5.3 Modules



Download Slot Configuration

Load Modules

With an E-Bus slave this dialog is hidden. 🏷 Chapter 11.9 'Grouping logic' on page 391

In this dialog you can assign modules to the appropriate slot.

Connect module to slot ("<<")</p>

Select your module from the list on the right and add it to a selected slot *'Terminals'* in the left list by clicking [<<]. This takes place according to the following rules:

- If no modules are configured, the module is connected to the highlighted slot.
 Each additional module is inserted below.
- If modules are already exist, the module is added to the highlighted slot and the following modules are moved accordingly.
- Disconnect module from slot ("X")
 - Select from the left list the appropriate slot, which you want to disconnect from the module again and click at ["X"].



- Option field 'Download slot configuration' When enabled, an Init Command is created, which contains the slot configuration with the unique module identifier. During start-up of the slave station the slot configuration serves for comparison between configured and inserted modules. This can prevent misconfigurations.
- 'Load modules' With this function you can load the configuration from the EtherCAT master for the selected slave station.

Load PDO information

Configuration - slave station > PDO Mapping

11.5.4 PDO Mapping

Project Explorer	Select	The Inputs			
 EC-Mastersystem 	•	Inputs			0x1AFF
 Slave_001 (0001) [VI 		Name	Index	Bit Length	_
1 001: Module 1		Hardware Interrupt	0xF100:01	32	
		Diagnostic Interrup	0xF100:02	32	
	▼		1BB10).Eingänge		0x1A00
		Name	Index	Bit Length	_
		O IA	0x6000:01	16	
		AI 1	0x6000:02	16	

Add

This dialog shows a list of the assigned PDOs. With some slave stations it is possible to activate respectively de-activate certain PDO configurations.

Edit

Delete

- Select the Inputs
 - If your slave station supports it, you can hide the corresponding input PDO from the configuration by disabling the checkbox.

Up

Down

- Select the Outputs
 - If your slave station supports it, you can hide the corresponding output PDO from the configuration by disabling the checkbox.
- Only 'Expert mode'
 - Add / Delete / Edit:

Used for changing the lists, if it is allowed by the ESI. First the list, which you want changed, must be selected.

Up / Down:

Moving the selected PDO in the selected list up or down.

– Load PDO information:

Here you can load PDO information directly from the slave station.

Configuration - slave station > PDO Mapping

11.5.4.1 Add or edit PDO (Expert mode)

🚽 Edit PDO			
General			Optional
Name	Module 1 (021-1BD00)	.Inputs	Exclude:
Index	0x1A00	Dec Hex	1AFF
Flags	Direction		
Mandatory	TxPdo		
✓ Fixed Content	◯ RxPdo		
Virtual PDO	Sync Manager		
	0 -		
Entries			
Name	Index	Bit Length	n Comment 🔺
DI 0	0x6000:01	1	
DI 1	0x6000:02	1	
DI 2	0x6000:03	1	
DI 3	0x6000:04	1	
Add	Delete Edit	Up	Down
	ОК	Cancel	

PDOs can only be edited in the 'Expert mode'! Otherwise, the functions are hidden. With [Edit] the dialog 'Edit PDO' opens.

- General
 - Name: Name of the PDO
 - Index: Index of the PDO (can be entered in hexadecimal or decimal)
- Flags
 - Mandatory: If activated the PDO cannot be deleted.
 - Fixed Content: If activated the content of the PDO is write protected. to create new or to edit existing PDOs you have to disable 'Fixed Content'.
 - Virtual PDO: If activated the PDO has no entries.
- Direction
 - TxPDO: Send PDO of the slave station for input data.
 - RxPDO: Receive PDO of the slave station for output data.
- Sync Manager
 - Selected the sync manager, which should be used. The selection is only visible if more than one sync manager can be used.
- Optional
 - Exclude: Select the PDOs which cannot be activated if this PDO is activated.
- Entries
 - Here is the list of configured PDO entries shown.

Configuration - slave station > PDO Mapping

\bigcirc

After editing the PDOs, the addresses need to be re-calculated! For this jump to register 'Process Image' and click at [Recalculate].

11.5.4.2 Add PDO (Expert mode)

Via the following dialog the user add a PDO entry.

- General
 - Name: Name of the PDO entry
 - Comment: Comment of the PDO entry
 - Swapping: Swapping mode of the PDO entry
- Settings
 - Index: Index of the PDO entry (can be entered in hexadecimal or decimal)
 - Subindex: Subindex of the PDO entry (hexadecimal)
 - Datatype: List of available datatypes
 - Bit Length: Length of the PDO entry in bits
- CoE Object-Dictionary (loaded only if Object-Dictionary is supported by slave)

11.5.4.3 Edit PDO (Expert mode)

Via the following dialog the user adit a PDO entry.

- General
 - Name: Name of the PDO entry
 - Comment: Comment of the PDO entry
 - Swapping: Swapping mode of the PDO entry

Configuration - slave station > Advanced Options (Expert mode)

11.5.5 Advanced Options (Expert mode)

Project Explorer EC-Mastersystem Slave_001 (0001) [VI 1 001: Module 1	Startup Checking Check Vendor ID Check Product Code Check Revision Number == Check Serial Number	Timeouts SDO Access: Init->Pre-Op/Init->Bootstrap: Pre-Op->Safe-Op/Safe-Op->Op: Back to Pre-Op, Init: Op->Safe-Op:	Timeouts SDO Access: 0 (ms] Init->Pre-Op/Init->Bootstrap: 3000 (ms] Pre-Op->Safe-Op/Safe-Op->Op: 10000 (ms] Back to Pre-Op, Init: 5000 (ms] Op->Safe-Op: 200 (ms]				
	Identification Checking Check Identification 0 Dec Hex Select Local Address 0x0012 Dec Hex	Mailbox Mode © Cyclic © State Change	10 🛝 [ms]				
	Process Data Mode Disable LRW	Overwrite Mailbox Size Output Size: Input Size:	(bytes)				
	Overwrite Watchdog Set Multiplier (Reg.: 0x400): Set PDI Watchdog (Reg.: 0x410): Set SM Watchdog (Reg.: 0x420):						

This dialog is only visible in the '*Expert mode*'! Here you can make further adjustments to the slave station.

Slave Settings

Start-up checking:

Potential Reference Clock

Distributed Clocks

Here you can define the items, the EtherCAT master has to check during the transition '*Init* \rightarrow *Pre-Op*' (Vendor ID, Product code, Revision number).

- Revision number can be verified:
 - "==" \rightarrow High word is equal, Low word is equal
 - ">=" \rightarrow High word is equal or greater, Low word is equal or greater
 - "LW ==" \rightarrow Low word is equal

"LW ==, HW >=" \rightarrow Low word is equal, High word is equal or greater

- "HW ==" \rightarrow High word is equal
- "HW ==, LW >=" \rightarrow High word is equal, Low word is equal or greater
- Identification checking:
 - With these parameters, you determine via which HotConnect address the EtherCAT master should identify the slave station.
 - 'Check identification': When activated, the text box below shows the current Hot-Connect address, which the EtherCAT master has to use to identify the slave station.
 - For identification via the address set on the address switch of the slave station (Explicit Device ID), you have to activate 'Check identification' and enter the corresponding ESC register address for addressing via the address switch at 'Select local address'.
 - For identification via SSI (Configured Station Alias) you have to activate 'Check identification' and enter the corresponding ESC register address for SSI activation at 'Select local address'. In this case, the Configured Station Alias address must be specified via 'EEPROM' of the slave station in diagnostics mode. In addition, you must specify the Configured Station Alias address in your configuration in 'Group' by means 'Identification value'.

