SIEMENS

SIMATIC

Process control system PCS 7 Engineering System (V9.0 SP1)

Configuration Manual

Valid for PCS 7 as of V9.0 SP1

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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1 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines, and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit:
https://www.siemens.com/industrialsecurity

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/industrialsecurity.

2 Preface

Purpose of this documentation

This documentation shows you a way of optimizing the configuration of your plant using the PCS 7 Process Control System. The individual configuration tasks can be seen based on examples.

You can learn among other things the following:

- How to achieve a technological structure of the process control configuration of a plant in all phases
- How to use the different views (component view, plant view, process object view)
- Which phases you work through during configuration
- How to structure plants
- How to create process tag types and models

The following topics are dealt with in detail in this documentation; they are not addressed in any other manuals:

- Configuring a process control system
- Working with the plant hierarchy (PH) and the process object view (POV)
- Working with the import / export assistant (IEA)

Guide

This documentation gives you an insight into the key functions of PCS 7. You can also use this documentation for reference and read the particular information that you require.

The configuration tasks are described in a sequence that can be used for practical and fast configuration. The manual provides important background information and interrelationships for all of the configuration tasks in order to clarify their significance and context in the overall system.

All work instructions utilize paths that can be accessed via the menu commands of the menu bar. For many of the functions, you also have the option of using commands in the shortcut menu for the individual objects.

Options for accessing PCS 7 documentation

The documentation required for PCS 7 includes the following types:

- **PCS 7 Readme**
  The readme file is available in two versions:
  - **PCS 7 Readme (offline)**
    This version is installed by PCS 7 Setup. The file only contains general information and links to documents on the Internet.
  - **PCS 7 Readme (online)**
    This version contains all information on the installation and use of PCS 7 in the format which is already familiar to you. The file is only available on the Internet to keep it always up-to-date.

  Note

  The information provided in the *PCS 7 Readme* (online) on the Internet takes precedence over **all** other PCS 7 documentation.

  Read this *PCS 7 Readme* carefully, because it contains important information and amendments on PCS 7.

- **PUD Manager**
  The "PUD Manager" an innovative tool to access documentation, comes with PCS 7 DVD. Some of the highlights:
  - Create your own Manual Collection.
  - Customize the documentation set according to your needs.
  - Efficient search engine to access your information.

  To install the PUD Manager and integrate the documents, refer to Siemens Industry Support (https://support.industry.siemens.com/cs/de/en/view/109748882).
  As PUD Manager in SIMATIC manager using the path:
  SIMATIC Manager > Help > Introduction
  (Online help for STEP 7 appears on **SIMATIC Manager > Help > Contents**)
- **PCS 7 system documentation**
  System documentation contains information that covers several products, such as configuration manuals and Getting Started manuals. This documentation serves as a guideline for the overall system and explains the interaction between the individual hardware and software components.
  Note the information on "PCS 7 Documentation Portal Setup" in the product overview *Process Control System PCS 7; PCS 7 - Documentation*, Section "Options for accessing the documentation".
- **PCS 7 Product Documentation**
  Product documentation contains information about special hardware and software components. The individual documents provide detailed information on the specific component.
- **PCS 7 Technical Information and Solutions**
  For important technical information and solutions, refer to SIMATIC PCS 7 Overview (https://support.industry.siemens.com/cs/ww/en/view/63481413).

Full versions of the documentation are available from the "Technical Documentation SIMATIC PCS 7" website:
www.siemens.com/pcs7-documentation (www.siemens.com/pcs7-documentation)

You can find additional information in the product overview *Process Control System PCS 7; PCS 7 - Documentation*, Section "Options for accessing the documentation".

Required basic knowledge

General knowledge in the area of automation engineering and basic knowledge of PCS 7 is required to understand this documentation. It is also assumed that the reader knows how to use computers or other equipment similar to PCs (such as programming devices) with the Windows operating system.

The configuration manuals and the Getting Started documentation for PCS 7 will provide you with basic information regarding the use of PCS 7.

Getting Started Part 1 and Part 2

PCS 7 Getting Started - Part 1 is intended for newcomers to PCS 7. You get an initial overview of the PCS 7 process control system, enabling you to create a simple project yourself. The project is configured on an existing SIMATIC Station.

PCS 7 Getting Started – Part 2 is intended for users who have already worked through Getting Started – Part 1. It introduces you to the PCS 7 functions that you can use for fast and efficient plant configuration. These functions are used especially for the configuration of large complex plants.

PCS 7 Getting Started - Part 1 and Part 2 introduce the functions using the standard example project, "color_gs". At the same time, they show the correct configuration sequence.

You can download the completed PCS 7 project "color_gs" and the documentation *Getting Started - Part 1* from the Internet (www.siemens.com/pcs7-documentation):

1. Select the manuals of the PCS 7 version.
2. Click on the link to the *PCS 7 Getting Started - Part 1*
3. Click on the following icon to download the project:
   

Conventions

In this documentation, the names of elements in the software interface are specified in the language of this documentation. If you have installed a multi-language package for the operating system, some of the designations will be displayed in the base language of the operating system after a language switch and will, therefore, differ from the designations used in the documentation.

If you use the operating system Windows 10, you can find the Siemens SIMATIC programs in the "Start" menu under **All apps > Siemens Automation**.

Changes compared to the previous version

Below, you will find an overview of the most important changes:

- As of V9.0
  Configuring the distributed IO system on PROFINET based on the following:
  ET 200SP HA
  Compact Field Unit (CFU)
  Help button available instead of alarm information as an optional setting
  New life cycle business model for PCS 7 Engineering System.

See also

Configuring logical operations (Page 449)

Configuring the PCS 7 message system (Page 203)

Using the PCS 7 Documentation 3

3.1 Guide to the PCS 7 Engineering System Configuration Manual

Basic structure

The PCS 7 engineering system configuration manual is divided into three sections:

Section	Content
Specifying the components and the systems for the PCS 7 plant	
Planning the plant engineering	This contains all the information that you need to select the right systems and components based on the requirements of your PCS 7 plant. You can receive a complete overview of the installation options for the following components in PCS 7: • The automation system • The distributed I/O • The bus system • The network
Assembling components and systems	
Structure of the PCS 7 plant	A guide takes you through the manual's instructions on installing the hardware components. In addition, it will provides you with information and rules about how PCS 7 differs from using SIMATIC.
Engineering	
Basic concepts of engineering	Introduction into how the requirements for efficient engineering (for example, type-defining, reusability, central editing) are implemented with PCS 7.
Configuration of the PCS 7 engineering system	Introduction to the structure and use of the engineering software of PCS 7
Implementing the PCS 7 configuration	Complete PCS 7 configuration with step-by-step instructions, relationships and background information
Data exchange with plant engineering	Description of the import/export functions with step-by-step instructions, relationships and background information
Compiling and downloading	Information about how configuration data is compiled and downloaded to the CPUs (AS, OS).
Testing	Overview of the most important testing options prior to commissioning
Comparing project versions with VXM	Instructions on how to compare different project versions using the Version Cross Manager
Servicing and diagnostics	Information about diagnostics, service support, data security, versioning, and backing up project data

4 Planning the plant engineering

4.1 System ID

The purpose of the "System ID" is to provide transparency and to enable most efficient technical support.

"System ID" is a unique key to identify a specific PCS 7 System based on end-customer, location, plant, and production unit. It does not change over the lifetime of the PCS 7 System. It is linked to all offers, orders, service contracts and so on.

Creating and handling the System ID

The following steps describe the creation and handling of the system ID:

1. The registration of a new project via the website www.siemens.com/SIDregistry (www.siemens.com/SIDregistry), provides a unique **System ID**.

   Note

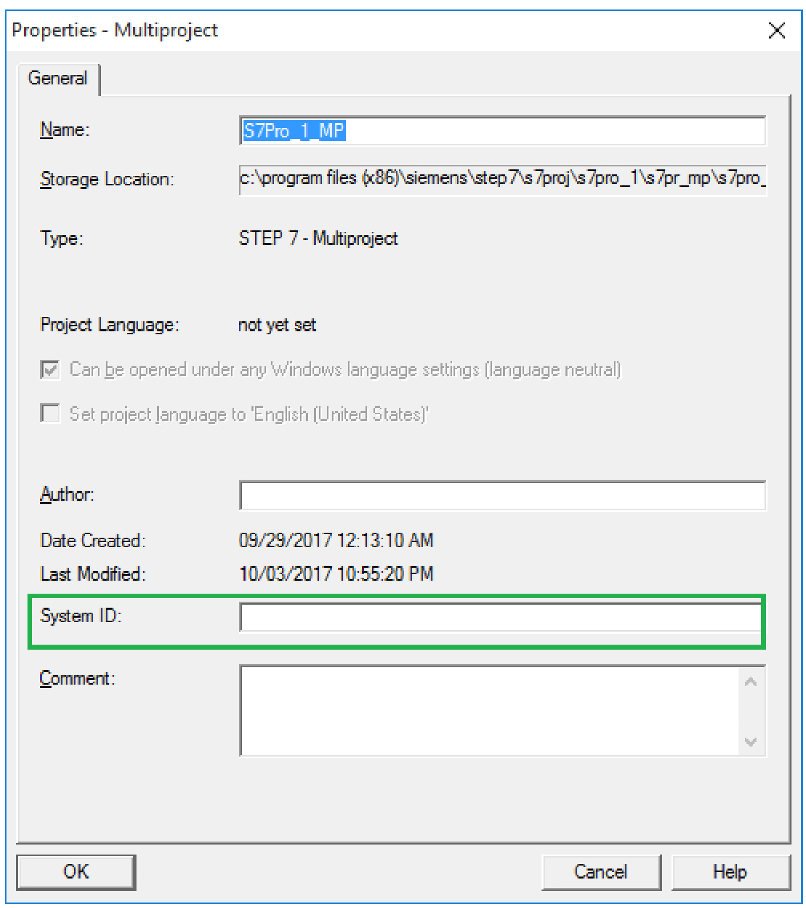
   If the project is opened in the SIMATIC Manager without the "System ID", the "Open Multiproject" dialog box appears with the message "Have you registered for the SID (system identification number)? If not, please register under www.siemens.com/SIDregistry ! ". This gives the user the option of receiving the registered System ID.

   ---

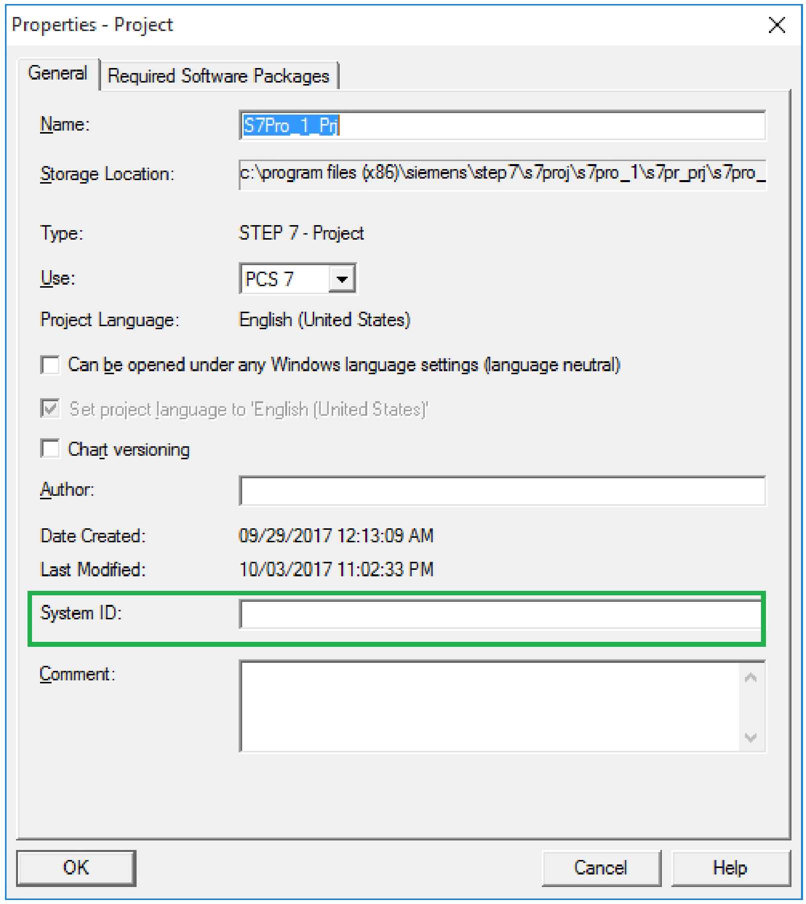
2. In the case of a multiproject, the System ID can be entered under the field "System ID" as shown below:

   Note

   A Multiproject's "System ID" is replicated in all of its subprojects.



3. In the case of a PCS 7 project, the System ID can be entered under the field "System ID" as shown below:



Note

Once the System ID has been entered in the ES project, the SIMATIC Management Console can retrieve the project inventory data together with the System ID.

Note

"System ID" is a unique key to identify a specific PCS 7 System based on end-customer, location, plant, and production unit. It does not change over the lifetime of the PCS 7 System. It is linked to all offers, orders, service contracts and so on.

4.2 Before beginning the engineering

Important questions for planning the plant

We recommend that you carefully study the questions contained in the table below. This will help you to effectively plan your plant. Under the heading "Additional sections in this manual," you can jump to sections containing additional information and overviews that should help you to answer these questions.

> **NOTICE**
>
> **Security Concept**
>
> As a general security measure Siemens strongly recommends to protect network access to the Industrial Products with appropriate procedures. It is advised to configure the environment according to Whitepaper *Process Control System PCS 7; PSC 7 Security Concept* in order to run the products in a protected IT environment.
>
> This applies particularly to access from PC components you use for maintaining and/or operating safety-relevant equipment within the plant:
>
> - We **recommend** maintaining and/or operating safety-relevant equipment only from PC components in the Process Control Network.
> - We **do not recommend** you maintaining and/or operating safety-relevant equipment using a web clients within the Enterprise Control Network.
>   HOWEVER, If you decide to maintaining and/or operating safety-relevant equipment from web clients within the Enterprise Control Network we recommend the following:
>   **Limit the usage rights to reading access only.**

Question	Related topics in this manual	Required knowledge for ...	Sections in this manual containing further information
What documentation is required?	Processing phase in which the documentation is needed: • Planning • Configuration • Commissioning	Quick location of sought-after information	• Guide to the PCS 7 Engineering System Configuration Manual (Page 21)
How should the plant be controlled and how should it react to disruptions?	• Process types: Continuous or discontinuous operation • Degree of automation • Controllability (central/ local) • Availability	Selecting systems and determining requirements for the components	• Selection of the components to be employed (Page 29) • What aspects are important when selecting components? (Page 33)

Question	Related topics in this manual	Required knowledge for ...	Sections in this manual containing further information
What areas are contained in the plant?	• Technological areas • System affiliations • Local factors	• Creating the plant hierarchy • Determining the areas; supporting areas, for example, the analysis of faults during plant operation	• How many objects can be handled in a project? (Page 46) • How many devices, sensors and actuators can be integrated? (Page 48) • How many CPUs are needed for automation? (Page 47) • What sources can be used in planning the plant structure? (Page 43)
Which components should be used? (Distances and technology for connecting paths)	Configuring signal paths	Determining • Bus systems and conventional cabling • Transmission rates • Limits to distances	• Which networks / bus systems are used for communication? (Page 59) • What are the expansion limits? (Page 50)
Which components should be used? (PC components)	PC components (operator control, monitoring, configuration systems)	Determining • Number • Availability • Data backup • Change documentation (validation)	• Which PC components can be used? (Page 101) • How can the plant be protected from unauthorized access? (Page 36) • How can the process management be verified? (Page 39) • How can project and process data be archived? (Page 41)
Which components should be used? (automation systems, I/O, sensors and actuators)	Automation systems (performance and areas of application) Planned or existing I/O devices, sensors and actuators	Determining • Number of AS • Availability • Failure safety • Ex protection • Employed modules and software	• What are the criteria for selecting the AS? (Page 103) • Which devices can be connected as distributed components? (Page 118)
What preparations can be made for efficient engineering?	• Number of process tags • Number and distribution of workstations for engineering	• Planning the engineering environment • Using multiprojects and the Import/Export Assistant • Using appropriate resources to create lists (e.g. for process tag lists)	• Which devices can be connected as distributed components? (Page 118) • Importable data and data formats (Page 129)

Question	Related topics in this manual	Required knowledge for ...	Sections in this manual containing further information
How can servicing and diagnostics be implemented in the PCS 7 plant?	• Activate preparation for servicing • Planning diagnostics • Using diagnostic tools	• Planning service support • Using the maintenance station	• What service support does SIEMENS offer for PCS 7? (Page 45) • Diagnostics with maintenance station (Asset Management) (Page 641)
Which languages are available?	• Configuration and process control – English – German – French – Italian – Spanish	Planning of the engineering and the process control	• How to set the defaults (Page 232) • How to set the language for display devices (Page 294)

Additional information

The *Process Control System PCS 7; PCS 7 Documentation* provides the following supplementary information to this manual:

- Options for accessing documentation
- Documentation for the planning phase
- Documentation for the realization phase
- Documentation for commissioning, operation, diagnostics and servicing
- Whitepaper *Process Control System PCS 7; PSC 7 Security Concept*

4.3 Components of a PCS 7 system

4.3.1 Selection of the components to be employed

Introduction

PCS 7 offers a range of options for implementing automation tasks. The large selection and variety of components facilitates the following:

- Employment of suitable components for special requirements
- Selection of components that can be configured exactly to meet specific requirements

The following table lists optimally matched systems, components and functions for specific process control requirements.