Schapter 11.8.4 'EEPROM (Expert mode)' on page 388

Schapter 11.9.3 'Create Hot Connect group' on page 394

Configuration - slave station > Advanced Options (Expert mode)

For more information about the ESC register addresses, refer to the manual for your slave station.

- Process Data Mode:
 - Here you specify the command that should be used for process data access.
 - 'LRW activate:' With one Logical-Read-Logical-Write command inputs are read and also outputs are set. This needs 1 frame.
 - *'LRW deactivate:' 'LRD/LWR:'* Read access with Logical-Read command to inputs and write access with Logical-Write command to outputs. This needs 2 frames.
- Overwrite Watchdog:

Writes the configured value in the relevant register of the slave station. Here among others you can set the time of the *'SM Watchdog'* (SyncManager-Watchdog).

- *'Set Multiplier'*: Writes the configured value to the corresponding slave register: 0x0400
- 'Set PDI Watchdog': Writes the configured value to the corresponding slave register: 0x0410
- 'Set SM Watchdog': Writes the configured value to the corresponding slave register: 0x0420

Please note that even if a watchdog is present, this need not be indicated in the ESI file and this is shown as inactive!

Timeouts:

'SDO Access': Internal master timeout for SDO access

'Init \rightarrow *Pre-Op'*: Internal master timeout for slave state change from *Init* to *Pre-Op 'Pre-Op* \rightarrow *Safe-Op*/*Safe-Op* \rightarrow *Op'*: Internal master timeout for slave state change from *Pre-Op* to *Safe-Op* and then to *Op*.

'Back to Pre-Op, Init': Internal master timeout for slave state change to Pre-Op and Init

'Op →Safe-Op': Internal master timeout for slave state change from Op to Safe-Op ⇔ Chapter 11.10 'EtherCAT State Machine' on page 396

Mailbox Mode:

The *'Mailbox'* is an a-cyclic communication channel. Here mostly *'Emergencies'* messages and *'SDOs'* are buffered. The way of accessing the just unread mailbox data can be specified here.

- 'Cyclic': Interval in ms within which the mailbox is to be read (polling mode). If you want short interrupt response times, you should select the mode 'Cyclic' and set a short time e.g. 1ms.
- *'State change'*: The mailbox is read only on a state bit change.
- Overwrite Mailbox Size
 - 'Output Size': Overwrites mailbox output size
 - *'Input Size'*: Overwrites mailbox input size

Configuration - slave station > Advanced Options (Expert mode)

- When changing the 'Process Data Mode' you have to refresh the addresses in the Register 'Process Image'.
 If the Process Data Mode 'LRW' is used, the input and the output address of the EtherCAT process image must be identical. Here address leaks can occur between slave stations. If an EtherCAT address exceeds the maximum address area of the CPU, the current configuration gets invalid. You need to reduce the configuration or change to process data mode 'LRD/LWR'.
 If you use long cycle times (> 100ms) you should always accordingly raise the 'SM Watchdog'. Otherwise your slave station changes after laps of 'SM Watchdog' time to Safe-Op and releases OB 86. From now on you can only manually set the slave to Op!
- Distributed Clocks: 'Potential Reference Clock'
 - Every slave station can be used as a 'Potential Reference Clock' if the slave supports the DC registers. The setting is used, when you remove the slave with activated 'Potential Reference Clock' e.g. via 'Hot Connect', then the master searches for a slave station where 'Potential Reference Clock' is activated. If no slave is available, the first DC slave is used.

Configuration - slave station > Ethernet (EoE)

11.5.6 Ethernet (EoE)

Project Explorer	Ethernet	
 EC-Mastersystem Slave_001 (0001) [VI 	Virtual MAC address	02 00 00 00 00 04 🗹 Auto
1 001: Module 1	Time Stamp Requested	
	Port Mode	Switch Port IP Port
	Overwrite IP Settings	
	IP Address	1 . 0 . 0 . 0
	Subnet Mask	1 . 0 . 0 . 0
	Default Gateway	1 . 0 . 0 . 0
	DNS Server	1 . 0 . 0 . 0
	DNS Name	

Here you activate or change EoE (Ethernet over EtherCAT) the settings.

- Ethernet (activates EoE support)
 - Virtual MAC address: Virtual MAC address. If 'Auto' is checked, the Virtual MAC address will be generated from the Station Address, e.g. Station Address is "1010" (= 0x03F2), will generate the Virtual MAC address: "01 00 00 00 3F2"
 - Time Stamp Requested: Slave station will response with the exact send time and the same Frame number and he should response as soon as possible.
 - Port Mode: Slave station can be run in 'Switch Port' or 'IP Port' mode.
- Override IP Settings
 - All IP settings will be overwritten from master like IP Address, Subnet Mask, Default Gateway, DNS Server and DNS Name.

Configuration - slave station > Distributed Clocks (Expert mode)

11.5.7 Distributed Clocks (Expert mode)

Project Explorer EC-Mastersystem Slave_001 (0001) [VI 001: Module 1	Distributed Clock Operation Mode Sync Unit Cycle (us) Overwrite Mode	DC for synchronization I000
	Sync Units	
	📝 Sync Unit 0	
	Cycle Time Sync Unit Cycle User defined Shift Time (us)	e × 1 • 1000 us
	Sync Unit 1	
	Cycle Time Sync Unit Cycl Sync 0 Cycle User defined	e x 1 • 0 us x 1 • 0 us
	Shift Time (us)	

This dialog is only visible in the 'Expert mode' if this is supported by your slave station! Here you can adjust the settings for Distributed Clocks accordingly. In EtherCAT "Distributed Clocks" (DC) means a logical combination of "clocks", which are located in the EtherCAT devices. With this there is the possibility to locally provide a synchronized time in each bus device. If an EtherCAT device supports the Distributed Clocks functionality, it has its own clock. After PowerON this first locally works, based on an own pulse generator. By selecting an EtherCAT slave station, which has to provide the reference time, the distributed clocks can be synchronized. This reference clock so represents the system time.

- Reference clock
 - Operation Mode: Here you can set the operation mode of the reference clock. More may be found in the manual of your slave station.
 - Sync Unit Cycle: Cycle time of the master. Schapter 11.4 'Configuration EC-Mastersystem' on page 358
- Sync Units
 - Sync Unit 0
 - Cycle Time: Here you can specify the cycle time in relation to the 'Master Cycle' or 'User defined'.
 - Time Shift: Specify here a time shift. This is used for fine adjustment.
 - Sync Unit 1
 - Cycle Time: Here you can specify the cycle time in relation to the *'Master Cycle'*, to the cycle of Sync Unit 0 *'Sync 0 Cycle'* or *'User defined'*.
 - Time Shift: Specify here a time shift. This is used for fine adjustment.



Due to the hardware with a local connection Distributed Clocks (connection via network adapter) is not supported!

Configuration - slave station > Init Commands (Expert mode)

11.5.8 Init Commands (Expert mode)

Proje	ct Explorer	Init Commands								
-	EC-Mastersystem	Transition	Protocol	Index	Value		Comment		Access	*
	r 🛛 📗 Slave_001 (0001) [VI	Pre-Op->Safe-Op	CoE	0x3100:007	0	D	ownload to Upper li	mit value channe	el O RW	
	1 001: Module 1	Pre-Op->Safe-Op	CoE	0x3100:003	0	D	ownload to Limit va	lue monitoring	RW	
		Edit Value								
		Va	lue:							
		Edit Init Commands	5							
		Move Up	Move Do	wn		New	Сору	Edit	Delete	

This dialog is only visible in the 'Expert mode'!