Selecting systems, components, and functions

Select the systems, components and functions based on the requirements of your PCS 7 plant:

Prompt	Specification	Performing system, component, function for PCS 7	Check √
Process mode - OS			
Operation and monitoring	Operation and monitoring in process mode	**PCS 7 Operator Station** with **WinCC** software	
Operator control and monitoring via the Internet/Intranet	Use of the operator control and monitoring functions in process mode via the Internet or Intranet	**PCS 7 Web server** and **PCS 7 Web client**	
Access to process data via the Internet/Intranet	Data communication with external systems via OPC and OLE DB	**OpenPCS 7**	
Monitoring the PCS 7 plant	Monitoring the process control	**PCS 7 maintenance station**	
Lifebeat monitoring	Monitors systems connected on the terminal bus and system bus	Function **"Lifebeat monitoring"** from **WinCC**	
Time synchronization	Central time synchronization from systems connected on the terminal bus, system bus, and field bus	**"Time synchronization"** function from **WinCC**	
Short-term archiving	Short-term archiving of process values and messages	**Archive systems** of **WinCC**	
Long-term archiving	Use of a PC station for long-term archiving of process values, messages and BATCH data	**Process Historian**	
Controlling and operating sequential control systems	Graphically displaying and operating configured sequential control systems	**SFC Visualization**	
Operating and monitoring of the Safety Matrix	Display and operation of configured safety reactions	**Safety Matrix Viewer** *)	

Prompt	**Specification**	**Performing system, component, function for PCS 7**	**Check** √
Access protection	Central user management, access protection and electronic signatures	**SIMATIC Logon** with **Electronic Signature**	
Batch processes	Controlling discontinuous process-es	**SIMATIC BATCH**	
Route control	Control, monitoring and diagnostics of material transports in piping sys-tems	**SIMATIC Route Control**	
Archived process data	Analysis of process data from ar-chives	Using Process Histori-an: • **OS** • **Information Server**	
		Without using the Proc-ess Historian: • **OS**	
Process mode – AS and I/O			
Availability	Using high availability automation systems	**S7-400H with distributed I/O** (e.g. ET 200...)	
Failure safety	Using fail-safe automation systems	**S7-400F with distributed I/O** (e.g. ET 200...)	
Availability and failure safety	Use of high availability and fail-safe automation systems	**S7-400FH with distributed I/O** (e.g. ET 200...)	
Control modes	Modules with controller functions	**S7-400 FM**	
Distributed I/O	Connecting field devices via PRO-FIBUS DP depending on the degree of protection, connections, and Ex zone Connecting distributed I/O via PRO-FINET I/O Connecting field devices via PRO-FINET	**Basis ET 200...**	
Sensors and actuators	Connecting actuators and sensors	**PROFIBUS PA** **PROFINET I/O** **FOUNDATION Field-bus**	
Intelligent field devices	Connecting intelligent field devices with PROFIBUS communication	**PROFIBUS DP/PA** **PROFINET** (via IE/ PB-Link or CFU)	
	Connecting intelligent field devices with HART communication	Distributed IO system (via **PROFIBUS DP or PROFINET IO**)	
	Connecting intelligent field devices to the FOUNDATION Fieldbus	**Compact FF Link**	

Prompt	Specification	Performing system, component, function for PCS 7	Check √
Coupling DP/PA	Gateway between PROFIBUS DP and PROFIBUS PA	**DP/PA coupler, PA-Link**	
Coupling DP/FF	Gateway between PROFIBUS DP and Foundation Fieldbus	**Compact FF Link**	
Coupling PROFINET/PA	Gateway between PROFINET and PROFIBUS PA	CFU IE/PB Link PN IO with downstream DP/PA coupler	
Non-redundant PROFI-BUS DP devices	Connecting non-redundant PROFI-BUS DP devices to redundant PRO-FIBUS DP	**Y-Link**	
Diagnostics (with hardware compo-nents)	Simple diagnostics for communica-tion errors in PROFIBUS DP lines You can find additional information in section "Additional service sup-port and diagnostics (Page 645)"	e.g. **Diagnostic Repeat-er**	
Diagnostics (with software compo-nents)	Using and activating the PCS 7 di-agnostic functions You can find additional information in section "Additional service sup-port and diagnostics (Page 645)"	e.g. **NCM S7 PROFI-BUS diagnostics**	
Hazardous area	Special I/O components for use in hazardous areas (zones 1 or 2)	**S7-300 Ex I/O modules, ET 200iSP**	
Plant changes	Changing configuration of AS com-ponents in RUN	**CiR/H-CiR**	
Plant changes	Changing interface of AS blocks in RUN	**CPU 410-5H** as of firm-ware version 8.1 or higher	
Process mode – communication/connection			
Communication (network)	Terminal bus, system bus	**Ethernet**	
	Support for communication through network components such as CPs, bus links	Network components of **SIMATIC NET**	
Connecting AS	Connecting automation systems to the system bus	**CP 443-1** or internal PROFINET interface of the CPU	
Connecting OS/BATCH	Connecting PCS 7 operator/ BATCH stations to the terminal bus or system bus	**Communication pro-cessor** or other **Ether-net connection**	
Connecting ES	Connecting the PCS 7 engineering station to the terminal bus or system bus	**Communication pro-cessor** or other **Ether-net connection**	
Point-to-point coupling	Communication between the AS and other stations via point-to-point link	**S7-400 CP** **S7-300 CP** (in ET 200M)	
Engineering			

Prompt	Specification	Performing system, component, function for PCS 7	Check √
Scalability	Licenses for various numbers of process objects	**Licenses**	
Basic engineering	Basic engineering of hardware, communication	**STEP 7** with **HW Config, NetPro**	
Continuous automation functions	Graphical configuration of automation functions	**CFC**	
Discontinuous automation functions	Graphical configuration of sequential control systems with step-enabling conditions	**SFC**	
Recurring technological functions	Using the PCS 7 library for technological functions	**PCS 7 Advanced Process Library**	
User function blocks, custom	Create your own user function blocks in accordance with IEC 61131-3	**SCL**	
Batch processes	Configuring recipes and batches (production jobs)	**SIMATIC BATCH**	
Route control	System for the configuration, control, monitoring and diagnostics of material transports in piping systems	**SIMATIC Route Control**	
Availability with S7-400H	Engineering for redundant automation systems	**S7 H Systems**	
Failure safety with S7-400F	F programming tool with F-function blocks	**S7 F Systems**	
Safety reactions to defined states	Assignment of precisely defined reactions to events occurring in the process	**Safety Matrix**	
Controller optimization	System-aided optimization of control circuits with PCS 7	**PCS 7 PID Tuner**	
Plant pictures for PCS 7 OS	Creation of plant pictures for the OS in process mode and interconnection of picture objects with single control units (dynamic display)	**Graphics Designer** of **WinCC**	
Logical operations of the Logic matrix	Implementing the control signals. It provides logical operators for the following functions: Permit, Protection and Interlock	Logic Matrix	
Intelligent field devices	Configuration, parameter assignment, and commissioning of field devices	**SIMATC PDM**	
Efficient engineering	Functions for efficient engineering • Working with the several project engineers • Type definitions with reusability and centralized modification capability	**Multiproject,** **SFC type, process tag type, model, control module type, process object view**	

Prompt	Specification	Performing system, component, function for PCS 7	Check √
Mass data processing	Creation: • Process tags from process tag types • Replicas of models	**Import/export assistant** **PCS 7 Advanced ES**	
Comparing project versions	Determining differences between various versions of a project	**Version Cross Manager (VXM)**	
Versioning	Versioning of multiprojects, projects or libraries	**Version Trail**	
Reading parameters back	Automatic cyclic reading of the parameters from the AS		
Testing	Functional testing of the configuration with a simulated SIMATIC S7 station	**S7-PLCSIM**	
Administration	Software administration and lifecycle management	**SIMATIC Management Console**	
Plant documentation	Documenting plants in PCS 7 projects in conformance with standards	**DOCPRO**	

Additional information

- Capacity options in configuring a PCS 7 plant (Page 46)
- Selecting the network components (Page 59)
- Selecting PC components (Page 101)
- Selecting AS components (Page 103)
- Selecting I/O components (Page 117)
- Preparation for efficient engineering (Page 128)

4.3.2 What aspects are important when selecting components?

Selection Criteria

The selection of components for a process control system involves a variety of factors. The most important factors are:

- The type of process (continuous or discontinuous)
- The reaction of a plant to disruptions (availability and safe state)

Type of process

There are two process types:

- **Continuous process**
  Process sequence in plants in which "the same product" is produced "unchanged" (e.g. water desalination plants). Such processes can be automated by PCS 7 using **sequential control system (SFC)**. The automation can be implemented for small plant units as well as for the entire plant.
- **Discontinuous (batch) process**
  Process sequence in plants in which "different products" are produced (e.g. various recipes for producing tablets or mixing paints). Such processes can be automated by PCS 7 using **SIMATIC BATCH**. With the recipe-based control strategies in SIMATIC BATCH, the process sequences of a PCS 7 plant can be flexibly adapted to changing products, material properties, plant conditions, product stages, etc.

Reaction of a plant to disruptions (availability and safe state)

The consequences of disruptions are often difficult to evaluate. Planned reactions to faults are therefore very important. This is achieved through the following measures:

- Using high availability components
- Using fail-safe components
- Using high availability and fail-safe components
- Implementing the appropriate configuration measures, for example:
  - Interlocks between process tags (dependencies ensure targeted system responses)
  - Sequential control charts for startup and shutdown (automatic control of entire systems)
  - Higher-level calculation and management functions (reacting directly to the effects of an event)
  - Control functions for targeted control of units and plants (e.g. control using fail-safe systems in a defined state)

Additional information

- Section "Decision in favor of high availability and fail-safe components (Page 52)"
- Function manual *Process Control System PCS 7; High Availability Process Control Systems*
- Manual *Process Control System PCS 7; SIMATIC BATCH*

4.3.3 With which "third-party systems" can PCS 7 communicate?

Communication with "Third-Party Systems"

You can link up with numerous systems within the framework of Totally Integrated Automation with PCS 7 (TIA components are used in PCS 7 without additional applications):

- **Administration level and remote access**
  PCS 7 is seamlessly integrated into the company-wide information network using standardized interfaces for data exchange such as Ethernet, OPC or OLE DB (OpenPCS 7 station). This makes process data available at any time and at any location within the company.
- **Data links to other communication systems**
  In addition, communication is possible with the following communication systems using an adapter:
  - AS interface
  - Modbus

Note

Please contact your Siemens representative for more information about other communication options.

Selection of the components

Select the components that you need for the data link to the third-party systems:

Prompt	Specification	Performing system, component, function for PCS 7	Check √
Process mode – communication/connection			
IT world	Integrating PCS 7 into SIMATIC IT	**SIMATIC IT**	
Access to MIS/MES process data	Company-wide access to process data acquired with PCS 7 via OpenPCS 7 station (OPC and OLE DB)	**OpenPCS 7**	
Simple actuators and sensors	Connection of simple (usually binary) actuators and sensors on the lowest field level	**AS-i Link**	
Modbus devices	Used to connect components with the Modbus interface	**CP 341 with Modbus driver**	
Engineering			
Links and couplers	Configuration, parameter assignment and commissioning	**HW Config** or specific component software	

Additional information

- Section "Administration level and remote access (Page 96)"
- Section "Data links to other systems (Page 91)"

4.3.4 How can the plant be protected from unauthorized access?

Protection against unauthorized access in an automated plant

A great number of components are networked together in modern industrial plants. A variety of bus systems and protocols (such as TCP/IP, COM/ DCOM) are used to form the network. In networked automated plants, it is important to protect against unauthorized access to the plant, for example, from "office networks". This ensures that there are no negative effects on the plant.

Plant protection in PCS 7

In addition to the standard resources from Windows (user logon) and the usual network components (bridges and firewalls), PCS 7 provides a variety of options to prevent unauthorized access in a plant.

Selecting components and functions

Select the components/functions from PCS 7 needed for protecting access:

Prompt	**Specification**	**System, component, function for PCS 7**	**Check √**
Permissions on the PCS 7 OS	Access protection using smart card containing operator permissions	Smart card reader	
	Configuring operator permissions	**Operator station** function "User Administrator" of WinCC **Engineering system** "Local operator permission" function	
	Representation of picture content without operator permission	"OS Project Editor" function	
Access protection on AS	Protecting loaded CPU against access	HW Config – Properties of the CPU	
Access protection for charts	"Write-protected" attribute for individual charts or all charts within a folder	SIMATIC Manager - Object properties	

Central user management in PCS 7			
User management with access protection control	User management with access protection control for engineering and process mode, determination of application-specific user roles for engineering and operator control and monitoring	SIMATIC Logon	
Access protection for project data	Central user management with access control for engineering The objects (for example, multiproject, project, library) of a multiproject can be provided with access protection	Access protection for access to project data" function	
Access protection on AS	Password protected access to tasks for changing data in the automation system (user program, HW Config)	"Password protected access to the CPU" function	
Electronic signature	Password protected execution of functions, e.g. for controlling batches with BATCH	Electronic signature based on SIMATIC Logon	

Principle of central user management with SIMATIC Logon

SIMATIC Logon from PCS 7 is based on the basic user management mechanism in Windows:

1. Users, user groups (available on the prevailing Windows server) and passwords are defined in Windows.
2. The SIMATIC Logon software defines user roles for the engineering system, operator station, BATCH station and Route Control station and their assignment to defined Windows user groups.
3. Additional limits to user roles and user rights can be defined within the application. The following additional limits can be defined with SIMATIC BATCH:
   - Limits to the user rights in a user role (global)
   - Permitted user roles per computer (for each specific computer)
   - Permitted user roles per plant unit (for each specific unit)
   - Permitted user roles per plant unit (for each project)

The components contained in PCS 7 are supplied with information about the logged on user via the central logon service and can be informed of any change of the logon, etc.

Note

User roles for the engineering station

The following user roles are provided for the engineering station:

- "Project **Administrator**"
  is permitted to perform all functions on the engineering station
- "Project **editor**"
  Restricted use of the engineering functions
  - No permission for changing the user management
  - No permission for export and import functions
  - No permission for changing archives (deleting, moving, exporting)
  - Additional restrictions on specific plant areas possible, e.g. through AS-specific access control

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Principle of electronic signatures

PCS 7 supports the "electronic signature" function conforming to FDA or 21 CFR Part 11 requirements. The engineering contains definitions of the actions or conditional transitions of objects that should be activated by the "electronic signature" function based on the user role. When such an event occurs, there is a dialog prompt for one or more signatures based on the usual logon dialog in Windows.

Requirement:

The SIMATIC Logon Service software verifies the logon data. Therefore the SIMATIC Logon Service must be installed on the PC in order to use the "electronic signature" function.

Additional information

- Section "Protecting projects/libraries with access protection (Page 166)"
- Manual *SIMATIC Logon; SIMATIC Electronic Signature*
- Configuration manual *Process Control System PCS 7; Operator Station*
- Whitepaper *Security Concept PCS 7 and WinCC*

4.3.5 How can the process management be verified?

What is the purpose of process and process management verification?

Legal and business requirements play a decisive role for many plants, especially in regard to the following:

- Verifying standards of quality
- Documenting the status of a plant
- Ensuring only authorized personnel have access to the plant and verifying the operator input
- Ensuring only authorized personnel can make changes to the plant

An additional requirement for a process control system is often complete automatic documentation of all critical plant data and process operation in an automated plant.

Food & Drug Administration (FDA)

The US Food & Drug Administration (FDA) has defined guidelines for these areas. The GMP laws 21 CFR Part 210, 211, 11 are based on these guidelines. The most important, internationally valid requirements for automation engineering (in regard to validation) are summarized in 21 CFR Part 11.

Validation with PCS 7 according to 21 CFR Part 11

PCS 7 and SIMATIC BATCH support validation in conformity to 21 CFR Part 11.

1. The FDA as an American authority does not make any valid requirements internationally.
2. The rules of the FDA are not guidelines, they are laws.
3. The FDA makes no requirements on the automation engineering. It deals with requirements on electronic data.
4. The part 11 of the FDA does not describe any requirements on the validation. You may find these guidelines in Annexe 11 in EU GMP.

Selecting components and functions

Select the components/functions from PCS 7 that you need for validating the process control:

Requirement	Specification	Performing system, component, function for PCS 7	Check √
Logging of performed modifications	BATCH: Logging of each of the following modifications: • Modifying the recipe • Modifying the user permissions	**BATCH change log**	
	BATCH: Logging of recipes	**BATCH recipe log**	
	BATCH: Logging of any changes during batch production (including operator input)	**BATCH log**	
	Route Control: Logging of changes in the transport routes	**Route log**	
Logging of protected actions	ES: Logging of the following processes: • Download to target system (entire program) • Download to target system (changes only) • Activating and deactivating test mode • Changing values in test mode	**Change log**	
	ES: Additional logging of the following processes in the CFC/SFC: • In the CFC – Configuration of connections – Activating and deactivating runtime groups • In SFC – Configuration of constants in steps – Configuration of constants in transitions – Configuration of constants in sequencer properties	**ES log**	
Logging of delete actions	BATCH: Documentation of all delete actions in a separate log	**BATCH log**	
Versioning projects and libraries	ES: Creating projects and libraries with different versions	**Version Trail**	
Consistency of project and library versions	ES: Compare versions of projects and libraries with graphic display of differences	**Version Cross Manager (VXM)**	
Versioning charts	ES: Creating CFC/SFCs with different versions	**Automatic prompt** after changing a chart	
Versioning	BATCH: Versioning recipes, recipe operations and formulas	**Automatic** when a new batch object is created	

Requirement	Specification	Performing system, component, function for PCS 7	Check √
System access	Central user management based on Windows	**SIMATIC Logon**	
User identification	The change log is automatically amended with the identification of the users.	**Automatic** in the **change logs**	
Electronic signature	Password protected execution of functions, e.g. for batch control with BATCH	**Electronic signature** based on **SIMATIC Logon**	
Logging of electronic signatures	BATCH: Documentation of the performed electronic signatures	**Automatic** in the **recipe/ batch report** and in the **BATCH change log**	
Logging of AS access	Logging modifications made in the AS	Access protection with **SIMATIC Logon** Logging through the **ES log**	
Proof for validation	BATCH: Logs and archives - completed batches can be archived in XML format	**"Archiving batches"** function in BATCH	

Additional information

- Section "Comparing Project Versions with VXM (Page 633)"
- Section "How to document changes in the ES log (Page 621)"
- Section "How to document changes in the change log (Page 624)"
- Online help for the *Version Cross* Manager
- Manual *Process Control System PCS 7; SIMATIC BATCH*
- Manual *Process Control System PCS 7; SIMATIC Route Control*
- Manual *SIMATIC Logon; SIMATIC Electronic Signature*

4.3.6 How can project and process data be archived?

Introduction

SIMATIC PCS 7 provides a variety of functions for archiving project data and process values.

Archiving project data

The central database organization for plant-wide configuration data is contained in the engineering system. To avoid loss of data we recommend that you regularly backup your project. Archiving involves saving configuration data in the compressed form of an archive file. This is possible on the hard disk or transportable data media (for example, CD, DVD). You can select the required archiving tool in the SIMATIC Manager.

Note

Use the Version Cross Manager to determine differences between various versions of a project.

Archiving process data

Process data (measured values and messages) can be saved in the following archives:

- **WinCC archives**
  These archives are circular archives with a limited capacity. As soon as the maximum capacity has been reached, the oldest values are deleted so that additional new values can be saved. This corresponds to the FiFo principle.
  You can prevent loss of these oldest values by exporting these archives to a different storage location.
- **BATCH archives**
  Batch data of completed batches can be archived in the Process Historian. Authorized persons or systems can view and evaluate information via the Information Server.

Components, functions for archiving

Archiving of	Specification	Performing system, component, function for PCS 7	Check √
Configuration data	The multiproject can be archived with all projects and the master data library.	**"Archiving"** function in the **STEP 7** SIMATIC Manager	
Process data (in circular archives)	The operator station saves measured values and messages in archives for long-term availability of the data.	• **Tag logging (archive)** • **Alarm logging (archive)**	
	WinCC archives must be configured and adapted with editors from WinCC.	• **Tag logging**: Process values • **Alarm logging**: Messages • **Report Designer**: Print layout	
	SIMATIC PC station as external archive server	• **Process Historian** • **Tag logging, alarm logging**	
Batch data	The batch logs of completed batches can be archived in a database.	• **SIMATIC BATCH** • **Process Historian**	

Swapping out the archived information

You can swap out the information (tag and alarm logs) in OS archives to external media (e.g. CD, DVD).

Additional information

- Section "Introduction to archiving/versioning and documenting (Page 646)"
- For information on the archiving of process and batch data, refer to the documentation on SIMATIC Process Historian
- Manual *Process Control System PCS 7; SIMATIC BATCH*

4.3.7 What sources can be used in planning the plant structure?

Plant structure

The plant structure is understood as the following:

- How and where the areas of a plant are configured and designed
- Which options are used to equip which areas of a plant

Planning the plant structure

Note

There is no plant structure which can be recommended as universally valid. The designs involved in engineering a plant for process automation depend on the following factors:

- Laws, regulations, standards
- Process engineering and manufacturing engineering relationships
- Local conditions (location, expansion capability, environmental conditions, etc.)
- Other requirements (e.g. sensors and actuators in use)

Sources for planning a plant structure

You can gather important information from the following sources:

Source	Topic	Example
Description of the process	• Process engineering continuity • Continuity based on location • Central/distributed configuration of the automation systems • Central/distributed configuration of the HMI systems • Number of workstations depending on the degree of automation	Plant (e.g. power station): • Plant with units (e.g. heating unit with burner control) • Relationship of units to the entire process (e.g. failure of unit = failure of plant or reduced quality/performance) • Information about hazards (e.g., explosive gases) • Information about units (e.g. pressure control) and components (e.g. pressure sensor, pumps, valves)
Process tag lists	Central or distributed configuration possible; please observe the following: • Distance and distribution • Maintenance • Environment (e.g. Ex zone, local operator input, heat, dust) • Configuration, operating and monitoring • Process tag types	• Types of sensors and actuators and their technical parameters - for example: – Fill-level sensor: 0 to 20 l – Pump: with motor, temperature sensor, overload protection – Valve: with drive and position feedback signal • Planned location of the sensors/actuators in the plant • Signals from sensors and actuators: acquisition and processing in an automation system • Process tags belonging to a process tag type (e.g. "fill level")

Importing data for the engineering

Electronic plant information can be imported into the engineering system to display the plant structure in PCS 7 (for example: process tags, plant pictures).

Additional information

- Section "Capacity options in configuring a PCS 7 plant (Page 46)"
- Section "Importable data and data formats (Page 129)"

4.3.8 What service support does SIEMENS offer for PCS 7?

Service Support

You can find support for servicing PCS 7 plants from Siemens on the Internet (https://support.industry.siemens.com/cs)

4.4 Capacity options in configuring a PCS 7 plant

4.4.1 How do I scale PCS 7?

Scalability

SIMATIC PCS 7 can be adapted flexibly in a variety of ways for different plant requirements and sizes. The configuration can be expanded or modified during later upgrading or if technological changes are made to the plant.

SIMATIC PCS 7 covers all plant sizes. Depending on the demands you have the following options:

- To choose between automation systems with different performance capacities – starting with applications having few control tasks (for example: with SIMATIC PCS 7 BOX) -- up to the automation of a very large production plant with integrated process data control
- To integrate distributed or central I/Os step-by-step
- To size and configure the display and operating components – starting with small single-station systems with approximately 160 process tags, e.g. for laboratory automation, up to distributed multiple station systems with client-server architecture including approximately 60,000 process tags, e.g. for automation of large-scale production plants
- To scale the number of configurable process objects (software for a variety of PO quantities)
- To define network components and configure communication networks
- To enhance the functionality by systematically adding a variety of hardware and software components (for example, operator stations with SIMATIC BATCH or a separate archive server)
- To integrate applications for connecting SIMATIC PCS 7 to the IT world

Capacity options

The following sections provide information about planning for PCS 7 plant capacity:

- How many objects can be handled in a project? (Page 46)
- How many CPUs are needed for automation? (Page 47)
- How many devices, sensors and actuators can be integrated? (Page 48)
- How many operator stations are required? (Page 49)
- What are the expansion limits? (Page 50)

4.4.2 How many objects can be handled in a project?

Plant size

The **configurable** size of a PCS 7 plant is scalable.

The software product licenses for engineering stations, Operator Stations, Maintenance Stations, SIMATIC BATCH Stations, Route Control Stations, and SIMATIC PDM are available with different quantity frameworks. You can expand these quantity frameworks by means of additional Powerpacks.

Process object

In PCS 7 V7.0 SP1 and higher, the following rules are valid for the licensing of process objects (PO):

All SFCs and all block instances that support operator control and monitoring and that produce messages are considered to be PCS 7 process objects. These are the objects that are transferred to the OS and require licenses.

In the CFC, a block that supports operator control and monitoring is assigned the attribute "S7_m_c" in the block properties.

A process object can be one of the following blocks and objects:

- Blocks for operator control and monitoring of a plant (for example, motors, valves)
- Objects for automation (for example, level control)
- Objects for signal acquisition and signal processing (not channel driver blocks, for example: MonAnL)

Level of the licensing

You can find information on the current license levels for the various components of the process control system and the plant sizes achievable with them in the installation manual *Process Control System PCS 7; Licenses and Quantity Frameworks*.

See also

PCS 7 license information (Page 464)

4.4.3 How many CPUs are needed for automation?

Criteria for required number of CPUs

The number of CPUs required in the PCS 7 plant depends on the following factors:

- Number of sensors and actuators
  The more actuators and sensors in use, the more automation systems required.
  You can find information about this in the section "How many devices, sensors and actuators can be integrated?" (Page 48)
- CPU type
  The more powerful the CPU, the fewer CPUs are required.
  You can find information about this in the section "Overview of the automation systems (Page 105)"

- Utilization and required expandability
  The more reserves required, the more CPUs are necessary.
- Limits of the CPUs
  You can find information about this in the section "Limits of the CPUs for PCS 7 projects (Page 109)"
- Expansion of the plant
  You can find information about this in the section "What are the expansion limits? (Page 50)".
- Environmental requirements
- Requested optimization of the CPU for faster program processing and fewer CPUs:
  - Optimizing the processing cycles for program sections
  - Optimizing the processing sequence

No multicomputing for PCS 7

Note

In PCS 7, you cannot use multicomputing (synchronous operation of multiple CPUs).

4.4.4 How many devices, sensors and actuators can be integrated?

Mixed capacities

The sections below include examples of mixed capacities for pre-assembled automation systems for PCS 7 plants:

- Section "Single automation system for PCS 7 (Page 106)"
- Section "Redundant automation system for PCS 7 (Page 107)"

Note

The values displayed are not AS specific maximum values for the respective position. They are an example list representing the typical distribution of the total AS capacity available during mixed operation of all positions in a cohesive block.

4.4.5 How many operator stations are required?

Capacity of the PCS 7 OS

SIMATIC PCS 7 supports both single station and multiple station systems with a client-server architecture. The following table shows the most important factors for planning operator stations in a multiple station system.

Parameter	Value
Max. number of servers / server pairs in the project (OS, BATCH, Route Control and archive servers)	18
Max. number of automation systems per OS server / server pairs	64
Max. number of OS clients in multi-client operation (per multi-station system)	40 Note: If each OS client has access to all OS servers/server pairs.
Max. number of monitors per operator station in multi-channel operation	4
Maximum number of permitted monitors for process mode in a system	60
Max. number of OS areas	64
Max. number of windows per monitor	1 up to 16 (adjustable)
Number of trends per trend window	10
OS process picture time-out (100 process symbols)	< 2 s
Max. number of process objects:	
• per OS single-station system	8 500 PO
• per OS server	12 000 PO
• per AS	2 600 PO
• per project	216 000 PO
Max. number of configurable alarms per server / single-station	200 000
Number of process tags:	
• per OS single-station system	approximately 4 500
• per OS server	approximately 7 000
• per multi-station system	approximately 128 000
Integrated high-performance archive system(cyclic buffer) for:	
• Process value archiving (per OS server/single-station system)	approximately 1 500/s
• Message archiving (per OS server/single-station system)	Messages as continuous load: ca. 10/s Message burst ca. 3 000 with a duration of 4 s Note: If the time until the next message burst is less than five minutes, messages can be lost.
Long-term archiving	

Parameter	Value
Process value archiving with SIMATIC Process Historian	For additional information on the configuration limits, refer to the SIMATIC Process Historian documentation. The Process Historian does not need separate license keys for archive tags of operator stations.
Max. number of PCS 7 Web clients	100
Max. number of PCS 7 Web Diagnostics clients	3
Number of maintenance stations	1 Maintenance station

Additional information

- Manual *Process Control System PCS 7; Operator Station*
- Manual *Process Control System PCS 7; Web Option for OS*
- Manual *Process Control System PCS 7; Maintenance Station*

4.4.6 What are the expansion limits?

Expansion limit

Any potential plant expansion depends on the following factors:

- Network type connecting the PCS 7 components
- Distance bridged between the sensors and actuators (taking into consideration the potential transmission rates)

Since almost all of the sensors and actuators for PCS 7 are integrated in the distributed I/O, the length of the communications network is a critical factor.

Maximum expansion

The following bus systems are used in PCS 7 with the following maximum lengths:

Bus system	Application in PCS 7	Maximum expansion
Industrial Ethernet	Communications network for networks and subnets with special components developed for use in commercial systems	1.5 km electrical coupling 150 km optical coupling (global)
PROFINET	Communications network for the cell and field area	5 km electrical coupling 150 km optical coupling
PROFIBUS DP	Communications network for the cell and field area	10 km electrical coupling 100 km optical coupling
PROFIBUS PA	PROFIBUS for process automation (PA)	1.9 km electrical coupling
FOUNDATION Fieldbus	FOUNDATION Fieldbus for process automation	1.9 km electrical coupling

Bus system	Application in PCS 7	Maximum expansion
HART communication	Sensors and actuators that use the HART protocol for data communication can communicate with the automation system over special modules.	3 km
Point-to-point coupling	Communication between two nodes with special protocols	Depends on the selected network
TIA solutions		
AS interface (ASI)	Communication network on the lowest automation level for connecting to (usually binary) actuators and sensors to the programmable controller	100 m
Modbus	Used to connect components with the Modbus interface	Depends on component
MPI	**M**ulti-**P**oint-**I**nterface for testing and diagnostics	15 m

Additional information

- Which networks / bus systems are used for communication? (Page 59)
- Maximum transmission rate of the network / bus systems (Page 62)

4.5 Selecting high availability and fail-safe components

Components

The reaction of the plant to faults is an important aspect in process control engineering. Since the report of a fault is often not enough, the following components are an important part of process control engineering:

- High availability components
- Fail-safe components

Investment costs

The high investment costs for high availability and fail-safe components are negligible in comparison to the costs and losses involved in the loss of production. The higher the costs resulting from production stoppage, the more advisable the use of high availability and fail-safe components.

4.5.1 Redundancy concept for PCS 7

High availability components

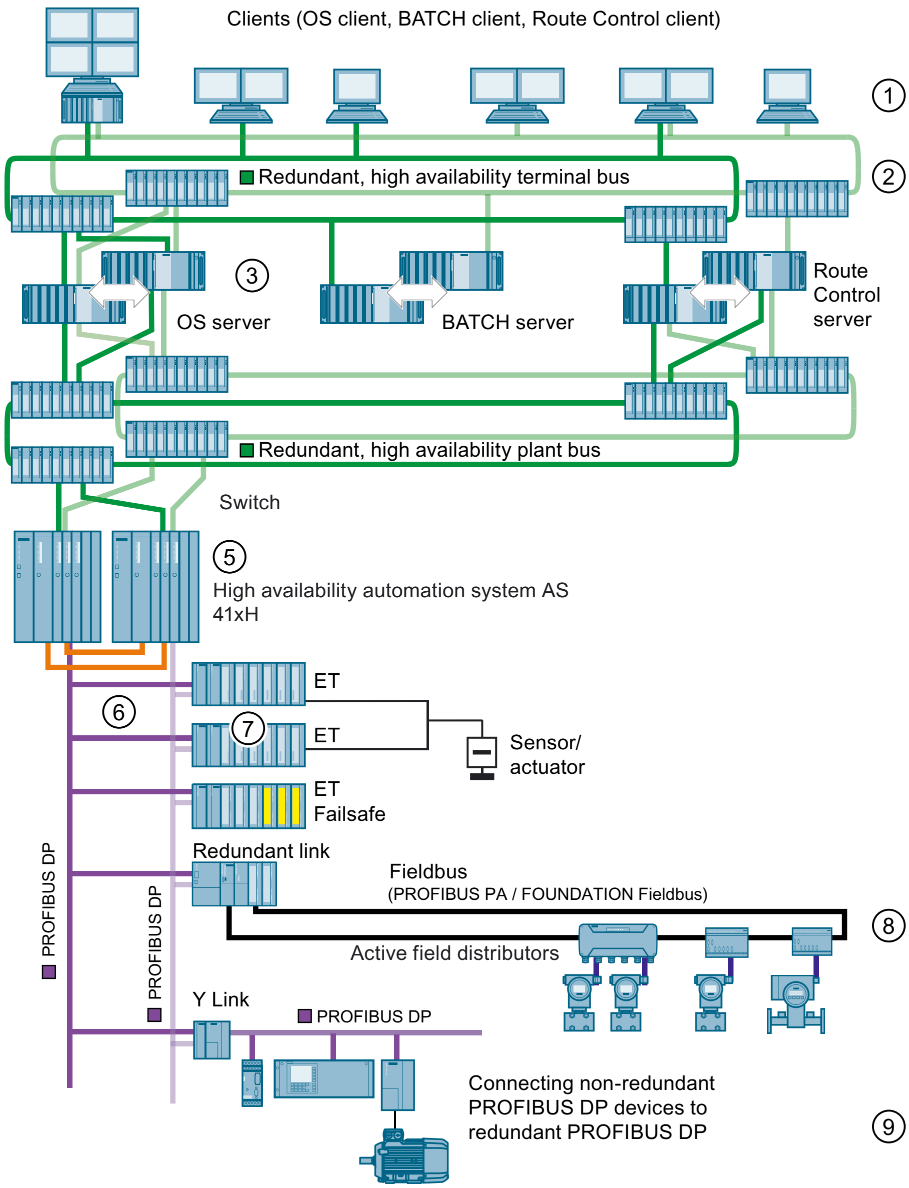
The use of high availability components in a process control system can minimize the risk of production loss. A redundant configuration guarantees high availability in a process control system. This means that all components involved in the process have a backup in continuous operation. When a fault occurs or one of the control system components fails, the correctly operating redundant component takes over the continuing control task.

Redundancy concept

The PCS 7 high availability components enable you to achieve the desired form of high availability in all automation levels:

- Operator stations, BATCH stations, Route Control stations, maintenance stations, external archive server (control level)
- Bus system
- Automation system (process level)
- Distributed I/O (field level)

The following graphic shows the theoretical structure on the basis of a configuration with high availability components.



No. in figure	Description
1	Several clients (OS clients, BATCH clients, Route Control clients) can access data on a server (OS server, BATCH server, Route Control server).
2	Communication between the operator stations (client and server) and communication with the engineering station is over a redundant, high availability terminal bus (Industrial Ethernet). The clients and server are connected to the terminal bus via switches.
3	The servers (OS server, BATCH server, Route Control server, maintenance server, external archive server) can, when necessary, be configured as redundant.

No. in figure	Description
4	Automation systems communicate with the OS servers/Route Control servers, BATCH servers (in AS-based operation) and engineering stations, as well as amongst themselves, via the redundant, high availability system bus (Industrial Ethernet). The automation systems, server and engineering station are connected to the system bus via switches.
5	Each part of the redundant high availability AS 41xH automation system is connected to the system bus via an Ethernet connection (CP or integrated interface of the CPU) . Each part of the AS can be connected to multiple distributed I/O systems. The internal interfaces or additional communications processors are used for the connection (Ethernet or PROFIBUS DP).
6	The redundant connection to the fieldbus is implemented with two interface modules (for example, IM 153-2) in each I/O system (for example, ET 200M).
7	You can evaluate the signals of sensors/actuators with redundant digital or analog input/output modules. If one of the two redundant modules fails, the input/output signal continues to be evaluated by the operational module.
8	The PROFIBUS PA I/O (or FF I/O) is connected to the redundant fieldbus (for example, PROFIBUS DP) using couplers and two interface modules. Through redundant links (PA-Link or Compact FF Link) a redundant fieldbus is implemented. Field devices are connected to the fieldbus by means of active field distributors: • For ring redundancy: AFD; AFDiS or AFDiSD • For coupler redundancy: AFS
9	The Y Link allows you to connect non-redundant PROFIBUS distributed I/O devices to a redundant PROFIBUS DP.