Here you can see a list of the current configured Init Commands and if it is allowed you can also add/edit/delete the commands.

- Init Commands: Init Commands come from the ESI file or are automatically generated on write access to CoE objects or can be created by the user. You either have fullaccess (RW = Read/Write) or only read access (RO = Read-only). Init commands from ESI files are automatically listed here. These cannot be changed or deleted.
- Edit Init Commands
 - New, Copy, Edit, Delete: Used for changing Init Commands.
 - Move Up, Move Down: Moving the selected Init Command up or down.

Configuration - slave station > Init Commands (Expert mode)

11.5.8.1 CoE Init Command (Expert mode)

🦪 Edit C	CoE Init Com	imand								
Genera	I .									
Index		0x3102	Dec Hex		SubIndex	0x0	001	Dec	Hex	
Value		0x000000	1					Dec	Hex	
Comn	nent	Download	to Diagnostic inter	rupt						
Transition Init->Pre-Op Pre-Op->Safe-Op Safe-Op->Pre-Op Safe-Op->Op Op->Safe-Op										
Further	Settings				Direction					
	Complete Ac	cess			Download					
V	/alidate valu	e								
CoE Ob	ject-Dictior	nary								
	Index Na	me			Flags		Туре	Value	*	
•	0x1C32 SM	output param	neter		(RO RO I	RO)	USINT	-		
•	0x1C33 SM	input parame	ter		(RO RO I	RO)	USINT	-		
•	0x3000 Co	upler paramet	er		(RO RO I	RO)	USINT	1 (0x01)		
•	0x3102 Par	ameter VIPA 0	31-1BB90		(RO RO I	RO)	USINT	14 (0x0E)	
	SubIndex Name				Flags		Туре	Value		
	0x01	Diagnostic int	errupt		(RW RW	RW)	USINT	0 (0x00	0	
	0v02	Wire break rer	conition		(RW RW	RW	LISTNI	n (0v0)	0 · ·	
			ОК	Ca	ancel					

This dialog is only visible in the '*Expert mode*'! With [New] the dialog 'Add CoE Init Command' opens. This dialog also opens to edit CoE Init Commands, which just exist.

- General
 - Index/Subindex: CoE-Index respectively Subindex of the Init Command
 - Value: Value of the Init Command, which should be written in the chose transition (only available if *'Direction'* is set to *'Download'*). If type of data is unknown, the hex format must be used. (Example: "0011 2233 ...").
 - Comment: Here you can comment your Init Command.
- Transition
 - Determines in which transition the Init Command will be executed.
- Further Settings
 - Complete Access: Determines if the complete SDO object should be written/read.
- Direction
 - Download: Writes value to slave station.
 - Upload: Reads value from slave.
- CoE Object Dictionary: Select here the value in the CoE Object Dictionary of the slave station, you want to edit.

Configuration - slave station > CoE Object Dictionary (Expert mode)

11.5.9 CoE Object Dictionary (Expert mode)

Project Explorer	Values					
 EC-Mastersystem 	Index	Name	Value	alue Type F		
 Slave_001 (0001) [VI 	0x1000	Device Type	-	UDINT	(RO RO RO) =
1 001: Module 1	0x1008	Device Name	-	STRING(17) (RO RO RO))
1	0x1009	Hardware Version	-	STRING(3)	(RO RO RO)
	0x100A	Software Version	-	STRING(12)) (RO RO RO))
	0x100B	System Version	-	USINT	(RO RO RO)
	▶ 0x1018	Identity	-	USINT	(RO RO RO	•
	Edit Value					
		Value:			Write Re	eset

This dialog is only visible in the 'Expert mode'! Here you will have read and write access to the CoE Object Dictionary of the slave station. This can be changed if your slave station permits. It is indicated by the 'Flags' of each object, if write access is permitted. Information about the structure of the Object Dictionary can be found in the manual of your slave station.

Description of the flags: "AA BB (CC DD EE)"

- AA. BB
 - Rx: Mapping as receive PDO
 - Tx: Mapping as send PDO
 - _ --: Mapping not allowed

Value:

- CC:
 - Access rights for state PreOp (RO, WO, RW) _
- DD:
 - Access rights for state SafeOp (RO, WO, RW)
- EE:
 - Access rights for state Op (RO, WO, RW)
 - Schapter 11.10 'EtherCAT State Machine' on page 396
- Edit Value
 - Write: Changes the selected entry _
 - Reset: Resets the selected entry to ESI default



Configuration - slave station > I/O Address Overview

11.5.10 Process Image

Project Explorer		I/O addresses									
· .	EC-Mastersystem	Input addresses					Output address	es			
-	📕 Slave_001 (0001) [VI	Start	address:				Start address:				
	1 001: Module 1	End /	Address:				End Address:				
1		Inputaddresses assigned (Byte).		e). 20)	Outputaddresses assigned (Byte).		15			
		No.	Bus address	Slave	Module	Slot	S7 Input address	S7 Output address	EtherCAT input address	EtherCAT output address	Ту
		2 1 Slave_001				0 - 7		0 - 7		VI	
		3 1 Slave_001 M		Module 1	1	8 - 11		8 - 11		VI	
		Here mod addr addr	e you hav ules of th ess area essing o	ve a list ne slave of the f the ing	of S7 e syste CPU. I out and	resp m. By e d ou	Dectively Eth The <i>'S7 ado</i> entering a ne tput areas o	nerCAT addre Iress' corresp ew <i>'Start add</i> of the module	esses, which are ponds to the add lress' you can a s accordingly.	e used by the dress in the djust the S7	I



Information about the assignment of the in/output area can be found in the manual of your module.

The 'I/O addresses EtherCAT' are only visible in 'Expert mode'! 'I/O addresses EtherCAT' are the addresses, which are used within the EtherCAT bus. You cannot change the address. You can use the addresses e.g. for EtherCAT network analysis.

11.5.11 I/O Address Overview



I/O addres	ses		
Input addre	sses Output a	ddresses	
Start address	s: 8 Start add	ress:	
End Address	8 End Addr	ess:	
Address	Name	Data type	Comment
ED 0	d_HardwareInterruptC_0_1	DWORD	ED 0.0 - Slave_001 Hardware Interrupt Counter When Auto-Acknowledge is enabled it indical process alarms. Otherwise it shows only that an alarm has occurred. Write on object 0x5000:6 to reset the counter or to acknowledge the alarm respectively. [Device: Slave_001 Slot 0]
ED 4	d_DiagnosticInterrup_4_1 DWOR		ED 4.0 - Slave_001 Diagnostic Interrupt Counter When Auto-Acknowledge is enabled it indica diagnostic alarms. Otherwise it shows only that an alarm has occurred. Write on object 0x5002:6 to reset the counter or to acknowledge the alarm respectively. [Device: Slave_001 Slot 0]

Here you have a list of addresses, which are used by the I/O components of the modules of the selected slave system in the address area of the CPU. By entering a new 'Start address' you can adjust the addressing of the input and output areas accordingly. You can edit 'Name' and 'Comment' by clicking at the corresponding entry.



Information about the assignment of the in/output area can be found in the manual of your module.