Additional information

- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

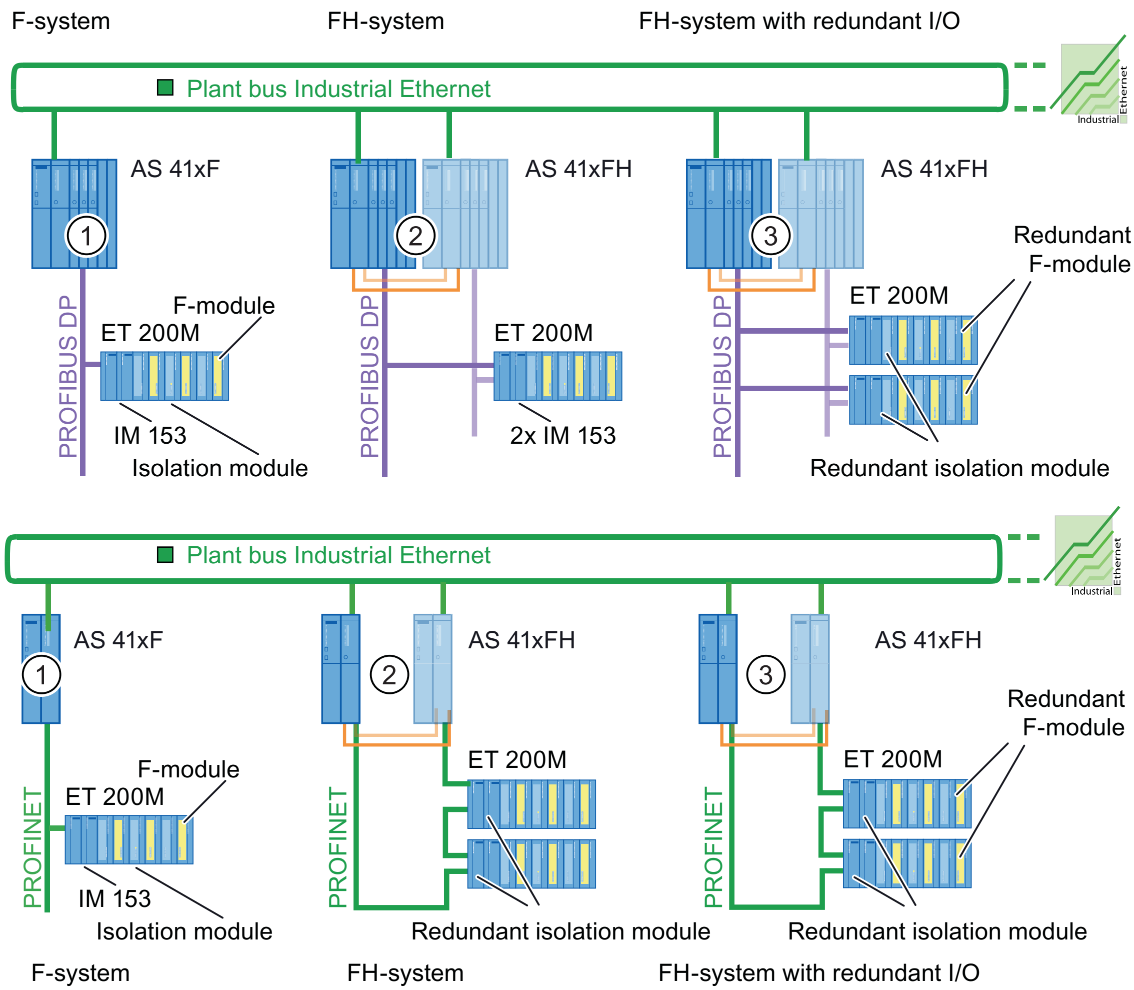
4.5.2 Operational reliability concept of PCS 7

Fail-safe components

Fail-safe automation systems are employed for PCS 7 when a fault could endanger human life, damage the plant or the environment. Fail-safe automation systems detect both errors in the process along with internal errors and automatically bring the plant to a safe state when a fault occurs.

Operating reliability concept

The fail-safe automation systems from PCS 7 can be configured single-channel (F system with one CPU) or redundant (FH system).



No. in figure	Description of example
1	The fail-safe S7-300 signal modules are connected to the fail-safe S7-400F automation system via the ET 200M.
2	Fail-safe automation systems can also be configured redundantly. The fail-safe and high availability automation system S7-400FH guarantees optimum availability and safety of the plant.
3	Fail-safe S7-300 signal modules (F modules) can also be redundantly connected to further enhance the availability.

Safety mechanisms

The following safety mechanisms are part of the PCS 7 operating reliability concept:

- The PROFIsafe profile is used for safety-related PROFIBUS DP communication between the F CPU and distributed I/O. The fail-safe automation systems and signal modules can recognize false user data and trigger the appropriate error responses with this safety frame.
- Following programming (F program), the configured safety functions are processed twice in different processor sections of the CPU. Potential errors are detected in a subsequent comparison of the results.
- Programming errors such as division by zero or a value overflow are intercepted by special fail-safe CFC blocks (F blocks).
- The following functions increase the level of safety:
  - Comparison of F programs
  - Detection of modified F-programs per checksum
  - Password-protected access authorization

  Note

  An error detected in the F program does not lead to a CPU stop but triggers a configurable response. It either brings the corresponding F runtime group or the entire F program into a safe state.

Using standard components

Standard modules can also be used in fail-safe automation systems in addition to fail-safe signal modules.

A user program may contain both F programs and standard programs. They are decoupled with special conversion blocks.

Certificates for S7-400F/FH

The fail-safe S7-400F/FH automation system used with PCS 7 has the following certification:

- German Technical Inspectorate (TÜV) certificate for the safety classes SIL1 to SIL3 from IEC 61508
- Requirement classes AK1 to AK6 from DIN V 19250/DIN V VDE 0801
- Categories 2 to 4 of EN 954-1

Additional information

- Product overview *Process Control System PCS 7; Released Modules*
- Add-on catalog for the SIMATIC PCS 7 process control system (catalog ST PCS 7 AO)
  In this catalog, you can find the components you can integrate in a fail-safe automation system.
- Manual *SIMATIC Programmable Controllers S7 F/FH*

- Manual *S7-300 Fail-safe Signal Modules*
- Manual *SIMATIC ET 200S Distributed I/O System*
- Manual *SIMATIC Distributed I/O System ET 200pro*
- Manual *SIMATIC Distributed I/O ET 200iSP Distributed I/O Device - Fail-safe Modules*

4.5.3 Recommended use of components

Selection of the components

The safety and availability requirements are also decisive factors in the selection of high availability and fail-safe components for a plant. The following table is a list of recommendations for selecting components according to the requirements of the system.

Requirement:	**Low or none**	**Medium**	**High/large**
AS			
Availability	Default	Proportion: SIMATIC H systems (Page 111)	SIMATIC H systems (Page 111)
Safety aspects	Default	Proportion: SIMATIC F systems (Page 114)	SIMATIC F Systems (Page 114)
Availability and safety aspects	Default	Proportion: SIMATIC FH systems (Page 114)	SIMATIC FH systems (Page 114)
Distributed I/O			
Availability	• ET 200M • ET 200iSP • ET 200SP HA	• Two IM 153 in ET 200M • Two IM 152-1 in ET 200iSP • Two IM 155-6 in ET 200SP HA	• Two IM 153 in ET 200M Redundant IO modules in ET 200M • Two IM 152-1 in ET 200iSP Redundant IO modules in ET 200iSP • Two IM 155-6 in ET 200SP HA Redundant IO modules in ET 200SP HA
	• PA Link • Compact FF Link	• Two IM 153-2 and two DP/PA couplers in the PA Link • Two Compact FF Link	• Two IM 153-2 and two DP/PA couplers in the PA Link • Two Compact FF Link
Safety aspects	• ET 200M • ET 200iSP	• Fail-safe IO modules in ET 200M • Fail-safe IO modules in ET 200iSP	• Fail-safe IO modules in ET 200M • Fail-safe IO modules in ET 200iSP
	• ET 200S	• Fail-safe IO and power modules	• Fail-safe IO and power modules

Requirement:	Low or none	Medium	High/large
Availability and safety aspects	• ET 200M • ET 200iSP	• Two IM 153 in ET 200M F Fail-safe IO modules in ET 200M • Two IM 152-1 in ET 200iSP Fail-safe IO modules in ET 200iSP (only firmware V2.0 supports fail-safe.)	• Two IM 153 in ET 200M Redundant fail-safe IO modules in ET 200M • Two IM 152-1 in ET 200iSP Redundant fail-safe IO modules in ET 200iSP (only firmware V2.0 supports fail-safe.)
Bus systems			
Availability on the terminal bus and plant bus	Industrial Ethernet: Standard ring structure	Industrial Ethernet: Standard ring structure	Industrial Ethernet: redundant ring configuration
Availability on field bus	PROFIBUS DP/PA	Redundant PROFIBUS DP/PA	Redundant PROFIBUS DP/PA
	PROFINET	Redundant PROFINET	Redundant PROFINET
	FOUNDATION Fieldbus	Redundancy with two Compact FF Link and active field splitter (AFS)	Ring redundancy with two Compact FF Link and active field distributor (AFD)
HMI systems			
Availability – Data security	PCS 7 OS, SIMATIC BATCH and SIMATIC Route Control	Redundant servers for PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, maintenance station and central archive server	Redundant servers for PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, maintenance station and central archive server

4.6 Selecting the network components

4.6.1 Communication within PCS 7

Introduction

The communication within PCS 7 is based on SIMATIC NET network components that conform with established worldwide standards. SIMATIC NET includes powerful and robust components which were developed especially for industrial use. They have the following properties:

- The components allow for the reliable exchange of data between all levels and components in the PCS 7 plant.
- The components can be enhanced and expanded using standard components.

SIMATIC NET

SIMATIC NET contains the following components:

- The communication network consists of the transmission medium, the corresponding connection and transmission components, and the respective transmission methods.
- The protocols and services are used for data communication between the components.
- The communication modules of the automation systems establish the connection to the communication network (e.g. communication processors CP).

4.6.2 Which networks / bus systems are used for communication?

Networks / bus systems for communication

The following table shows you the network / bus systems used for communication between components in a PCS 7 plant.

Communication between	Operator station, Route Control station	BATCH station	Engineering station	AS	Distributed I/O	Intelligent field devices, sensors and actuators
Operator station, Route Control station	Ethernet	Ethernet	Ethernet	Ethernet	None	None
BATCH station	Ethernet	Ethernet	Ethernet	Ethernet ***1)**	None	None
Engineering station	Ethernet	Ethernet	Ethernet	Ethernet	Ethernet via AS	Ethernet via AS

Communication between	Operator station, Route Control station	BATCH station	Engineering station	AS	Distributed I/O	Intelligent field devices, sensors and actuators
AS	Ethernet	Ethernet *1)	Ethernet	Ethernet	PROFIBUS DP or PROFINET	PROFIBUS DP; PROFIBUS PA; FOUNDATION Fieldbus; HART, AS-i, Modbus
Distributed I/O	None	None	Ethernet via AS	PROFIBUS DP or PROFINET	PROFIBUS DP or PROFINET (via AS)	via AS
Intelligent field devices, sensors and actuators	None	None	Ethernet via AS	PROFIBUS DP; PROFIBUS PA; FOUNDATION Fieldbus; HART, AS-i, Modbus	via AS	None

***1)** Path of communication between **BATCH Station and AS** is dependent upon the operating mode of the BATCH station:

- In PC-based operation: Via terminal bus (Ethernet) and OS to AS
- In AS-based operation: Via plant bus (Ethernet) to AS

4.6.3 Fields of application and parameters of the networks/bus systems

Fields of application / parameters of the networks/bus systems

The following tables provide an overview of the most important decision criteria for the use of network / bus systems.

Terminal bus and system bus

Areas of application / parameters	Information and configuration limits
Area of application	Terminal bus and system bus
Standards	IEEE 802.3
Transmission rate (Page 62)	100 Mbps, up to 10 Gbps
Network size (maximum):	
• Electrical	5 km*
• Optical	150 km*
• Wireless	1000 m*
• Global	WAN with TCP/IP
Topology	Ring, line, star, tree, redundant

Areas of application / parameters	Information and configuration limits
Number of nodes:	
• Typical	1023 per segment
• Maximum	(unlimited)
Specific parameter assignment	Address and protocol; no bus parameters
Special area of application	-

*) The max. network expansion depends on the network components used

Fieldbus

Parameter	Information and configuration limits				
Area of application	PROFIBUS DP	PROFINET	PROFIBUS PA*** or FOUNDATION Fieldbus	HART	AS-i
Standards	IEC 61158-2 EN 50170-1-2	IEC 61158/61784	IEC 61158-2 EN 50170-1-2 ISA S50.2	Conforming to Bell 202 standard	IEC 62026 EN 50295
Transmission rate (Page 62)	up to 12 Mbps depending on distance	max.100 Mbps	31.25 Kbps	1.2 Kbps (PTP) 19.2 Kbps (Bus)	Max. cycle time: 5 ms (for 31 AS-i slaves)
Network size (maximum):					
• Electrical	9.6 km** (with a repeater)	5 km*	1.9 km	3 km (PTP) 100 m (bus)	max. 100 m
• Optical	90 km	150 km*	-	-	-
• Wireless	15 m (with ILM)	1000 m*	-	-	-
Topology	Ring, line, star, tree, redundant	Ring, line, star, tree, redundant	Line, star, tree	Line - direct connection to special input modules	Line, star, tree
Number of nodes:					
• Typical	32 per segment	1023 per segment	32 per segment 64 per PA link	1 nodes	15
• Maximum	Max. 125	(unlimited)	Max. 125	1 nodes	max. 32 (31 slaves with a maximum of 124 binary elements)
Specific parameter assignment	Data throughput and connection parameters	Address and protocol; no bus parameters	Data throughput and connection parameters	Configuration for devices with SIMATIC PDM	Connection using S7 configuration
Special area of application	-	-	Hazardous area	-	Analog sensors slave profile 7.3/7.4

*) The max. network expansion depends on the network components used

**) PROFIBUS DP segment with repeaters: You can find information on this in the section "Electrical transmission media (Page 75)".

***) Similar parameters apply for the FOUNDATION Fieldbus. You can find information about this in the *SIMATIC Process Control System PCS 7, FOUNDATION Fieldbus* documentation.

4.6.4 Maximum transmission rate of the network / bus systems

Maximum transmission rates

The following table lists the maximum transmission rates of the networks / bus systems. The transmission rate depends on the network physics:

- Electrical network: Network installed with electrical conductive connections (copper cable)
- Optical network: Network installed with fiber-optic cables (FO)

Network / bus system	Electrical network	Optical network	Recommendation
Industrial Ethernet	100 Mbps, up to 10 Gbps	100 Mbps, up to 10 Gbps	Always use components that support 100 Mbps or 1 Gbps
PROFINET	Max.100 Mbps	Max.100 Mbps	Transmission paths can be equipped with Industrial Ethernet components.
PROFIBUS DP	Transmission rate for max. segment lengths: • 12 Mbps max. 60 m • 6 Mbps max. 60 m • 3 Mbps max. 100 m • 1.5 Mbps max. 200 m • 500 Kbps max. 400 m • 187.5 Kbps max. 700 m • 93.75 Kbps max. 900 m • 45.45 Kbps max. 900 m • 19.2 Kbps max. 900 m • 9.6 Kbps max. 900 m	max. 12 Mbps • Used with plastic FO max. 400 m • Used with glass fiber FO max. 10 m	We recommend the use of optical networks if interference immunity and control-to-load isolation are important. You can find information about the correlation between transmission rate and distance for electrical networks in the section "Electrical transmission media (Page 75)"
PROFIBUS PA	31.25 Kbps	-	The communication is carried out via the PROFIBUS DP. You can find information about this in the section "Connecting PROFIBUS DP to PROFIBUS PA (Page 79)"
FOUNDATION Fieldbus	31.25 Kbps	-	The communication is carried out via the PROFIBUS DP. For additional information, please refer to the *SIMATIC Process Control System PCS 7, FOUNDATION Fieldbus documentation.*

Network / bus system	Electrical network	Optical network	Recommendation
HART	1.2 Kbps (PTP) 19.2 Kbps (bus)	-	-
AS-i	Max. cycle time: 5 ms (for 31 AS-i slaves)	-	The communication is carried out via the PROFIBUS DP. You can find information about this in the section "Connecting an AS interface to PROFIBUS DP (Page 94)"

*) SCALANCE X-400 Switches are suitable for 10/100/1000 Mbps (electrical or optical). (The DTEs are connected to the 10/100 Mbps ports.)

4.6.5 Optical transmission media

4.6.5.1 Optical and electrical transmission media with Industrial Ethernet

Optical transmission media

Glass fiber-optics are preferably used as the optical transmission media. PCS 7 offers standard cables that are suitable for above-ground installation indoors and outdoors.

Standard cables can be supplied pre-assembled with fixed lengths,

- With 2 x 2 BFOC connectors (FO standard cable)
- With 2 x 2 SC connectors (FO standard cable)
  The FO standard cable with 2 x 2 SC connectors is required for optical networks in the Gigabit range.

Electrical transmission media

The terminals are connected with Industrial Twisted Pair (ITP). Prefabricated cable or meterware (ITP standard cable) in a variety of designs are offered with sub D connectors to allow direct connection between the nodes and network components.

Terminals can be optionally connected with twisted pair (TP) using so called TP cord cables.

SCALANCE X100 media converters

SCALANCE X100 media converters enable the configuration of optical and combined (electrical/optical) networks:

- SCALANCE X101-1
  the maximum transmission range (segment length) is 3 km
- SCALANCE X101-1 LD
  the maximum transmission range (segment length) is 26 km

Additional information

- see section "Which networks / bus systems are used for communication? (Page 59)"
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*

4.6.5.2 Optical transmission media on PROFIBUS

Recommendation

Note

Recommendation: Use the optical transmission type for large distances or for connections between buildings.

Glass fiber-optic cables or plastic fiber-optic cables are used as transmission media for optical PROFIBUS networks.

Glass fiber-optic cables

PCS 7 offers standard cables for glass fiber-optic cables with a compatible connector set (20 BFOC connectors) that are suitable for indoor and outdoor cable installation.

Plastic fiber-optic cables

PCS 7 offers standard cables for plastic fiber-optic cables with compatible plug adapters that are suitable for indoor cable installation.

Optical Link Module (OLM)

OLMs enable the configuration of optical and combined (electrical/optical) networks:

- The OLM features an RS 485 interface and 2 fiber-optic cable interfaces.

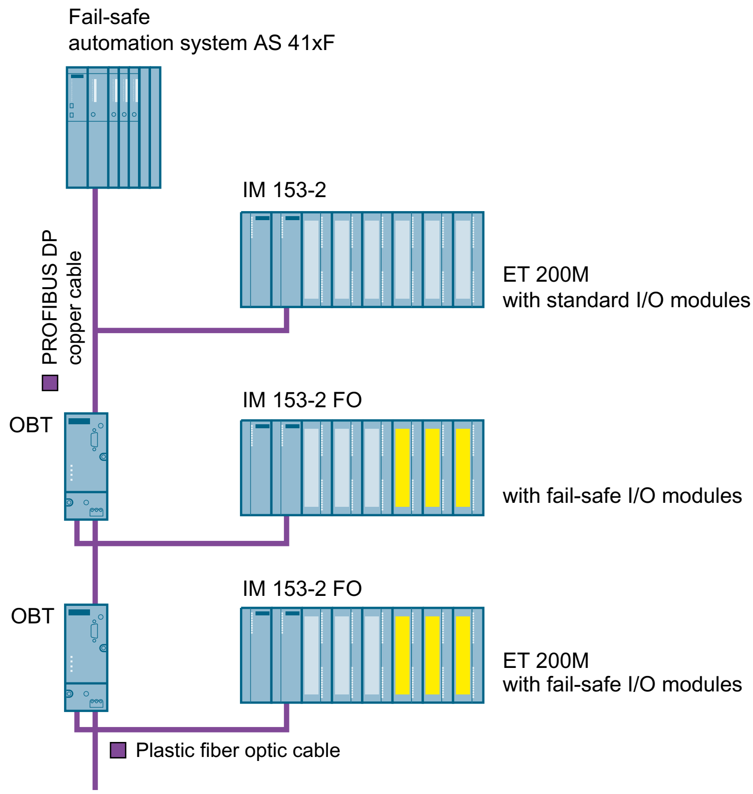
Optical Bus Terminal (OBT)

The OBT allows a PROFIBUS DP node with integrated optical interface to be connected to an RS 485 segment or PROFIBUS DP node without integrated optical interface.