Reset

Configuration - modules > Preparation

11.5.12 Parameter

Pro	ject E	xplorer	Parameter			
-	U.	EC-Mastersystem	Auto-Acknowledge	5		
	-	📲 Slave_001 (0001) [VI				
		1 001: Module 1				

If the parameters of the slave station can be determined such as a System SLIO slave station, the slave parameters can be set here. With [Reset], the parameters of the slave station are reset to their default values.



More information about the parameters can be found in the manual of you slave station.

11.6 Configuration - modules



With an E-Bus slave the dialog of the module configuration are hidden! & Chapter 11.9 'Grouping logic' on page 391

11.6.1 Preparation

Select in the configuration mode in the *'Project Explorer'* the module of the according slave station. The following registers are available now:

- & Chapter 11.6.2 'MDP Slot Properties' on page 381
- & Chapter 11.6.3 'Process Image' on page 381
- & Chapter 11.6.4 'I/O Address Overview' on page 382
- ♦ Chapter 11.6.5 'Parameter' on page 382

Configuration - modules > Process Image

11.6.2 MDP Slot Properties

Projec	t Explorer	General	
*	EC-Mastersystem	Vendor	VIPA GmbH (0xAFFE / 45054)
-	📱 Slave_001 (0001) [VI	ESI File of Slave	C:\Users\Public\Documents\VIPA GmbH\SPEED7 Studio\EtherCAT\EsiFiles\Vipa 053-1EC00 MDP.xml
	î 001: Module 1	Slot	
		Name	Terminals
		Number	001
		Module	
		Name	Module 1
		Description	VIPA 031-1BB10, AI 2x12Bit 020mA, potentialgetrennt
		Туре	031-1BB10
		Class	sm_ana_in

Here you can see the MDP Slot Properties of the corresponding module. This dialog serves for information. You cannot change something.

General

Ident

- Vendor: Name of the vendor of the module.

0x04111543 (68228419)

- ESI file: Path and name of the device file, in which the data of the module and the associated slave station is stored.
- Slot
 - Name: Name of the slot
 - Number: Number of the slot
- Module
 - Name: Name of the module
 - Type: Order number of the module
 - Class: Module class
 - Identificator: Identification number of the according module class.

11.6.3 Process Image

Project Explorer		I/O addresses								
 EC-Mastersystem 	Inpu	t addresses				Output address	es			
 Slave_001 (0001) [VI 	Start address:				Start address:					
î 🛿 001: Module 1	End Address:				End Address:					
	Inputaddresses assigned (Byte).		e). 20		Outputaddresses	s assigned (Byte).	0			
	No.	Bus address	Slave	Module	Slot	S7 Input address	S7 Output address	EtherCAT input address	EtherCAT output address	Ту
	2	1	Slave_001	Module 1	1	8 - 11		8 - 11		VIF

Here you have a list of S7 respectively EtherCAT addresses, which are used by the modules of all the slave stations. The 'S7 *address*' corresponds to the address in the address area of the CPU. By entering a new 'Start Address' you can adjust the S7 addressing of the input and output areas of the modules accordingly.



Information about the assignment of the in/output area can be found in the manual of your module.

Configuration - modules > Parameter

The 'I/O Addresses EtherCAT' are only visible in 'Expert mode'! 'I/O Addresses EtherCAT' are the addresses, which are used within the EtherCAT bus. You cannot change the addresses. You can use the addresses e.g. for EtherCAT network analysis.

11.6.4 I/O Address Overview

Project Explorer EC-Mastersystem Slave_001 (0001) [VI 001: Module 1

I/O addres	ses						
Input addresses		Output addresses					
Start address	s: 8 Sta	art address:					
End Address	: 11 En	d Address:					
Address	Name	Data type	Comment				
EW 8	w_AI_CH01_715	WORD	E 8 - AI2x12Bit 020mA, 420mA - ISO [Device: Slave_001, Slot: 1, Rack: 0]				
EW 10	w_AI_CH02_715	WORD	E 10 - AI2x12Bit 020mA, 420mA - ISO [Device: Slave_001, Slot: 1, Rack: 0]				

Here you have a list of addresses that are used by the module in the address area of the CPU. By entering a new 'Start address' you can adjust the addressing of the input and output areas accordingly. You can edit 'Name' and 'Comment' by clicking at the corresponding entry.

)
5	

Information about the assignment of the in/output area can be found in the manual of your module.

11.6.5 Parameter

Project Explorer	Parameter						
 EC-Mastersystem Slave 001 (0001) [V] 	Diagnostic interrupt	0 -					
1 001: Module 1	Temperature system	Degree Celsius °C 🔹					
	Interference frequency suppression	50 Hz 🔹					
	**** Ch0 ****						
	Wire break recognition	1 .					
	Limit value monitoring	•					
	If there is a parametrizable	module, whose paramete	rs can be determined such as a				

System SLIO module, the module parameters can be set here. Here also the necessary Init command for the EtherCAT slave station is generated & *Chapter 11.5.8 'Init Commands (Expert mode)' on page 376.* With [Reset], the parameters of the module are reset to their default values.

\bigcirc

More information about the parameters can be found in the manual of you module.

11.7 Diagnostics - EC-Mastersystem

11.7.1 Preparation

To use the 'Diagnostics' functions, you must be connected online with your EtherCAT system.

- **1.** Click in the Toolbar at [Configuration] and select *'EC-Mastersystem'* in the *'Project Explorer'*.
- **2.** Activate in the 'Device editor' the register 'Master'.
- 3. Set depending on the on-line access in the 'Device Editor > Master' as follows:
 - If you are directly connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network Adapter* and click at [Select].
 - If you are connected to the PG/OP channel of you CPU, please enter IP Address, Port and Master Instance and click at [Select]. With VIPA Port 6000 and Master Instance 0 is to be set.
 - ⇒ The SPEED7 EtherCAT Manager uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.
- 4. Click in the Toolbar at [Diagnosis Mode].
 - An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the 'Project Explorer'.

With an online connection the 2 LEDs flash alternately in the 'Status area'. In addition 'Modus' switches to 'Diagnosis'.

- 5. Click in the 'Project Explorer' at Master.
 - ⇒ The following registers are available now:
 - Schapter 11.7.2 'General' on page 383
 - & Chapter 11.7.3 'CoE Object Dictionary' on page 385
 - & Chapter 11.7.4 'History (Expert mode)' on page 385

11.7.2 General

Project Explorer		cplorer	State Machine						
-	-	EC-Mastersystem	Current State	Ор					
	-	Slave 001 (0001) [V]	Requested State	Requested State Op					
		001: Module 1		Init Boo	tstrap				
		• 001. Module 1	Change State	Pre-Op Safe	-Op				
				Ор					
			Information			Frame Counter			
			Number of found slaves	2		Sent frames	20388		
			Number of slaves in configuration	2		Lost frames	0		
			Number of DC slaves	0		Cyclic frames	20306		
			DC in-sync	-		Acyclic frames	82		
			Topology Ok	Yes					
			Link Connected	Yes					
			Slaves in Master State	Yes					
			Link Connected Slaves in Master State	Yes Yes					

Colors and states

The state of the state machine can be determined via the color according to the following specifications:

Diagnostics - EC-Mastersystem > General

Color	State of the state machine
🥥 - red	Init / Bootstrap
🔵 - blue	Pre-Op
🥥 - yellow	Safe-Op
🔵 - green	Ор

Here you will get master and bus-specific information.

- State Machine
 - Current State: Shows the current state of master. State Machine' on page 396
 - Requested State: Shows the currently requested state of the master which was requested by 'Change State'.
 - Change State: Here you can change the state of the master.
- Information
 - Number of found slaves: Shows number of found slave stations at the bus.
 - Number of slaves in configuration: Shows number of configured slave stations at the bus.
 - Number of DC slaves: Shows the number of slave stations, which support distributed clocks functionality (DC).
 - DC in-sync: If distributed clocks is configured you can find here information about the synchronization status of the system.
 - Topology OK: The 'Topology' is OK ('Yes'), if the number of configured matches the number of found slave stations. Here only the mandatory slaves stations are considered.
 - Link Connected: Here you will find 'Yes', if there is a physical connection to the configured slave stations.
 - Slaves in Master State: Here you will find 'Yes', if every configured slave station is in master state.
- Frame Counter
 - Sent frames: Number of sent frames since the last power cycle.
 - Lost frames: Number of lost frames since the last power cycle.
 - Cyclic frames: Number of cyclic frames since the last power cycle.
 - Acyclic frames: Number of acyclic frames since the last power cycle.

Diagnostics - EC-Mastersystem > History (Expert mode)

11.7.3 **CoE Object Dictionary**

Project Explorer		Values						
-	EC-Mastersystem		Index	Name	Value	Туре	Flags	*
	 Slave_001 (0001) [VI 		0x1000	Device type	1100 (0x44C)	UDINT	(RO RO RO)	
	001: Module 1		0x1008	Device name	EC-Master	STRING(11)	(RO RO RO)	
1			0x1009	Hardware version	V 02.06.00.07	STRING(14)	(RO RO RO)	
			0x100A	Software version	V 02.06.00.07	STRING(14)	(RO RO RO)	
		•	0x1018	Identity	4 (0x04)	USINT	(RO RO RO)	
		•	0x10F3	History	254 (0xFE)	USINT	(RO RO RO)	
			0x2000	Master State Change Command	0 (0x00)	UDINT	(RW RW RW)	
			0x2001	Master State Summary	67457 (0x10781)	UDINT	(RO RO RO)	
		•	0x2002	Bus Diagnosis Object	14 (0x0E)	USINT	(RO RO RO)	
			0v2005	MAC Address Object	4 (0v04)	LISTNIT	(POPOPO)	*
		Edit Va	alue					
				Value:			Wri	ite

Here you will have read and write access to the CoE Object Dictionary of the slave station. This can be changed if your slave station permits. It is indicated by the 'Flags' of each object, if write access is permitted. Information about the structure of the Object Dictionary can be found in the manual of your slave station.

11.7.4 History (Expert mode)

Proje	ect Explorer EC-Mastersystem Slave_001 (0001) [VI 001: Module 1	Settings Show Info Mess Show Warning N Show Error Mes Show Emergence Current Mode Messages	ages Aessages sages y Messages	True True False False Overwrite Mode					
		Severity	Time	▼ ID	Acknowledged	Code	Message	^	
		🔺 wrn	13.01.2014 12:5	58:34 010) No	0x0000001	(0x4413) I2T Amplifier overload		
		🔔 wrn	13.01.2014 12:5	58:33 009	No No	0x0000001	(0x4101) Terminal-Overtemperature		
		🔀 ERR	13.01.2014 12:5	58:32 008	Yes	0x0000001	(0x8406) Undervoltage DC-Link		
		() INF	13.01.2014 12:5	58:31 007	Yes	0x0000001	(0x0002) Communication established	~	
							Number of messag	jes: 200 / 200	
		Change Messag	e Handling						
			Task: Keine					Execute	

In this dialog box, you can access all the diagnostic messages in the master and edit them if necessary. Via 'Settings' they may be filtered accordingly.

Diagnostics - slave station > General

11.8 Diagnostics - slave station

11.8.1 Preparation

To use the '*Diagnostics*' functions, you must be connected online with your EtherCAT system.

- **1.** Click in the Toolbar at [Configuration] and select *'EC-Mastersystem'* in the *'Project Explorer'*.
- **<u>2.</u>** Activate in the 'Device editor' the register 'Master'.
- 3. Set depending on the on-line access in the 'Device Editor > Master' as follows:
 - If you are directly connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network Adapter* and click at [Select].
 - If you are connected to the PG/OP channel of you CPU, please enter IP Address, Port and Master Instance and click at [Select]. With VIPA Port 6000 and Master Instance 0 is to be set.
 - ⇒ The SPEED7 EtherCAT Manager uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.
- 4. Click in the Toolbar at [Diagnosis Mode].
 - An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the 'Project Explorer'

With an online connection the 2 LEDs flash alternately in the 'Status area'. In addition 'Modus' switches to 'Diagnosis'.

5. Click in the 'Project Explorer' at the according slave station 'Slave_...'

The following registers are available now:

Schapter 11.8.2 'General' on page 386

- Schapter 11.8.3 'ESC Register (Expert mode)' on page 387
- Schapter 11.8.4 'EEPROM (Expert mode)' on page 388
- Schapter 11.8.5 'Extended Diagnosis (Expert mode)' on page 388
- Schapter 11.8.6 'DC Diagnosis (Expert mode)' on page 389
- Chapter 11.8.7 'CoE Object Dictionary' on page 389

11.8.2 General

Project Explorer		State Machine	
▼ ● EC-Masters	system	Current State	Op
👻 🌒 Slave O	001 (0001) IVI	Requested State	Op
	L Module 1		Init Bootstrap
• 001	I: MODULE I	Change State	Pre-Op Safe-Op
			Op
		Error State Current	

Colors and states

The state of the state machine can be determined via the color according to the following specifications:

Diagnostics - slave station > ESC Register (Expert mode)

Color	State of the state machine
🥌 - red	Init / Bootstrap
🔵 - blue	Pre-Op
🥥 - yellow	Safe-Op
🥥 - green	Ор

State Machine

- Current State: Shows the current state of the state machine of the slave station.
 ⁽⁵⁾ Chapter 11.10 'EtherCAT State Machine' on page 396
- Requested State: Shows the requested state of the slave station.
- Change State: Here you can change the state of the state machine of the slave station.
- Error State
 - Current: Slave error which occurred during state transition.

11.8.3 ESC Register (Expert mode)



Setti	ngs								
Offset 0x0			0x0000	<0000					
Ler	igth		0x0400			Dec	Hex		
Со	mpact								
Regi	sters								
	Index		Name	Value	Туре		*		
I	• 0x0000		Туре	17 (0x11)	USINT				
1	• 0x0001		Revision	0 (0x00)	USINT				
1	• 0x0002		Build	2 (0x0002)	UINT				
1	• 0x0004		FMMUs supported	8 (0x08)	USINT				
1	• 0x0005		SyncManagers supported	8 (0x08)	USINT				
I	• 0x0006		RAM Size	8 (0x08)	USINT		-		
Edit	Register								
		Value:				V	Vrite		

This dialog is only visible in the '*Expert mode*'! Here you can directly access the registers of the EtherCAT ASIC. You should not make any changes here!

Smart View Hex View

Write

Diagnostics - slave station > Extended Diagnosis (Expert mode)

11.8.4 **EEPROM** (Expert mode)



EPROM Values				
Index	Name	Value	Туре	*
0x0000	PDI Control	3080 (0x0C08)	UINT	
0x0001	PDI Configuration	34818 (0x8802)	UINT	
0x0002	Pulse Length of SYNC Signals	0 (0x0000)	UINT	
0x0003	Extended PDI Configuration	0 (0x0000)	UINT	
0x0004	Configured Station Alias	0 (0x0000)	UINT	
0x0005	Reserved	0 (0x0000000)	UDINT	
0x0007	Checksum	0 (0x0000)	UINT	
0x0008	Vendor ID	45054 (0x0000AFFE)	UDINT	
0x000A	Product Code	87157760 (0x0531EC00)	UDINT	*

This dialog is only visible in the 'Expert mode'! Here you can access the contents of the EEPROM of the slave station. Currently you can only change the parameter 'Configured Station Alias'. This can be used for forming groups. & Chapter 11.9 'Grouping logic' on page 391



CAUTION!