Using fiber-optic cables and OBTs for S7-400F/FH

Fiber-optic cables and OBTs are recommended for fail-safe automation systems (with F modules only) to meet the requirements of safety level SIL 3. ET 200M is connected to the electrical bus cable of the PROFIBUS DP through an OBT using fiber-optic cables.

Advantage with required safety class **SIL 3**: A safety protector is not needed to isolate signals between IM 153-2 and F modules when a direct, electrical connection is made.



Additional information

- see section "Maximum transmission rate of the network / bus systems (Page 62)"
- Manual *SIMATIC NET; PROFIBUS Networks*
- Manual *SIMATIC NET; Twisted Pair and Fiber-Optic Networks*

4.6.5.3 Optical and electrical transmission media with PROFINET IO

Optical transmission media

Glass fiber-optics are preferably used as the optical transmission media. PCS 7 offers standard cables that are suitable for above-ground installation indoors and outdoors.

Standard cables can be supplied pre-assembled with fixed lengths (check your system for what is usable),

- With 2 x 2 BFOC connectors (FO standard cable)
- With 2 x 2 SC connectors (FO standard cable)
- With 2 x 2 FC LC Plug (IE FC FO cable) for use of ET 200SP HA und CFU

Electrical transmission media

The components on PROFINET IO are connected with Industrial Twisted Pair (ITP). Prefabricated cable or meterware (ITP standard cable) in a variety of designs allow direct connection between the nodes and network components.

Additional information

- see section "Which networks / bus systems are used for communication? (Page 59)"
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*

4.6.6 Terminal bus and plant bus with Ethernet

4.6.6.1 Planning the management level with Ethernet

Isolation of the system bus and the terminal bus

Note

We recommend the isolation of the system bus and the terminal bus. For smaller configurations, however, this is not strictly necessary.

The MES level should always be connected via a router. This prevents unauthorized access to the process control system.

Ethernet/Gigabit Ethernet

The network components used in PCS 7 are Industrial Ethernet components. This means the following:

- Communication speed of 100 Mbps or 1 Gbps
- Using switching technology
- Redundancy using optical/electric rings

Components used for PCS 7

Network nodes are connected to SCALANCE X switches by network cables. Used for data transmission:

- Twisted pair cables (ITP or TP)
- Fiber-optic cable (FO)
- Coaxial and triaxial cables

Additional information

- Section "Data paths via terminal bus and plant bus (Page 149)"
- Additional information concerning the PCS 7 security concept can be found on the Internet (http://support.industry.siemens.com/cs/ww/en/view/60119725). Whitepaper *Security Concept PCS 7 and WinCC*
- Section "Maximum transmission rate of the network / bus systems (Page 62)"

4.6.6.2 Using switching technology with SCALANCE X

SCALANCE X

SCALANCE X is the switch product family of Industrial Ethernet switches from SIMATIC NET. Switches are active network components that distribute data to targeted addressees.

- SCALANCE X switches used for PCS 7
  You can find suitable switches in the product overview *Process Control System PCS 7; Released Modules*.
- SCALANCE X media converters used for PCS 7
  You can use media converters to interconnect optical and electrical connection paths. SCALANCE-X101-1 and SCALANCE X101-1LD are examples of this.

Ring with redundancy manager

You can build ring structures with switches serving as redundancy managers. In PCS 7, you can build networks with optical or electrical connection paths. You can configure up to 50 switches in a line topology in the networks.

Selection of the SCALANCE X Variants

Switch	Port type and number					Redundancy Manager	Standby Manager
	Gigabit Ethernet 10/100/1000 Mbps	Ethernet (10/100 Mbps)					
		Sub D (ITP)	RJ45 (TP)	Multimode FO	Single mode FO		
X414-3E[4]	2 x TP or 2 x 1 Gbps FO	-	12/20[1]	4[2]/12[1]	4[3]/12[1]	Yes	Yes
X408-2[4]	4 x TP or 4 x 1 Gbps FO	-	4	4	4	Yes	Yes
X310	3 x TP	-	7	-	-	Yes	Yes
X308-2	3 x TP or 2 x 1 Gbps FO	-	7	2	-	Yes	Yes
X308-2LD	3 x TP or 2 x 1 Gbps FO	-	7	-	2	Yes	Yes
X204IRT	-	-	4	-	-	Yes[5]	Yes[5]
X202-2IRT	-	-	2	2	-	Yes[5]	Yes[5]

Switch	Port type and number					Redundancy Manager	Standby Manager
	Gigabit Ethernet 10/100/1000 Mbps	Ethernet (10/100 Mbps)					
		Sub D (ITP)	RJ45 (TP)	Multimode FO	Single mode FO		
XC200	-	-	8	-	-	No[6)]	No
XP208	-	-	8	-	-	Yes	No
XC206-2	-	-	6	2	-	Yes	No
X101-1	-	-	1	1	-	No	No
X101-1LD	-	-	1	-	1	No	No

1) Including extension module

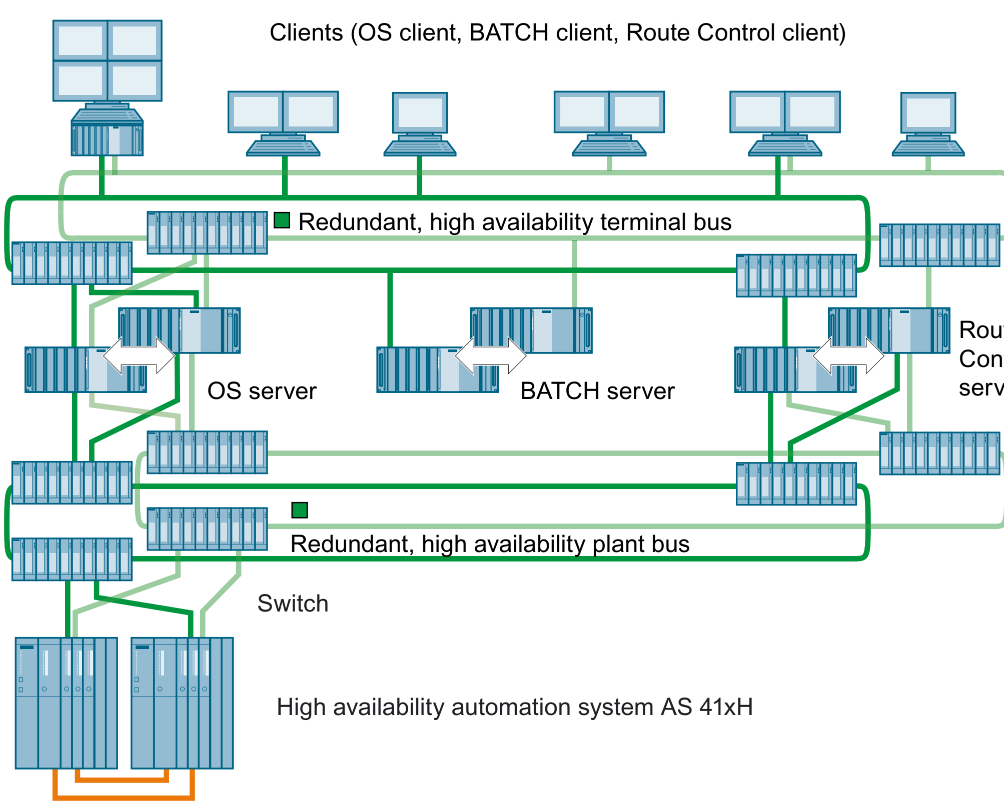
2) Can be stacked with 2 multimode media modules

3) Can be stacked with 2 single-mode media modules

4) Fiber optic modules for optical connection
100 Mbps: MM491-2 Fast Ethernet fiber optic module (100Base FX)
1000 Mbps: MM492-2 Gigabit media module (1000Base-FX)

5) Redundancy manager and standby manager cannot be run at the same time

Example of switching technology with SCALANCE X

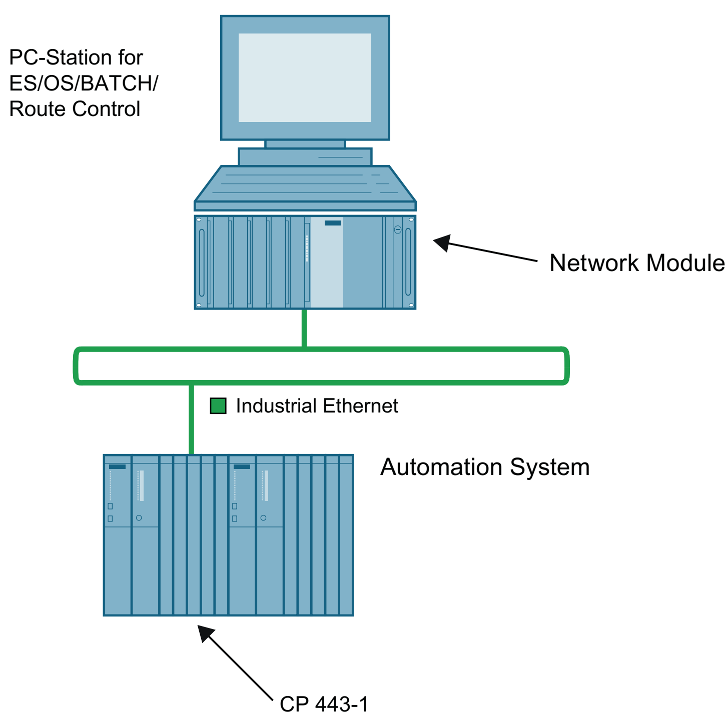


Additional information

- Section "Data paths over the terminal bus and system bus (Page 149)"
- Function manual *Process Control System PCS 7; High Availability Process Control Systems*
- Operating Instructions *Industrial Communication; Industrial Ethernet Switches SCALANCE X-400*
- Configuration Manual *Industrial Communication; Industrial Ethernet Switches SCALANCE X-300 SCALANCE X-400*
- Operating Instructions *Industrial Communication; Industrial Ethernet Switches SCALANCE X-200*
- Operating Instructions *Industrial Communication; Industrial Ethernet Switches SCALANCE X-300*
- Operating Instructions *Industrial Communication; Industrial Ethernet SCALANCE X-100 and SCALANCE X-200 product line*

4.6.6.3 Connecting network nodes to Ethernet

Bus connection of AS and PC stations



Connection of the AS

The protocol for the connection of the AS to Industrial Ethernet TCP / IP or ISO. The following interfaces in the AS are suitable:

- Communications processor CP 443-1
- Ethernet onboard interface of the CPU (if available)

Connecting PC stations

Note

Bundle PC

Observe the requirements for the PC components. You can find information on this in the *PCS 7 readme*.

Connection to the terminal bus

For connection to the terminal bus:

- Released communication modules for the PC station (for example, Intel® Gigabit CT Desktop Adapter; Ethernet onboard interface)
- Versions for the redundant connection of the PC station to a terminal bus:
  - Parallel Redundancy Protocol
  You can find information on this in the function manual *Process Control System PCS 7; High Availability Process Control Systems*.

Use the product documentation to verify that the communication modules are suitable for the terminal bus when implementing the respective concept.

Connecting to the system bus

You can use the following network adapters to connect to the system bus:

- Standard communication modules:
  – If you connect up to 8 communication partners per PC station (automation systems or servers).
  – If high availability automation systems are used with CPUs (firmware version as of V6.0 or above / CPU 410 Process Automation V8).
  – If you require connections between PC station with 2 network adapters and high availability automation systems (2 way redundancy).
- Communication modules with onboard processors **(CP 16xx)** are required in the following cases:
  – If you connect between 9 and a maximum of 64 communication partners per PC station (automation systems or servers).
  – If high availability automation systems are used with CPUs (firmware version earlier than V6.0 or CPU 410 Process Automation V8).
  – If you require connections between PC station with 2 network adapters and high availability automation systems (2 way redundancy and 4 way redundancy).

Additional information

- Function manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- Section "Data paths over the terminal bus and system bus (Page 149)
- You can find information on high availability automation systems in the function manual *Process Control System PCS 7; High Availability Process Control Systems*.
- You can find information about approved network adapters and communications processors in the product overview *Process Control System PCS 7; Released Modules.*
- You can find information about time synchronization in the function manual *Process Control System PCS 7; Time synchronization*.

4.6.6.4 Configuring redundant Ethernet networks

Redundant system bus / terminal bus

The following communication solutions increase the availability by eliminating individual errors:

- Redundant electrical network
- Redundant optical network
- Combined redundant network

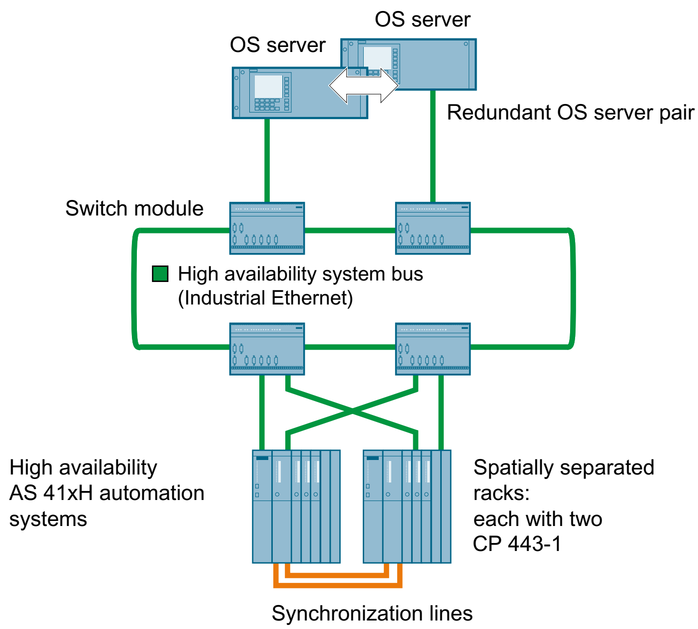
Application of the ring structure

Redundancy can also be achieved by means of a ring structure configuration:

- Single ring (see example of a high availability system bus)
- Double ring (see example of a redundant high availability system bus)
  An additional ring with SCALANCE X and two interface cards for each connected component (for example AS, OS) increases the level of availability.

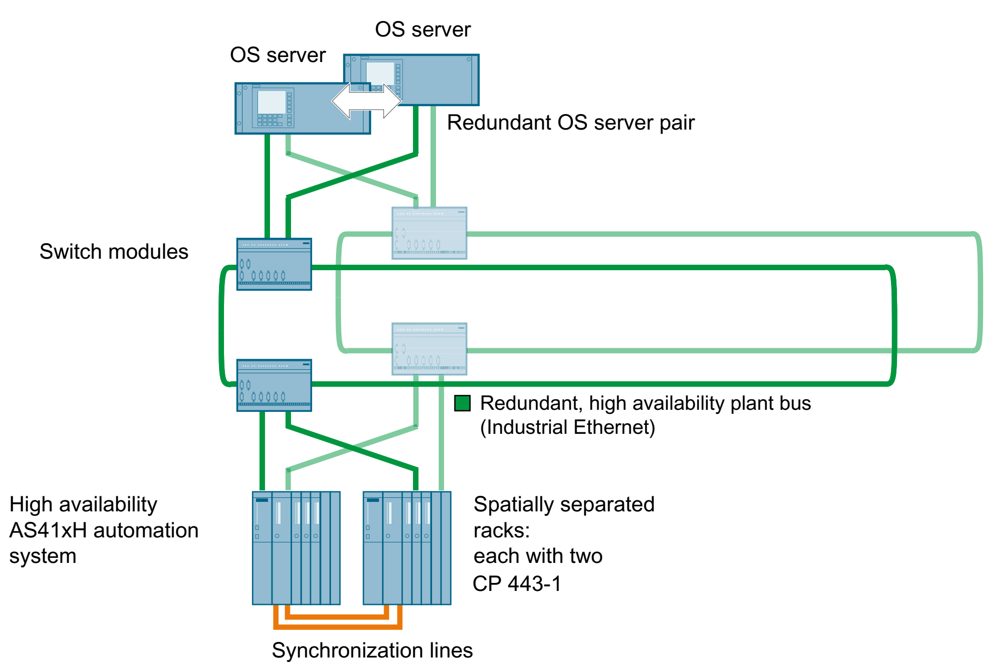
Example of a high availability system bus

The following figure shows an example of a high availability system bus in ring structure. All components are configured redundantly, except the system bus.



Example of a redundant high availability system bus

The following figure shows an example of a redundant, high availability system bus with a double ring structure. All components are configured redundantly.



Switches

All switches (SCALANCE X-400/-300/-200) feature 2-ring ports to enable connection to double Ethernet ring structures.

Additional information

- Section "Using switching technology with SCALANCE X (Page 67)"
- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

4.6.6.5 Planning diagnostics on the Ethernet

Diagnostic functions of SCALANCE X switches

The following diagnostic functions are available when SCALANCE X is used:

- Segmental analysis of the Ethernet network
- Diagnostics of communication errors
- Signaling of error to other SIMATIC NET network components or setting the own LED to Fault.

Additional Diagnostic Tools and Information

Additional tools are available for network diagnostics. Refer to the configuration manuals *Process Control System PCS 7; Operator station* and the manual *Process Control System PCS 7; Service Support and Diagnostics* to learn about other diagnostic tools you can use for commissioning and the process mode.

4.6.7 Fieldbus with PROFIBUS

4.6.7.1 Planning the field level with PROFIBUS

PROFIBUS in a PCS 7 plant

PROFIBUS is used on the field level of PCS 7. The following PROFIBUS profiles are used:

- PROFIBUS DP - for communication between the AS and distributed I/O
- PROFIBUS PA (according to IEC 61158) - for direct connection bus-capable intelligent field devices
- PROFIBUS DP as gateway to FOUNDATION Fieldbus

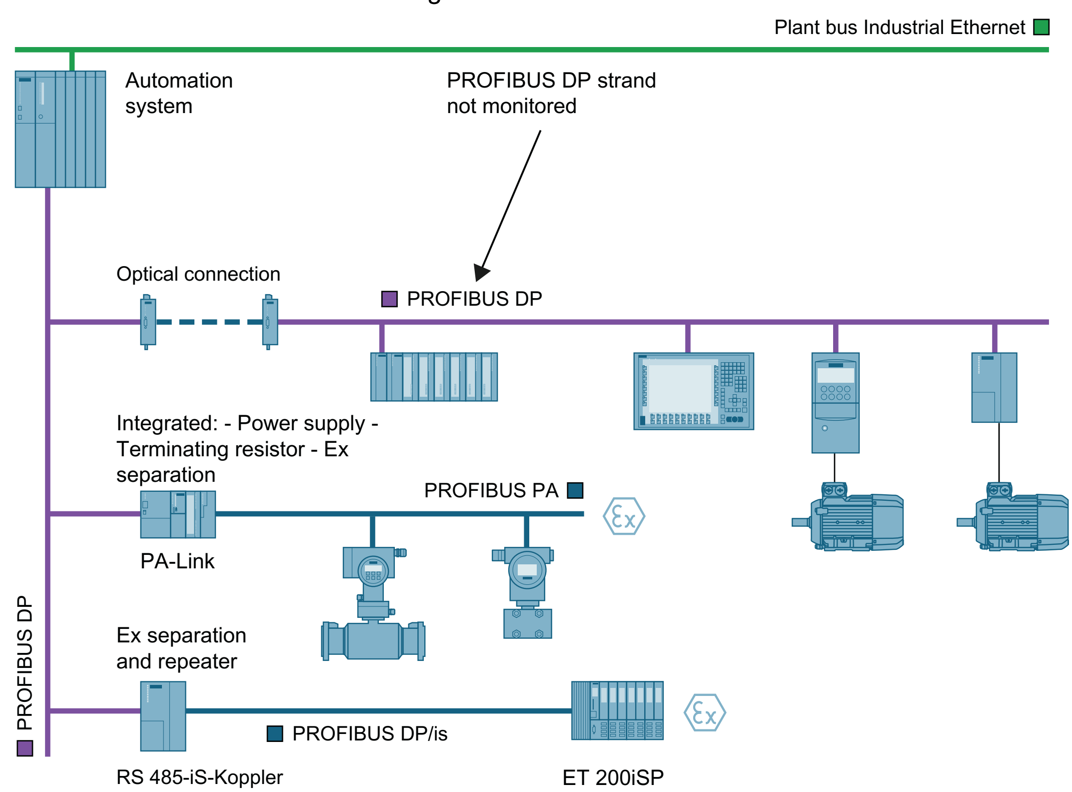
Components used for PCS 7

PROFIBUS can be operated with the following combinations of transmission media for a wide variety of applications:

- Shielded two-wire cable - for electrical data transmission
- Fiber-optic cable (FO) - for optical data transmission

PROFIBUS networks can be configured using the following components based on the transmission medium used and the devices to be connected:

- Optical connection: Optical Link Module (OLM) / Optical Bus Terminal (OBT)
- Link between PROFIBUS DP and PROFIBUS PA: PA-Link or DP/PA coupler
- Link between PROFIBUS DP and FOUNDATION Fieldbus: Compact FF Link
- Link between redundant PROFIBUS DP and single PROFIBUS DP: Y-Link
- Repeaters: Diagnostic repeaters / RS 485 repeater
- Bus termination: RS 485 terminating element



FOUNDATION Fieldbus

You can find information on integrating the FOUNDATION Fieldbus in a PCS 7 system in the commissioning manual *Process Control System PCS 7; PCS 7 - FOUNDATION Fieldbus*.

4.6.7.2 Electrical transmission media

Introduction

Shielded, twisted pair cables are used as the transmission media for electrical PROFIBUS networks. PROFIBUS nodes are connected to bus cables through a bus terminal with spur line or bus cable connectors.

PROFIBUS segment

A PROFIBUS segment is formed by a bus cable terminated at both ends with surge impedance. The individual PROFIBUS segments are connected to each other through repeaters. The maximum segment cable length depends on the following factors:

- Transmission rate
- Type of cable used

The maximum cable length of a PROFIBUS segment is limited. You can find additional information on this topic in the section "Maximum transmission rates of the networks/bus systems (Page 62)".

RS 485 Repeater

The RS 485 repeater is a signal amplifier. It allows the cable length to be increased. A maximum of 9 RS 485 repeaters can be connected in series. The following cable lengths are possible between two nodes for RS 485 repeaters:

Transmission rate	Max. cable length between 2 nodes (with 9 RS 485 repeaters connected in series)
9.6 to 187.5 Kbps	10,000 m
500 Kbps	4,000 m
1.5 Mbps	2,000 m
3 to 12 Mbps	1,000 m

Active RS 485 terminating element

All PROFIBUS segments must be terminated at both ends regardless of the transmission rate. The RS 485 terminating element is used as a permanent line termination to terminate the PROFIBUS segments.

RS 485-iS coupler

The RS 485-iS coupler is an isolating transformer used for intrinsically safe transfer of PROFIBUS DP in hazardous areas.

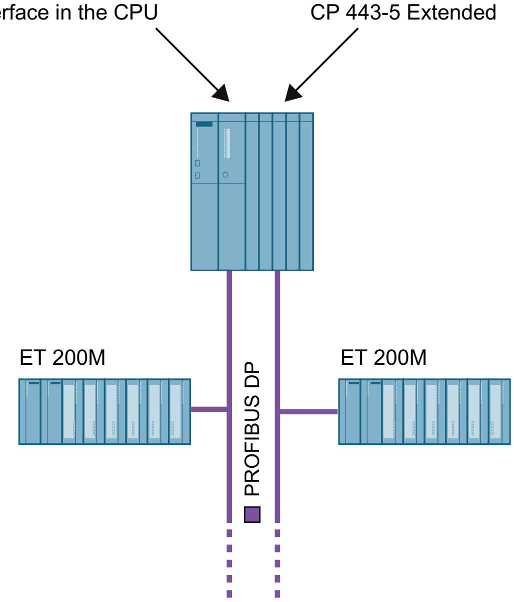
The RS 485-iS coupler is required to connect intrinsically safe PROFIBUS DP nodes, for example, ET 200iSP or third-party devices with Ex i DP connection, to PROFIBUS DP. The RS 485-iS coupler can also be used as a repeater in hazardous areas.

Additional information

- Manual *SIMATIC NET; PROFIBUS Networks*
- Manual *SIMATIC, Distributed I/O Device ET 200iSP*

4.6.7.3 Connecting PROFIBUS DP nodes

Bus connection of AS, ET 200M, ET 200S, ET 200iSP, and ET 200pro



Connection of the AS

Automation systems are connected to PROFIBUS DP over the following components:

- CP 443-5 Extended
- Internal PROFIBUS DP interface of the CPU

The PROFIBUS DP lines can be connected to a maximum of 4 internal PROFIBUS DP interfaces per automation system (with add-on modules depending on the CPU) and also to a maximum additional 10 CP 443-5 Extended. IF 964-DP interface modules are available for the PROFIBUS DP interfaces. These can be installed in the open module slots of the CPU.

Connection of ET 200M, ET 200S, ET 200iSP, and ET 200pro

Bus connectors in a variety of designs are used to connect ET 200M, ET 200S, ET 200iSP, and ET 200pro to PROFIBUS DP. The matching connectors can be ordered together with the ET 200 components.

4.6.7.4 Signal assembly (single channel or dual channel)

Single channel IO (used also for switched IO)

The input or output signals are connected by a single IO module (single channel) to the system.

Dual channel IO (part of the redundant I/O)

The input or output signals are connected via two IO modules (dual channel) to the system. The controller sends and gets two independent values. It is irrelevant, if the value generated by one or two souces or will be send to one or two receivers. Assembly variants of dual channel IO:

- One sensor resp. actor is connected via MTA to two IO modules within the one station. The values of the two channels has to be proceeded by the REDLib.
- One sensor resp. actor is connected via MTA to two IO modules in two different stations. The values of the two channels has to be proceeded by the REDLib.
- One sensor resp. actor is connected via a redundant terminal block of the IO device to two IO modules within the station (redundancy supported by hardware). For use of a distibuted IO station based on ET 200SP HA the PCS 7 Basis Library (≥V9.0) is necessary to proceed the values of the two channels.
- Two sensors resp. two actors are connected to two IO modules each within the one station. The values of the two channels can be proceeded by the REDLib.
- Two sensors resp. two actors are connected to two IO modules each in two different stations. The values of the two channels can be proceeded by the REDLib

4.6.7.5 Layout of redundant PROFIBUS DP networks

Redundant PROFIBUS DP

The S7-400H high availability automation system features a DP master interface on each CPU for connecting to PROFIBUS DP. With connected distributed I/O, PROFIBUS DP is connected to the I/O device through two interface modules of the type IM 153-2.

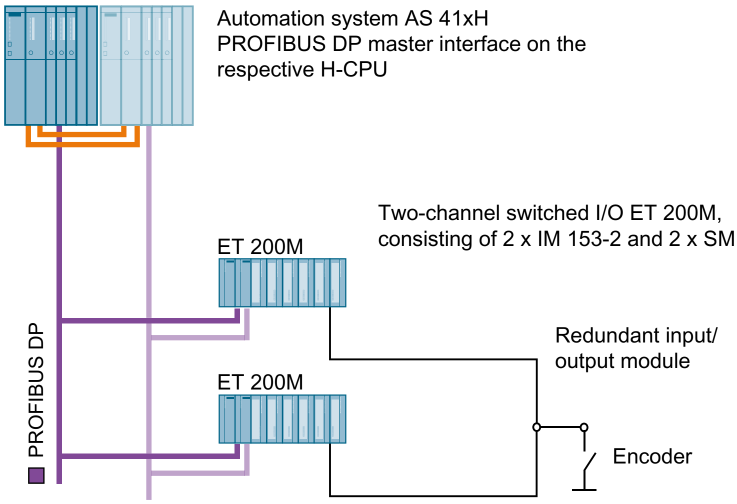
Layout options: The following high availability communication solutions are offered for PROFIBUS DP:

- Redundant PROFIBUS DP as electrical network
- Redundant optical network with OLM in line, ring and star layout

Example of redundant PROFIBUS DP

The figure below shows an electrical network with redundant PROFIBUS DP.

When the active PROFIBUS DP bus connection fails, the redundant bus connection takes over communication from the encoder to the high availability system.



Additional information

- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

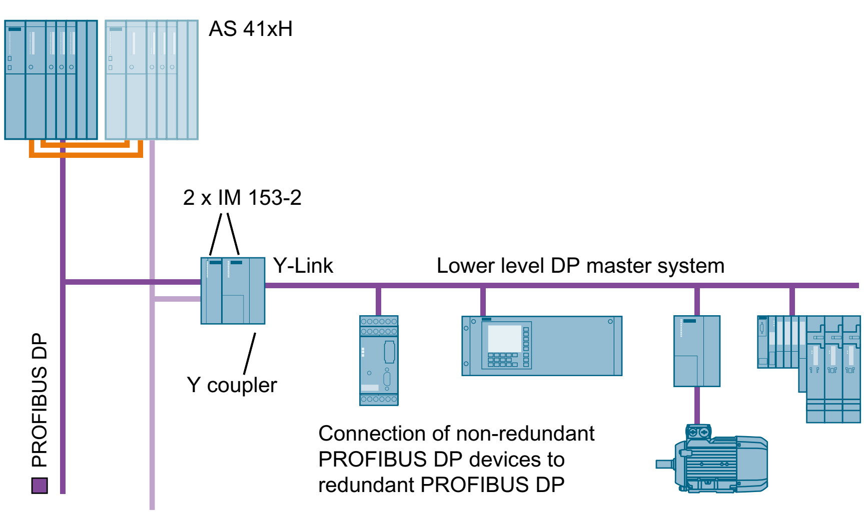
4.6.7.6 Connecting non-redundant PROFIBUS DP devices to redundant PROFIBUS DP

Y-Link

The Y-Link as bus link is preferred as the gateway from a redundant PROFIBUS master system to a single-channel PROFIBUS master system.

Structure of the Y-Link

The Y-Link consists of two IM 153-2 interface modules and a Y-coupler. The Y-coupler is a component of the Y-Link and is used to connect the lower-level PROFIBUS DP to the DP master in the IM 153-2.



Note

Use only the active backplane bus module when configuring the Y-Link .

Properties of the Y-Link

- When a fault occurs, the Y-Link bumplessly switches the complete I/O line to the active PROFIBUS DP of the redundant H system.
- From the point of view of the programmable controller, the Y-Link is a DP slave, and from the point of view of the underlying DP master system, it is a DP master.
- Transmission rates:
  – For the connection to the H system: From 9.6 Kbps to 12 Mbps
  – For the switched PROFIBUS DP: From 187.5 Kbps to 1.5 Mbps
- Capacity:
  – The number of Y-Links on an S7-400H is only limited by the maximum number of 126 bus nodes.
  – The number of nodes in each underlying DP master system is limited to 64.
- Supports configuration changes in RUN (CiR)
- Modular design mounted on an S7-300 rail with an **active** backplane bus
- Isolation between the lower-level DP master system and power supply via the RS-485 repeater
- Degree of protection IP 20 (Degree of Protection) (Page 668))

Additional information

- *Manual DP/PA Link and Y-Link bus couplers*

4.6.7.7 Connecting field devices to PROFIBUS DP

PA Link

The PA-Link is the preferred gateway between PROFIBUS DP and PROFIBUS PA.

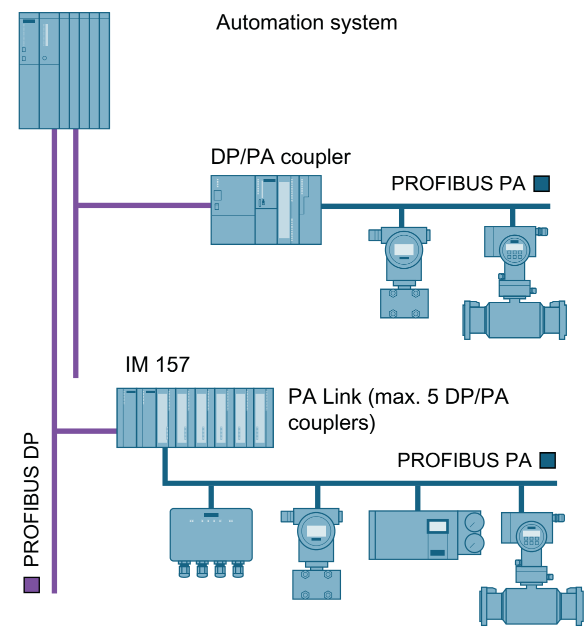
Structure of the PA Link

The PA Link consists of an IM 153-2 interface module and a maximum of 5 DP/PA couplers. A PA Link can be connected to the redundant PROFIBUS DP via two IM 153-2 .

DP/PA coupler

The DP/PA coupler is a physical link between PROFIBUS DP and PROFIBUS PA. The DP/PA coupler is available in both Ex and Non-ex variations.

When few numbers are involved, the real-time requirements are not important, and no redundant PROFIBUS DP is used, the DP/PA coupler can also be operated in "stand-alone" mode (without IM 153-2).



Communication via PROFIBUS PA

PROFIBUS PA uses the same communication protocol as PROFIBUS DP; communication services and frames are identical.

Each PROFIBUS PA segment must be terminated by a SpliTConnect terminator.

Properties of the PA Link

- When a fault occurs, the PA Link switches bumplessly to the active PROFIBUS DP of the redundant H system.
- Modules can be "hot swapped" during online operation when a special bus module is used.
- Capacity:
  - A maximum of 5 DP/PA couplers can be connected to a PA Link .
  - The number of nodes in each underlying PROFIBUS PA is limited to 64.
- Supports configuration changes in RUN (CiR)
- Isolation of the higher-level DP master system

- Suitable for connecting sensors/actuators in the areas with explosion danger (hazardous areas)
- Configuration, commissioning and diagnostics of PA Link and connected field devices with the *SIMATIC PDM* tool integrated in the ES

PA Link or DP/PA coupler

The use of a PA Link or DP/PA coupler depends on the following factors:

- Size of the plant
- Required performance
- Automation system in use

Components	PA Link	DP/PA coupler
Structure	The PA Link is built from a combination of: • Interface module IM 153-2 and • DP/PA coupler (max. 2 with standard model or max. 5 for hazardous zone)	• Stand-alone operation without additional components possible • Integrated power supply and bus terminal for PROFIBUS PA
Use and performance	For extensive addressing volumes and high cycle time requirements	For small number of devices and low real-time requirements
Transmission rate	• at the DP end: From 9.6 Kbps to max. 12 Mbps • at the PA end: 31.25 Kbps	• at the DP end: 45.45 Kbps • at the PA end: 31.25 Kbps
Function	Field devices are addressed by the automation system indirectly through the PA Link (DP slave).	When using the DP/PA coupler, the field devices are addressed directly by the automation system; in other words the DP/PA coupler is transparent.
Housing safety level	Designs for hazardous areas are available. **Only sensors and actuators can be used in the hazardous zone!**	Designs for hazardous areas are available. **Only sensors and actuators can be used in the hazardous zone!**
Redundancy	A configuration with two IM 153-2 modules enables use in an H system.	-
Diagnostics	Via diagnostic frame and LED	Via LED

Connection of HART-devices

Information how to connect HART devices you find in section "Connecting HART devices (Page 91)".

Additional information

- See Operating Instructions *DP/PA coupler, Active Field Distributor, PA Link and Y Link*

4.6.7.8 Configuration of redundant PROFIBUS PA networks

Redundant PROFIBUS PA

PROFIBUS PA can be configured as redundant to supplement the redundant PROFIBUS DP.

A redundant PROFIBUS PA is connected to redundant DP/PA couplers. If a communication path fails, the communication path is preserved as far as the spur line to the field devices.

High availability communication solutions

The following communication solutions are offered to increase the system availability:

- Ring redundancy with the active AFD (Active Field Distributor)
- Coupler redundancy with the AFS (Active Field Splitter)

The FDC 157-0 DP/PA coupler can be used stand-alone or in the PA Link.

A maximum of 2 redundant PROFIBUS PA can be connected per PA Link.