Value:

Please regard that your slave station can get unusable by entering incorrect values especially in 'Hex view'! In this case, any warranty of the vendor is excluded!

11.8.5 Extended Diagnosis (Expert mode)

Explorer Common Error Counter			Clear Error C		
EC-Mastersystem	Processing Unit Error Counter	1			
Slave_001 (0001) [VI 001: Module 1	PDI Error Counter	0			
	Port 0 (In port)		Port 1		
	Invalid Frame Counter	0	Invalid Frame Counter	0	
	RX Error Counter	0	RX Error Counter	0	
	Lost Link Counter	0	Lost Link Counter	0	
	Forwarded RX Error Counter	0	Forwarded RX Error Counter	0	
	Port 2		Port 3		
	Invalid Frame Counter	0	Invalid Frame Counter	0	
	RX Error Counter	0	RX Error Counter	0	
	Lost Link Counter	0	Lost Link Counter	0	
	Forwarded RX Error Counter	0	Forwarded RX Error Counter	0	

This dialog is only visible in the 'Expert mode'!

Project Explorer

- Common Error Counter
 - Processing Unit Error Counter: Number of received frames by the slave station, which are no EtherCAT frames.
 - PDI Error Counter: Number of PDI access errors (Process Data Interface). These are physical errors, which were detected by the PDI at the EtherCAT bus.
 - With [Clear Error Counters] the error counters can be reset.
- Port 0...3
 - Invalid Frame Counter: Number of invalid frames from *Port* y (access at register 0x300+y*2)
 - RX Error Counter: Number of RX errors from *Port* y (access at register 0x300+y*2+8bit)
 - Lost Link Counter: Number of lost connections from *Port* y (access at register 0x310+y)
 - Forwarded RX Error Counter: Number of forwarded RX errors from *Port* y (access at register 0x380+y)

11.8.6 DC Diagnosis (Expert mode)



This dialog is only visible in the '*Expert mode*'! Here status information for the distributed clock of your slave station is shown. More may be found in the manual of the slave station.

11.8.7 CoE Object Dictionary

Project Explorer	Values Designation from	ESI Design	ation from SI	ave Slingle Object
EC-Mastersystem	Index Name V	Value	Туре	Flags
 Slave_001 (0001) [vi 001: Module 1 	0x1000 Device Type		UDINT	(RO RO RO)
• 001. MOdule 1	0x1008 Device Name	-	STRING(17)	(RO RO RO)
	0x1009 Hardware Version	-	STRING(3)	(RORORO)
	0x1008 System Version		USINT	(RO RO RO)
	Ox1018 Identity	-	USINT	(RO RO RO) *
	Edit Value			
	Value:			Write Reset

Here you will have read and write access to the CoE Object Dictionary of the slave station. This can be changed if your slave station permits. It is indicated by the *'Flags'* of each object, if write access is permitted. Information about the structure of the Object Dictionary can be found in the manual of your slave station.

If a write access to an object in the diagnosis mode is performed, and the written value does not reflect to the default value of the object, so this command is automatically added to the 'Init commands'. & Chapter 11.5.8 'Init Commands (Expert mode)' on page 376

This dialog is only visible in the 'Expert mode':

- Designation from ESI
 - By selecting this function the designations are loaded from the ESI file. _
- Designation from slave
 - By selecting this function the designations are loaded from the slave station.
- Single Object
 - With this function you have read and write access to a single object in the object dictionary by specifying index and subindex.

11.8.8 **FoE Download/Upload**

Project Explorer C-Mastersystem Slave_001 (0001) [VI 001: Module 1	FoE Download Local Filename Slave Filename Password (hex) Timeout (s)	0x0000000 Dec 6 Download to 5	Hex 50 🜩 Slave
	FoE Upload Local Filename Slave Filename Password (hex) Timeout (s) Max File Size (kb)	0x0000000 Dec 6 300 Upload from 5	Hex 50 🔷 00 🗣 Slave

- With this function you have the possibility to transfer files between PC and slave sta-tion (if this is supported by the device). If the slave station is in state Bootstrap, a firmware update of the slave station can be established via 'FoE Download'. Here you have to enter the file name without extension. & Chapter 11.11 'Firmware update -VIPA System SLIO IM 053-1EC0x' on page 397
 - Local filename: Name of the file at the PC.
 - Slave filename: Name of the file at the slave station.
 - Password: Password to access the slave station.
 - Timeout: Maximum time for data transfer.
 - Max. file size: Maximum size of the file, which is to be transferred from the slave station to the PC.

11.9 Grouping logic						
11.9.1 Overview						
Slave types	With EtherCAT, the following slave types are distinguished:					
	 MII - MII corresponds to Media Independant Interface. An MII slave has an EtherCAT interface to connect to EtherCAT for integration into a system bus (backplane bus) for connecting peripheral modules. The MII slave receives data via EtherCAT and passes them through its backplane to the according peripheral module. Conversely, it reads the input data and passes it via EtherCAT. The System SLIO 053-1EC0x e.g. is a MII-Slave. 					
	E-Bus - In an E-Bus slave the EtherCAT protocol is used for communication on the backplane bus For this reason, the attached peripheral modules are also shown as a slave station in the <i>SPEED7 EtherCAT Manager</i>					
Possibilities	The EtherCAT Manager supports the following ways to group the individual slave sta- tions. Each group may consist of 1 n slave stations. Group nesting is not supported:					
	Chapter 11.9.2 'Create group with pinned process data offset' on page 393					
	🌣 'Hot Connect group with Dynamic Position in Topology' on page 395					
	🌣 'Hot Connect group with Fixed Position in Topology' on page 395					
	🌣 'Hot Connect group with Pinned or Dynamic Process Data Offset' on page 395					
	Please consider that Hot Connect groups are not possible with E-Bus slaves!					
Create Group	1. Click in the Toolbar of the SPEED7 EtherCAT Manager at [Configuration].					
	 Click in the Project Explorer at the slave station and select 'Context menu → Create Group'. 					
	⇒ The dialog 'Create Group' opens. Here always the 1. slave station is selected. You can either select more slave stations or depending on the group type selec-					

+	Slave_001 (0001)				Address	
	Slave_005 (000	+	Append Slave(s)		Station Address Information	9 🗧
	Slave_007 (0007	Ļ.	Cut Slave(s) Ctrl+X	-	Name	Slave_009
	Slave_009 (0009	D	Copy Slave(s) Ctrl+C		Vendor	EL3001 1Ch. Ana. Input +/-10V Beckhoff Automation GmbH (0x00000002)
۲	Slave_010 (0010)	4	Paste Slave(s) Ctrl+V Enable Slave(s)	-	Product Code	0x08B93052 (196685906)
		×	Disable Slave(s)		Revision Number	0x00140000 (1310720)
		0	Reload ESI data		ESI File	C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles\Beckhoff EL30xx.xml
		1	Change Slave Select from Project Template		Donte	Not Used
		×	Create Group]	A 🌒	Slave_008 (0008) / Port B
		×	Remove Group	-	D	Not Connected
		×	Detach HC Group		в	Not Connected
		P	Attach HC Group	1	c 🍥	Not Connected

tion, the necessary save stations are automatically selected.

With the 'Create Group' functionality you have two different functions:

- You can create a new group if the selected slave station is not yet part of a group.
- If the selected slave station is already part of a group, the current group is divided into two sub-groups from the selected slave station.

Grouping logic > Overview

Edit Group

After creating a group, the 'Device Editor' of the slave station is extended with the register 'Group'. Here you can adjust the group properties accordingly.

Project Explorer		Device Edite	or					
 CPU 015-CE Stare_00 Stare Stare Stare Stare Stare Stare Stare Stare Stare 	FNR00 1 (0001) .004 (0004) Iawe_005 (0005) Iawe_007 (0007) Iawe_007 (0007) Iawe_009 (0008) 0 (0010)	General General MSU Id Name Pinned Gr Input O Output Hot Conn Identific	Group froup ffset (byte Offset (by ect Group cation Off cation Val	Advanced Option e) /te) set ue	s Process Image	1/O Address Overview	Dee H	EX EX
Classic View Flat	new n							
Information	· *	Severit	y Time	Message			1	•
Name	Slave_004	ERR ERR	16:50:	34 Invalid topolog	ly from Slave 'Slave_	010' (slave connected to HC group).	1	
Description	EK1100 EtherCAT Coupler (2A E-Bus)							

The new group can be selected by selecting this group via 'Cut Slave(s)' be changed.

► ▼ [Slave_001 (0001) Slave_004 (0004) Slave_005 (0005) Slave_005 (0006) Slave_006 (0006)	+	Append Slave(s)		Address Station Address Information		9 0
	Slave_007 (0007	×	Remove Slave(s) D	el	Name		Slave 009
	Slave_008 (0008)	7	Cut Slave(s) Ctrl+	x	Description		EL3001 1Ch. Ana. Input +/-10V
	- Slave_009 (0009)		Copy Slave(s) Ctrl+	c	Vendor		Backhoff Automation SmhH (0v0000002)
۲	Slave_010 (0010)	D	Paste Slave(s) Ctrl+	/			
		÷	Enable Slave(s)		Product Code		0x08893052 (196685906)
		×	Disable Slave(s)		Revision Number		0x00140000 (1310720)
			Reload ESI data		ESI File		C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles\Beckhoff EL30xxxxnl
		1	Change Slave		Identification Value		Not Used
		1	Select from Project Template		Ports		
		j.	Create Group		A	۲	Slave_008 (0008) / Port B
		×	Remove Group		D	۲	Not Connected
		×	Detach HC Group		в	۲	Not Connected
		1	Attach HC Group		с		Not Connected

Detach HC Group

If you want to connect this group to an other slave station on the network, you can detach the current connection by *'Detach HC Group'*.

Slave_001 (0001)						
۲	Slave_010	(0010	0)		Address	
÷	Slave 0	04.00	004)		Station Address	4
	Slar	Slave Append Slave(s) Slave X Append Slave(s) Slave X Remove Slave(s)		Information	51 004	
	Slav Tr Cut Slave(s) Ctrl+X		Cut Slave(s) Ctrl+X		Description	Slave_004 EK1100 EtherCAT Coupler (2A E-Bus)
	- Slav	P P	Parte Slave(s) CtrleV		Vendor	Beckhoff Automation GmbH (0x00000002)
	Slov (Paste Slov(s) Curv V Enable Slov(s) Disolate Slov(s)			Product Code	0x044C2C52 (72100946)	
			Revision Number	0x00120000 (1179648)		
	P Reload ESI data		ESI File	C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles\Beckhoff EKxxxxxml		
		1	Change Slave		Identification Value	Not Used
		1	Select from Project Template		Ports	
		1	Create Group		A [X1 IN]	Slave_010 (0010) / Port B
		×	Remove Group		D	Not Connected
		×	Detach HC Group		в	Slave_005 (0005)
		${\mathbb Z}^{\mathbb N}$	Attach HC Group		C [X2 OUT]	Not Connected

Remove Group

- To remove a group click in the SPEED7 EtherCAT Manager at a slave station and select 'Context menu → Remove Group'.
 - ⇒ The group is removed. Depending on the group, the previously grouped slave stations are reintegrated into the topology or remain at the current position.

Grouping logic > Create group with pinned process data offset

11.9.2 Create group with pinned process data offset

Procedure



Create Group

1. Click in the Toolbar of the SPEED7 EtherCAT Manager at [Configuration].

This group may start at any slave station and either end at himself, at a following slave

station, at a following group or at the last slave station. The group functionality is possible

- 2. Click in the *Project Explorer* at the slave station and select 'Context menu' → Create Group'.
 - ⇒ The dialog 'Create Group' opens. Here always the 1. slave station is selected. You can either select more slave stations or depending on the group type selection, the necessary save stations are automatically selected.

) •	Issue_001(0001) Issue_004(0004) Issue_005(0005) Append Stare(s) Issue_005(0006) Remove Stare(s) Del		Address Station Address Information	9 8		
	Slave_007 (0007 Slave_008 (0008	ŕ	Cut Slave(s) Ctrl+X Copy Slave(s) Ctrl+C		Description	Slave_009 EL3001 1Ch. Ana. input +/-10V
۲	Slave_010 (0010)	0 4	Paste Slave(s) Ctrl+V Enable Slave(s)		Product Code	beckhoff Automation ombili (UXUUUUUUU2) 0x08893052 (196685906)
		× Ľ	Disable Slave(s) Reload ESI data		ESI File	UNIVLI-VUUV (LSLV/ZV) C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles\Beckhoff EL30xxxml
		2	Change Slave Select from Project Template		Ports	
		××	Remove Group Detach HC Group		D	Single Concerted Not Connected Not Connected
		P	Attach HC Group]	с	Not Connected

Pinned group

Proj

- 1. Choose from 'Select the slaves' the slave stations, which you want to include in the 'Pinned group'.
 - ⇒ The dialog is closed, the slave station is marked as group in the 'Project Explorer' and a tab "Group" is created in the 'Device Editor'.

ect	Explorer		Group	
EC-Mastersystem		Pinned Group		
•	🌻 📗 Slave_001 (0001)	Input Offset (byte)	0	Dec Hex
	î 🛛 001: Module 1	Output Offset (byte)	0	Dec Hex
		Hot Connect Group		
		Identification Offset	0x0012	
		Identification Value	0x0000	Dec Hex
		Fixed Position in Topology		

- **2.** Enable the option *'Pinned Group'*.
- 3. Enable the option 'Input Offset = Output Offset' if the input and output addresses are identical.
 - \Rightarrow The group is now defined as *Pinned Group*.

Grouping logic > Create Hot Connect group

11.9.3 Create Hot Connect group

Proceeding



Create Group

- **1.** Click in the Toolbar of the SPEED7 EtherCAT Manager at [Configuration].
- 2. Click in the *Project Explorer* at the slave station and select *'Context menu* → *Create Group'*.
 - ⇒ The dialog 'Create Group' opens. Here always the 1. slave station is selected. You can either select more slave stations or depending on the group type selection, the necessary save stations are automatically selected.