Connecting the high availability PROFIBUS PA to PROFIBUS DP

You can connect the high availability PROFIBUS PA to the PROFIBUS DP as follows:

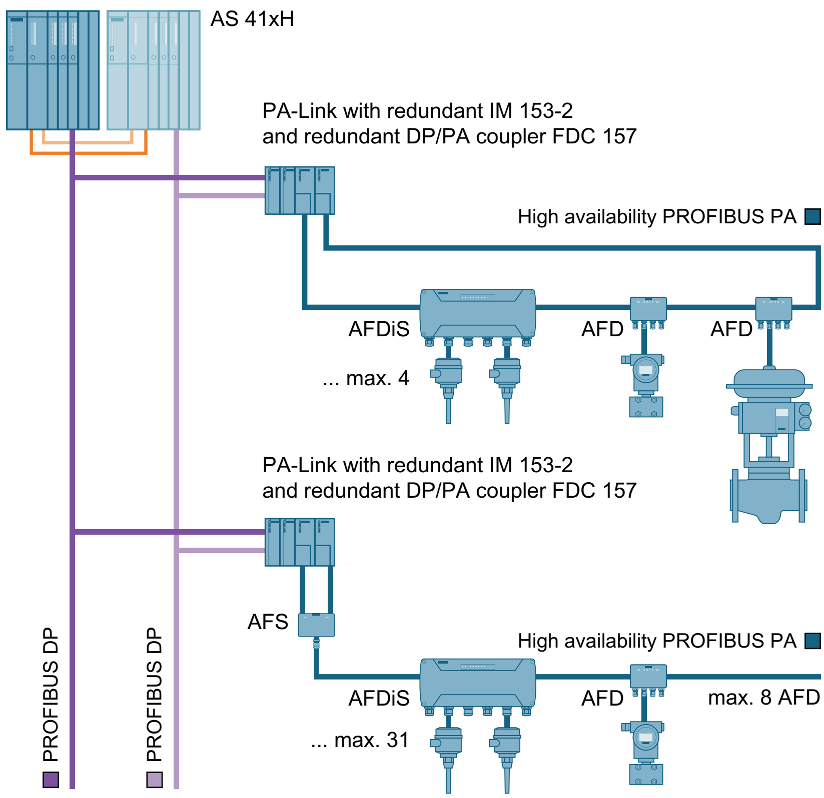
- Redundant connection to the redundant PROFIBUS DP with two IM 153-2
- Single-channel interfacing with PROFIBUS DP using one IM 153-2

We recommend the following configuration limits in PCS 7 when connecting PA devices using AFD or AFS :

- Maximum of 8 AFD at a redundant DP/PA coupler, maximum of 4 field devices per AFD (one field device per spur line)
- Maximum of 4 AFDIS or AFDiSD at a redundant DP/PA coupler, maximum of 6 field devices per AFD (one field device per spur line)
- 1 AFS connected to a redundant DP/PA coupler
- You can connect a maximum of 31 field devices per PROFIBUS PA.

Example of a high availability PROFIBUS PA

The connections of the field devices via AFD and AFS are shown in the following figure. The connection to PROFIBUS DP is shown as a redundant link.



Additional information

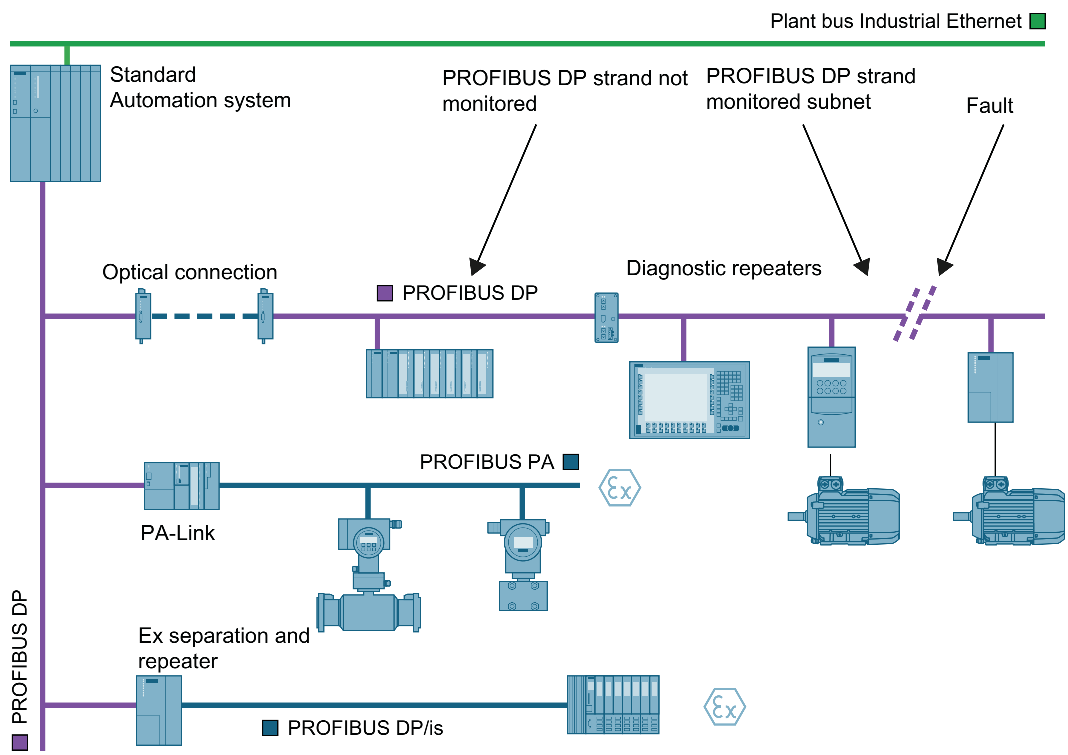
- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

4.6.7.9 Planning diagnostics on the PROFIBUS

Diagnostic repeaters

We recommend the use of diagnostic repeaters to provide detailed diagnostics for PROFIBUS DP segments (copper cable). When a fault occurs it sends a diagnostic alarm to the DP master with detailed information about the type of fault and the location.

Principle: To be able to localize a problem in the network, the diagnostic repeater must know the topology of the PROFIBUS subnet to which it is attached. With the function "Prepare Line Diagnostics", the diagnostics repeater determines the distances to all nodes and saves the data internally in a table. By calculating the distance to a line fault, the repeater can then identify the nodes between which the fault is located based on the table.



Properties of the diagnostics repeater

The diagnostics repeater has the following features:

- Diagnostic function for two PROFIBUS segments
  The diagnostic function localizes both the position and the cause of the error for cable errors, such as cable rupture or missing terminating resistors.
- Repeater function for three PROFIBUS segments
  The diagnostic repeater amplifies data signals on bus cables and connects individual RS 485 segments.
- Transmission rate: From 9.6 Kbps to 12 Mbps
  You can also find information about this in the section "Maximum transmission rates of the networks / bus systems (Page 62)"
- Cable length
  When standard cables are used, the diagnostic repeater can monitor a maximum of 100 meters of cable in each PROFIBUS segment.

Note

Only use the active backplane bus module.

Additional information

- Manual *SIMATIC Diagnostic Repeater for PROFIBUS-DP*
- Manual *Process Control System PCS 7; Service Support and Diagnostics*

4.6.8 Fieldbus with PROFINET

4.6.8.1 Planning the field level with PROFINET

Overview

PROFINET is an open standard of the PROFIBUS User Organization (PNO) and is 100% compatible with Ethernet in accordance with IEEE standards. The following minimum requirements of data communication are specified for PROFINET:

- 100 Mbps data communication with transmission via copper or fiber optic cable (100 Base TX and 100 Base FX)
- Full duplex transmission
- Switched Ethernet
- Auto negotiation (negotiation of transmission parameters)
- Auto crossover (crossed send and receive lines in the switch)
- Wireless communication

Fieldbus integration

PROFINET enables the simple connection of existing fieldbus systems with PROFIBUS PA without having to make changes to the existing PA field devices.

Distributed field devices

Likewise, PROFINET enables the connection of distributed field devices to the fieldbus.

Available modules or devices, e.g: intelligent DP-capable field devices, can be used with PROFINET-capable connection interfaces or Link modules.

You can find additional information on PROFINET in the *SIMATIC PROFINET system description* manual.

Configuration in RUN (CiR)

For some process cells that must not be shut down during an operation due to the complexity of the automated process or the high cost of restarting, configuration in runtime is necessary.

For more information on CiR, refer to the *Process Control System PCS 7; CPU 410 Process Automation* manual.

PROFINET as fieldbus in PCS 7

PCS 7 enables installation of PROFINET networks with the following components:

- Distributed I/O devices e.g.:
  - ET 200SP HA with IM 155-6PN HA
  - ET 200M with IM 153-4PN HF
  - ET 200SP with IM 155-6PN HF
  - PN-Field device
- IE/PB Link PN IO for connection of intelligent DP field devices
- IE/PB Link PN IO with downstream DP/PA coupler for connection of PA field devices
- Compact Field Unit PA for connection of 8 PA field devices and 8 free configurable channels

For more information on the usage of SIMATIC PCS 7 with PROFINET, refer to SIMATIC PCS 7 with PROFINET (https://support.industry.siemens.com/cs/ww/en/view/72887082)

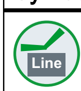
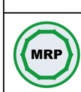
You can find additional information in the product overview *Process Control System PCS 7; Released Modules*.

4.6.8.2 PROFINET configuration

PROFINET topology

Symbols for topology

The following symbols indicate specific mechanisms which are used within the PROFINET architecture for identifying availability and/ or redundancy within the PN device:

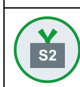
Symbol	Definition
	A single line represents no availability. Only redundant PROFINET lines can increase the availability. Redundant PROFINET lines require a special operation mode of the PN devices (R1).
	A ring represnts high available topology. For PROFINET the MRP (media redundancy protocol) is used. PROFINET IO rings can be built by the PN devices or/and switches with MRP functionality. A MRP ring must be configured, otherwise a loop will be created which can result in a network failure.
	PROFINET IO: To split PROFINET lines, only a multichannel switch (with PROFINET support) is necessary. A star represents an increase in the availability, but does not represent highly availability. Redundant PROFINET stars require a special operation mode of the PN devices (R1).

Periphery assembly

Single periphery assembly

Symbol	Definition
	The periphery devices or stations are connected with the controller by one interface module (IM of the device/station) only. The device resp. station is connected with only one controller in the configuration also (single system or one side configuration within a high available system). In PROFINET IO environment, this type of connection is called **"single PROFINET (S1)“**.

Redundant periphery assembly (H system used)

Symbol	Definition
	For system connection of the periphery device two interface modules are used. The interface modules are connected to their corresponding controller of the high available system. In the PROFINET IO environment, this type of connection is called **"redundant PROFINET (R1)“**.
	Additionally it is possible to connect a high available system by one interface module. In this case the interface module has two logical connections to each controller of the high available system. In the PROFINET IO environment, this type of connection is called **"system redundancy (S2)“**.

Availability variants

- **High available**
  High availability will increase the availability by any kind of mechanism. This can by redundancy, but it can by also a single ring topology. Bus systems set up as a ring are high available. In ring structures, the signal path remains intact even if there is a disconnection on the transmission cable at any point in the ring (for example due to a wire break).
- **Redundant I/O (distributed I/O)**
  The entire signal path up to the sensor/actuator is configured redundantly.
- **Switched I/O (distributed I/O)**
  The communication path to the I/O (station) is redundant. There is only one input/output module (SM) for processing a process signal.

- **System redundancy (H system used)**
  The system redundancy can used in high available systems only. The PN device has to support the functionality of „system redundancy“ (S2). Two logical active connections will be used independent from the physical connection. The physical layer can be redundant, high available or single!
- **Redundant**
  Redundant components, software or technical solutions, describes the situation when the component, software or technical solution is doubly available.

Special features on PROFINET IO

Features

PCS 7 assist the following features on PROFINET IO:

Features	Definition
CiR	CiR (Configuration in Run) required to change parameters of the devices resp stations or of the controller themselves during operation of the system.
~~CiR~~	If the functionality is not supported, no change of the periphery device/station can be done. This results in signal failures partly (with PROFINET IO). A missing CiR functionality of a device can have influences of the configuration change of stations in the network.
SoE	SoE based on time synchronization at the field bus.
PA ready	PROFINET IO: According the standards, a PN device is suitable for process automation if the following three functions are fulfilled: • system redundancy (S2) support • MRP functionality • CiR support Additional useful (optional): support of high available system redundancy (R1) or SoE functionality

Recommended combination of periphery and topology

Name of the connection	Symbols	Topology	Periphery interface
Single PROFINET line	S1 ~~CiR~~	Single line Line	Single IM (S1) S1
High available PROFINET (MRP)	S1 ~~CiR~~	Single ring (MRP) MRP	Single IM (S1) S1

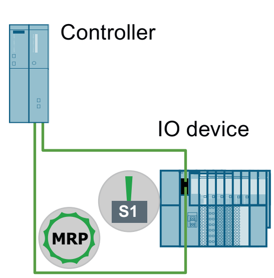
System redundancy (S2)	S2	Single line or single star/hierarchy Line or Star	Single IM (S2) S2
High available system redundancy (MRP/S2)	S2 ~~CiR~~	Single ring (MRP) MRP	Single IM (S2) S2
System redundancy (S2)	S2 CiR	Line or Star or MRP	S2 PA ready
Redundant PROFINET (R1)	R1 CiR SoE	Double line or double star Line Line Star Star	Double IM (R1) R1 PA ready
Redundant high available PROFINET (MRP/R1)	R1 CiR ~~CiR~~	Double ring (MRP) MRP MRP	Double IM (R1) R1 PA ready

4.6.8.3 Configuration of a IO device with PROFINET

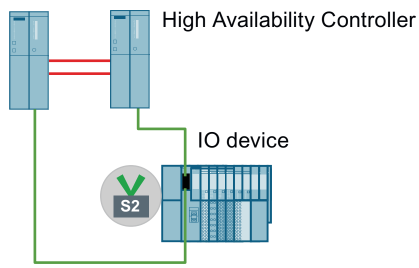
The examples in the following figures shows you the most recommendet variita to integrat an IO device via PROFINET fieldbus to the AS.

- Connection of an (non-redundant) single PROFINET fieldbus to the AS by use of MRP
- Connection of an single IO device to the redundant AS (S2 redundancy)
- Connection of an redundant IO device to the redundant AS (R1 redundancy)
- Connection of an redundant IO device to the redundant AS via rings with MRP (R1 redundancy)

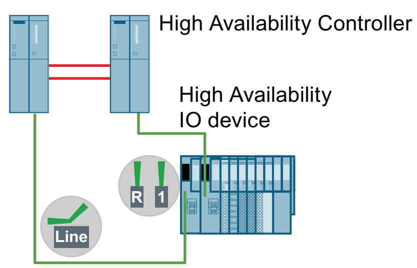
Connection of an (non-redundant) single PROFINET fieldbus to the AS via ring with MRP



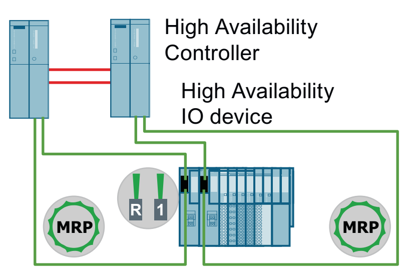
Connection of an single IO device to the redundant AS (S2 redundancy)



Connection of an redundant IO device to the redundant AS (R1 redundancy)



Connection of an redundant IO device to the redundant AS via rings with MRP



Additional Information

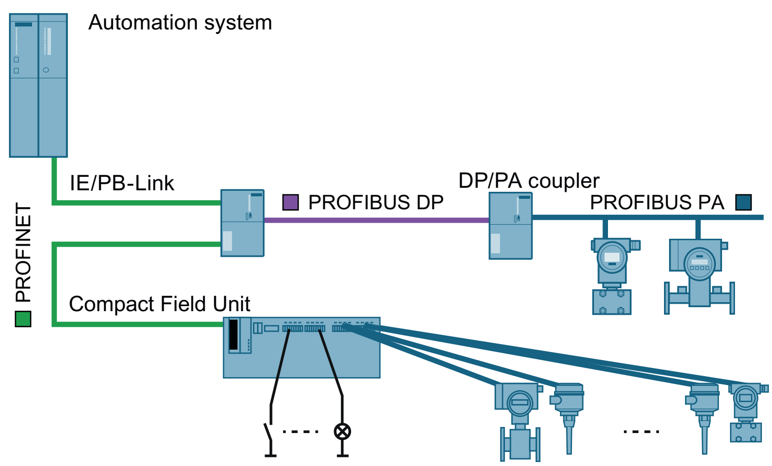
For more information regarding use of redundancy please see function manual *Process Control System PCS 7; HighAvailability Process Control Systems*.

4.6.8.4 Connecting field devices to PROFINET IO

IE/PB-Link and CFU

The IE/PB Link is a gateway between PROFINET IO and PROFIBUS DP. To connect field devices, you also add a PA coupler-Link.

For field devices, the CFU PA is a gateway between PROFINET IO and PROFIBUS PA.



4.6.9 Data links to other systems

4.6.9.1 Introduction to data links to other systems

Introduction

Within the context of PCS 7, Totally Integrated Automation (TIA) provides solutions for configuring a wide range of communication tasks.

Potential communication partners

TIA solutions are available for devices and plants that communicate with the following protocols:

- HART devices (Page 91)
- MODBUS (Page 93)
- AS-Interface (Page 94)

4.6.9.2 Connecting HART devices

What is HART?

HART (Highway Addressable Remote Transducer) is a serial transmission method used to transmit additional parameter data, such as measurement range or damping, to connected measuring transducers and actuators over a 4-20 mA current loop.

HART devices used in PCS 7

HART devices can be used with the following ET 200 families in PCS 7:

- **ET 200M**
- **ET 200iSP**
- **ET 200SP**
- **ET 200SP HA**

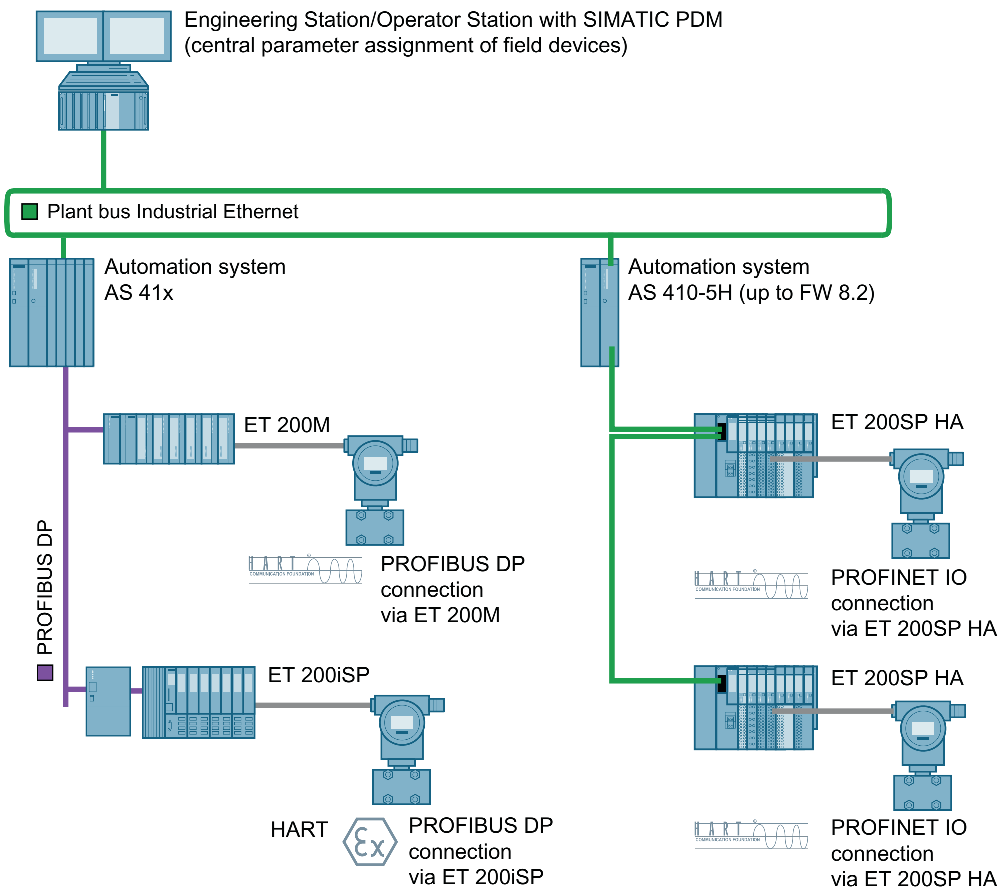
For all of these, the following applies:

- HART devices can be connected to special analog HART electronic modules
- All transducers or HART actuators certified for digital communication using the HART protocol can be connected through HART electronic modules.