Slave_001 (0001) Slave_004 (0004) Slave_004 (0004) Slave_005 (000 Slave_006 (000 Slave_007 Slave_00 Slave_007 Slave_007 Slave_00 Slave_007 Slave_007 Slave_00 Slave_007 Slave_00 Slave_007 Slave_00 Slave_0 Slave_00 Sla	6 + 7 ×	Append Slave(s) Remove Slave(s) Del		Address Station Address Information Name	9 2 Slave_009
Slave_008 (000	1 m	Conv Sizua(c) Ctri+X		Description	EL3001 1Ch. Ana. Input +/-10V
I Slave_009 (000	12	Parte Slave(r) Ctrl+V		Vendor	Beckhoff Automation GmbH (0x0000002)
Slave_010 (0010)			-	Product Code	0x08893052 (196685906)
	-	Enable Slave(s)		Revision Number	0x00140000 (1310720)
		Dilable States	-	ESI File	C:\Users\Public\Documents\VIPA GmbH\SPEED7 EtherCAT Manager\EtherCAT\EsiFiles\Beckhoff EL30xx.xml
	1	Change Slave		Identification Value	Not Used
	2	Select from Project Template		Ports	
	è	Create Group	1	A	Slave_008 (0008) / Port B
	×	Remove Group		D	Not Connected
	×	Detach HC Group		в	Not Connected
	1	Attach HC Group		с	Not Connected

Hot connect group

Project

- **1.** Choose from 'Select the slaves' the slave stations, which you want to include in the 'Hot connect group'.
 - ⇒ The dialog is closed, the slave station is marked as group in the *'Project Explorer'* and a tab "Group" is created in the *'Device Editor'*.

Explorer		Group	
EC-Mastersystem	Pinned Group		
🌻 📗 Slave_001 (0001)	Input Offset (byte)	0	Dec Hex
႞ 001: Module 1	Output Offset (byte)	0	Dec Hex
	Hot Connect Group		
	Identification Offset	0x0012	
	Identification Value	0x0000	Dec Hex
	Fixed Position in Topology	Value > 0 expected!	
	• Enchlathe anti-	- (11-t t	

- **2.** Enable the option *'Hot connect group'*.
- 3. ► Enter an 'Identification value': This is the Station-Alias-Address, which you have to assign before to the slave station in the 'Diagnosis' Mode. Schapter 11.8.4 'EEPROM (Expert mode)' on page 388

Please regard that the slave station takes the new address after a power-cycle.

4. For a fix position of the group in the topology the option *'Pinned group'* can be enabled.

11.9.3.1 Combination possibilities

Hot Connect group with
Dynamic Position in Top-
ologyThe group must start with a MII slave. Here, all slave stations below the selected are
automatically added to the group. This group ends at himself, at a following slave station,
at a following group or at the last slave station.

Hot Connect group with Fixed Position in Topology The group is fix coupled to a predecessor slave station and its port. You always have the possibility to change the link to the previous slave station via the dialog box. If the group is removed, the slave stations remain in place.



A Hot Connect group with Fixed Position in Topology cannot be removed, if the slave stations before are a part of another Hot Connect group with Fixed Position in Topology!

Hot Connect group with Pinned or Dynamic Process Data Offset

This group does not depend on slave station or port. The group has no predecessor slave station and is moved to the end of the tree when created. When the group is removed it is searched for a suited free port starting from the end of the main tree. If there is no suited slave station available, the group will be rejected! Due to the system the group has no predecessor slave station, the connection cannot be changed via the dialog box.

EtherCAT State Machine

11.10 EtherCAT State Machine

States

In each EtherCAT communication device a *state machine* is implemented. For each state there is defined which communication service is active via EtherCAT. The state machine of the slave station is controlled by the state machine of the EtherCAT master.



Init - 01h	After power-on the EtherCAT members are in state <i>Init</i> . There is neither mailbox nor process data communication possible. The EtherCAT master initializes the SyncManager channels 0 and 1 for the mailbox communication.
Pre-Operational (Pre-Op) - 02h	The EtherCAT master initializes the SyncManager channels for process data (starting with SyncManager channel 2), the FMMU channels and the PDO mapping respectively the SyncManager PDO assignment. Further in this state the settings for process data transfer and the module-specific parameters, which deviate from the default values are transferred. During the transition from <i>Init</i> to <i>Pre-Op</i> the EtherCAT slave checks whether the mailbox was correctly initialized. In the state <i>Pre-Op</i> mailbox communication and Ethernet over EtherCAT (EoE) are possible but the process data communication is blocked.
Safe-Operational (Safe- Op) - 04h	In <i>Safe-Op</i> the input data are cyclically updated but the outputs are de-activated. With the transition from <i>Pre-Op</i> to <i>Safe-Op</i> the EtherCAT slave checks if the SyncManager channels for process data communication are correct. Before it acknowledges the state change, the EtherCAT slave copies current input data to the corresponding DP RAM areas of the EtherCAT slave controller. In the state <i>Safe-Op</i> mailbox and process data communication is possible.
Operational (Op) - 08h	In the state <i>Op</i> the input data are cyclically updated and the EtherCAT master sends output data to the EtherCAT slave. The EtherCAT slave copies the output data of the master to its outputs and return input data to the EtherCAT master. In this state process data and mailbox communication is possible.
Bootstrap - option (Boot) - 03h	In state <i>Boot</i> the firmware of an EtherCAT slave may be updated via the EtherCAT master. This state may only be reached via Init. In the state <i>Boot</i> is mailbox communication via the protocol File-Access over EtherCAT (FoE) possible. Other mailbox and process data communications are de-activated.
Firmware update - VIPA System SLIO IM 053-1EC0x

11.11 Firmware update - VIPA System SLIO IM 053-1EC0x

Current firmware at www.vipa.com

Precondition

Proceeding

The latest firmware versions are to be found in the service area at www.vipa.com. Load the Px000xxx.pkg file.

	 CAUTION! When installing a new firmware you have to be extremely careful. Under certain circumstances you may destroy the slave station, for example if the voltage supply is interrupted during transfer or if the firmware file is defective. In this case, please call the VIPA Hotline! Please regard that the version of the update firmware has to be dif- ferent from the existing firmware otherwise no update is executed.
■ T E	here is an Ethernet respectively remote connection between the PC and the VIPA therCAT slave station, where a firmware update is to be established.
Belov	v the proceeding is shown by the example of the VIPA System SLIO slave station.
1	Open if net already done the SPEEDZ EtherCAT Manager
1. 2	Click in the 'Broject Explorer' at 'EC Mactersustem'
3.	Select in <i>'Device Editor > Master'</i> at <i>'Network Adapter'</i> your network card and enter at <i>'IP Address'</i> the IP address of the PG/OP channel of the CPU and click at [Select].
4.	Click in the Toolbar at [Diagnosis Mode].
	An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the 'Project explorer'.
5.	Click in the 'Project explorer' at the master.
j	Select in the register ' <i>General</i> ' at 'State Machine' the state 'Init'. Wait, until all slave station response the state 'Init'.
`	Click in the ' <i>Project explorer</i> ' at the slave, where the firmware update is to be established.
3.	Select in the register 'General' at 'State Machine' the state 'Bootstrap'.
9.	Enter in the register 'FoE ' at 'FoE Download' as follows:
	- Filename: Px000xxx
	- Password (hex): 0x0000000
	- Timeout (ms): 60000
	- Max File Size (kb): 3000
10.	Click at [Download].
	\Rightarrow A dialog for file selection opens.
11.	Select the file. The transfer starts with [OK].
	⇒ There will be a progress bar displayed, which informs you about the transfer state.
12.	After successful download bring your slave in the 'Init' state.
	\Rightarrow With this operation the firmware file is taken.

12 Index

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