For the **ET 200M** family the following applies:

- Special S7-300-Ex IO modules with HART enable connection to HART devices certified for use in hazardous areas.
  The S7-300-EX modules with HART are diagnostics-capable (with channel and module diagnostics).
- HART devices can be connected in standard environments and hazardous areas to special IO modules.

Example configuration



Use in hazardous areas

- On an ET 200M in hazardous area Zone 2
- On an ET 200iSP in hazardous area Zone 1 or 2

Configuration of HART field devices

HART field devices are configured for PCS 7 with SIMATIC PDM.

4.6.9.3 Connecting Modbus

Modbus

Modbus is an open serial communication protocol. The Modbus protocol is used to network third-party systems. Due to the maximum transmission rate of 38.4 Kbps, Modbus is recommended when there are few bus nodes and low real-time requirements.

Connecting Modbus

Modbus is connected to PCS 7 via a CP 341 which is inserted in the distributed I/O station ET 200M. CP 341 enables faster data communication using point-to-point coupling with the Modbus protocol.

CP 341

The CP 341 is available in the following 3 models (interface physics):

- RS 232C (V.24)
- 20 mA (TTY)
- RS 422/RS 485 (X.27)

Special drivers are needed for Modbus master and Modbus slave to implement the Modbus link. These must be ordered separately.

Additional information

- Manual *SIMATIC CP 341 Point-to-Point Connection; Installation and Parameter Assignment*
- Manual *SIMATIC Loadable Drivers for PtP CPs; Modbus Protocol RTU Format; S7 is Master*
- Manual *SIMATIC Loadable Drivers for PtP CPs; Modbus Protocol RTU Format, S7 is Slave*

4.6.9.4 Connecting the AS-Interface

AS-Interface (AS-i)

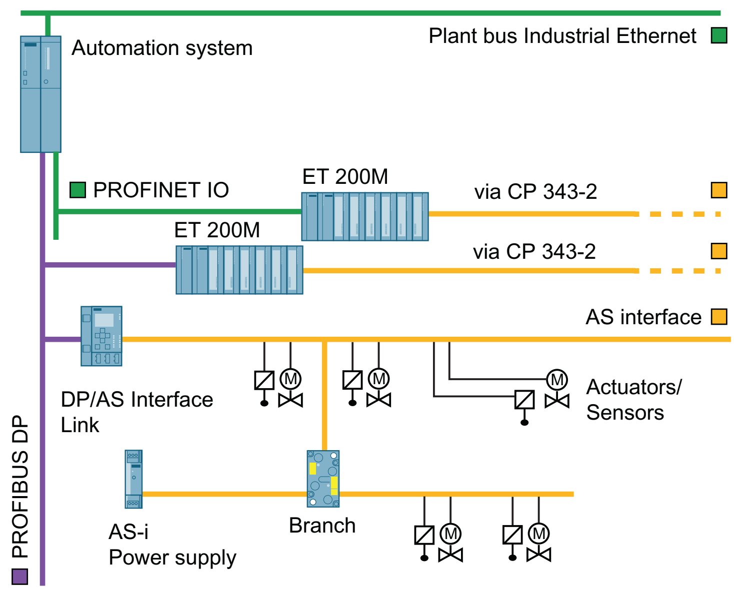
The actuator sensor interface (AS-Interface) is a multi-vendor networking system for simple, usually binary actuators and sensors at the lowest field level. The AS-Interface is an international standard based on EN 50 295.

The AS-Interface allows you to address all sensors and actuators on a common 2-wire cable while supplying them with the required supply voltage at the same time.

Connecting the AS-Interface to PROFINET IO or to PROFIBUS DP

In a PCS 7 plant you have the following possibilites to connect field devices via AS-Interface.

- Connecting AS-Interface via PROFINET IO:
  - use ET 200M with a AS-Interface master module CP 343-2
- Connecting AS-Interface via PROFIBUS DP:
  - use ET 200M with a AS-Interface master module CP 343-2
  - use DP/AS-Interface link



Connecting the AS-Interface to PROFIBUS DP

The AS-Interface is connected to PCS 7 through a DP/AS-Interface link to the PROFIBUS DP.

The AS-Interface is integrated in PCS 7 as an underlying bus through the DP/AS-Interface link. This does not permit use of the full range of PCS 7 features (no diagnostics capability, for example).

The AS-Interface operates according to the master slave principle. The sensors/actuators connected through the AS-Interface line are controlled as slaves by the master DP/AS-Interface link.

The DP/AS-Interface link is a DP slave from the point of view of the DP master system.

The PROFIBUS DP and AS-Interface are electrically isolated.

DP/AS-Interface Link

The following DP/AS-Interface links can be used:

- DP/AS-INTERFACE LINK Advanced with IP20 degree of protection
- DP/AS-Interface LINK 20E with IP20 degree of protection

All DP/AS-Interface links can be operated on the PROFIBUS DP with a maximum transmission rate of 12,000 Kbps.

The following is required for the configuration:

- Power supply
- PROFIBUS connector plug
- AS-Interface connection sockets

Additional information

- Manual *SIMATIC NET* ; CP 343-2 / CP 343-2 P AS-Interface master
- Manual *SIMATIC NET; DP/AS-INTERFACE LINK Advanced*
- Manual *SIMATIC NET; DP/AS-Interface Link 20E*

4.6.10 Administration level and remote access

4.6.10.1 Connecting to MIS/MES

Connection options to MIS/MES

The following options are available for connecting MIS/MES systems to SIMATIC PCS 7:

- Connecting to the IT world - SIMATIC IT (Page 96)
- Connecting HMI systems via OPC (Page 98)
- Connecting to the IT world via OpenPCS 7 (Page 97)
- Access to the PCS 7 OS via PCS 7 Web client (Page 99)

Additional information

Note

When connecting MIS/MES systems to SIMATIC PCS 7 also observe the information in the white paper *Security Concept PCS 7 and WinCC*.

4.6.10.2 Connecting to the IT world - SIMATIC IT

SIMATIC IT

SIMATIC IT is a technology platform for MES (Manufacturing Execution Systems), based on the ISA 95 standard. According to this standard, explicit business and production rules coordinate functionality to achieve optimal workflow.

SIMATIC IT has the following main elements:

- SIMATIC IT Modeler
- SIMATIC IT components

SIMATIC IT Modeler

SIMATIC IT Modeler connects the automation level with the ERP (Enterprise Resource Planning) level:

- Plant control and production control levels
- Company and design level

SIMATIC IT Modeler is a cross-industry integration and coordination platform for operating processes, data, and functions. In addition to the basic functions for internal procedural control, user administration, etc. it also possesses the facility for plant and production modeling.

SIMATIC IT components

The functions and architecture of the SIMATIC IT Production Modeler and SIMATIC IT components conform to the ISA-95 standard. Each SIMATIC IT component is reserved for a specific task that conforms to a function of the ISA-95 standard.

Together, the components fulfill all standard production functions of the ISA-95 standard. The ISA-95 terminology is used in the SIMATIC IT software, "Material list" for example.

SIMATIC IT components:

- SIMATIC IT Production Suite (basic MES functions such as material management, production order management, etc.)
- SIMATIC IT Historian (plant performance analysis and archiving)
- SIMATIC IT Unilab (laboratory information management system)
- SIMATIC IT Interspec (product specification management system)
- Detailed Production Scheduler
- SIMATIC IT Libraries

Connection of PCS 7

The SIMATIC PCS 7 process control system is integrated into SIMATIC IT via the CP 443-1.

Additional information

- Manual *SIMATIC PCS 7/SIMATIC IT Integration Manual*
- In the Internet (http://support.industry.siemens.com/cs/ww/en/view/26639558)

4.6.10.3 Connecting to the IT world via OpenPCS 7

OpenPCS 7

A PC station with OpenPCS 7 (OpenPCS 7 station) can be used to exchange data with external systems without knowledge of the topology or installation of a PCS 7 OS.

You can use OpenPCS 7 for data exchange with the following levels:

- Automation level
- Plant control and production control levels
- MES level (Manufacturing Execution Systems)
- ERP level (Enterprise Resource Planning)

Standard interface formats

OpenPCS 7 uses the following standard interface formats for data exchange:

- OPC UA (Unified Architecture)
- OPC DA (Data Access)
- OPC A&E (Alarm and Event and Historical Alarm and Event)
- OPC HDA (Historical Data Access)
- OLE DB (integration of data in OLE-capable applications (such as MS Office))

Additional information

- Section "Configuration of the OpenPCS 7 Station (Page 147)"
- *Process Control System PCS 7; OpenPCS 7* manual
- Section "How to insert an OpenPCS 7 station (Page 256)"
- Section "How to configure the OpenPCS 7 station to access PCS 7 data (Page 567)"

4.6.10.4 Connecting HMI systems via OPC

OPC

OLE for **P**rocess **C**ontrol (OPC) provides a standard mechanism for communicating with numerous data sources. It does not matter whether these sources are machines in your factory or a database in your control room. OPC is based on the OLE/COM technology from Microsoft.

For detailed information about OPC, refer to the documentation *OLE for Process Control Data Access Standard, Version 2.0,* published by the OPC Foundation.

Connecting HMI Systems

The OPC interfaces of PCS 7 conform to the specifications from the OPC Foundation. Data communication can be performed in PCS 7 using process tags (Data Access).

PCS 7 OS server with OPC Data Access server

The applications of the OPC interface are based on the client-server model.

An OPC Data Access server is installed together with the PCS 7 software. The PCS 7 OS server provides the industrial communication capability of Data Access as an interface to the systems. Each OPC client application can access the process data (tag management) of this OPC server.

The PCS 7 OS server can be used in the following capacities:

- OPC Data Access server
- OPC Data Access client

OPC is used to connect one or more operator stations to the PCS 7 OS server. You can connect to the operator station via a network (e.g. local data network).

Additional information

- Documentation *OLE for Process Control Data Access Standard, Version 2.0*
- You can find the OPC Foundation address on the Internet (http://www.opcfoundation.org).

4.6.10.5 Access to the PCS 7 OS via PCS 7 Web client

PCS 7 provides the Web option for the OS for using operator control and monitoring functions of the PCS 7 OS (single station or multiple station system) in process mode over the Internet or intranet.

Web option for OS

The use of the Web option for OS requires the following components:

- **PCS 7 Web Server**
  A stand-alone PCS 7 Web server provides the PCS 7 Web client with all necessary OS pictures. The PCS 7 Web server is an OS client with PCS 7 Web server functionality.
  - OS multiple station system: An OS client that is configured as a PCS 7 Web server can no longer be utilized as an operator station (OS client) within the PCS 7 plant in the case of an OS multiple station system.
  - OS single station system: The OS single station system that is configured with PCS 7 Web server can still be utilized within the PCS 7 plant as a PCS 7 OS.
- **PCS 7 Web Client**
  The PCS 7 Web client is a computer in the intranet/Internet with the Internet Explorer. Users log on via a Web page in Internet Explorer on a PCS 7 Web server. The PCS 7 Web server enables user-specific access to the available project data. The process can be operated and monitored.

How the PCS 7 Web client works

Users log on to the PCS 7 Web server in an Internet Explorer logon dialog at the PCS 7 Web client and can then access all the functions corresponding to their user permissions (setting in the "User Administrator" WinCC Editor). All operations performed on the PCS 7 Web client are logged automatically with the name of the plant operator.

The PCS 7 Web client offers, for example, the following functions:

- Operator control and monitoring functions, which are also used on an OS.
- Message lists which are launched on a user-specific basis in the same way as on an OS. Messages can also be acknowledged depending on the user.
- Display of the picture hierarchy according to the plant hierarchy
- Batch message functions including the function "loop-in-alarm"
- Audible alarm indication
- Extended status display

Note

Not all functions are available. Information on the availability of functions is provided in the manual *Process Control System PCS 7; Web Option for OS*.

Additional information

- Manual *Process Control System PCS 7; Web Option for OS*
- *Manual Process Control System PCS 7: SIMATIC BATCH*

4.7 Selecting PC components

4.7.1 Which PC components can be used?

Introduction

A wide range of basic devices is available for engineering stations (ES), operator stations (OS), Maintenance Station (MS), BATCH stations (BATCH), route control stations and for connecting SIMATIC PCS 7 to the IT world. A basic device consists of the following components:

- Basic hardware (PC base unit)
- Color monitor

Current information on recommended equipment and minimum basic hardware

The latest information on recommended equipment and minimum basic hardware is provided with each new PCS 7 version in the *PCS 7 Readme (online)*.
This version includes all information on installation and use of PCS 7. The file is only available on the Internet so that we can keep it up to date.

Network

The network for PCS 7 systems must be isolated using switches, routers, or gateways to prevent interference to the PCS 7 network from office networks.

Additional information

- "AUTOHOTSPOT"
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- Whitepaper *Security Concept PCS 7 and WinCC*
- Catalog *ST PCS 7 AO* (add-ons for SIMATIC PCS 7)

4.7.2 Pre-configured systems of PCS 7 (bundle)

Basic hardware

Special versions of the basic hardware (bundles) are available for engineering stations (ES), operator stations (OS), BATCH stations (BATCH), Route Control stations and for connecting SIMATIC PCS 7 to the IT world. The bundles are optimized for special applications.

SIMATIC PCS 7 BOX basic hardware

SIMATIC PCS 7 BOX is an industrial PC. SIMATIC PCS 7 BOX is employed in small plants.

Various SIMATIC PCS 7 BOX PCs (PC bundles) are available for use in PCS 7:

Information concerning the equipment can be found in the manual *Process Control System PCS 7; SIMATIC PCS 7 BOX*.

Color monitors

Siemens offers industrial monitor series for use as process monitors. These are selected based on the ambient temperature of the plant.

A maximum of 4 monitors can be connected to a station (OS client) using a multi-monitor PC installation. Plant areas that have been split up in this way can be managed using 1 keyboard and 1 mouse.

Additional information

- Catalog *ST PCS 7*
- Catalog *ST PCS 7 AO* (add-ons for SIMATIC PCS 7)

4.7.3 Connecting PC components

You can find more information about connecting PC components in the section "Connecting network nodes to Ethernet (Page 69)".

4.7.4 Additional components for acoustical and optical signals

Signal module

OS single station systems and OS clients can be expanded with a signal module. These signal modules can control a horn and a maximum of 3 different lamps or buzzer tones that represent a variety of message classes.

Using a hardware timer (watchdog), the signal modules can detect and signal the failure of an operator station. A hardware acknowledgment button can also be connected.

The signal modules are installed in a PCI slot in the operator station.

Sound card

You can also use a standard sound card installed in the operator station.

Additional information

- You can find information about the function and the installation of signal modules in *WinCC Information System* under "Options > Options for Process Control".
- You can find more information about the configuration of audible signal devices in the configuration manual *Process Control System PCS 7; Operator Station*.

4.8 Selecting AS components

4.8.1 What are the criteria for selecting the AS?

Automation systems in a PCS 7

The PCS 7 process control system is based on selected components from the SIMATIC AS-41x product series. You select the automation system according to the requirements of the plant:

- Standard automation system
- High availability automation system (H system)
- When the automation system is built with a CPU 41xH, you can configure fail-safe automation systems.

Making changes in RUN with PCS 7 CPU 410 Process Automation

The following functions are available in RUN:

- Expanding the configuration limits of the CPU 410 in runtime

Automation system	Online upgrade of maximum process objects of a CPU 410-5H
Functionality for **AS 410H** with CPU 410-5H as of firmware version 8.1 or higher	The maximum number of loadable process objects for an AS is specified by a specific volume stored on the system expansion card (SEC) of the AS. The specific volume must include at least the number of process objects that are configured for the AS. The specific volume of the system expansion card can be increased by CPU 410 expansion packs in runtime up to PO 2600 (equal with PO 2000+).

- Change interfaces of AS blocks

Automation system	Interface change in RUN
Functionality for **AS 410H** with CPU 410-5H as of firmware version 8.1 or higher	The following actions are possible: • Downloading interface changes for AS blocks • Downloading blocks from other libraries to an AS • Gradual update of an AS library

- Change parameter assignments

- Change program
- Change configuration of AS components

Automation system	Configuration changes in RUN (CiR/HCiR)
Functionality for all automation systems	The following actions are possible: • Add/remove new slaves • Add/remove new modules • Making new parameter settings for inserted modules. • With CPU 410 V8.2, CiR/H-CiR on PROFINET is possible.
Additional functionality for high availability automation systems	The following actions are possible: • Changing the memory capacity • Changing the CPU parameters (marked in blue in the HW Config: e.g. **CPU Properties > Protection > Password Protection**) • Add/remove S7-400 modules

SIMATIC PCS 7 BOX PC with integrated AS, CPU for small plants

SIMATIC PCS 7 BOX offers variants of industrial PCs in which the PCS 7 AS/ES/OS/RC/BATCH components can be integrated. SIMATIC PCS 7 BOX is used for autonomous small plants or combined AS/OS stations that can be integrated in the PCS 7 network. If an automation system is integrated in SIMATIC PCS 7 BOX, it is always a standard automation system.

The following SIMATIC PCS 7 BOX PCs (PC bundles) are available for use in PCS 7:

- SIMATIC PCS 7 BOX RTX: BOX PC with PLC WinLC RTX software
- SIMATIC PCS 7 AS mEC RTX: AS in S7-300 design with PLC WinLC RTX software
- SIMATIC PCS 7 AS RTX: MICROBOX PC with PLC WinLC RTX software

Refer to the manual *Process Control System PCS 7; SIMATIC PCS 7 BOX* to find all of the required information about the use of SIMATIC PCS 7 BOX.

Criteria for selecting the automation systems

The vast array of requirements for automation systems makes it difficult to generalize about the system to be employed. The following provides an overview of the most important information for selecting automation systems:

- Section "How many CPUs are needed for automation? (Page 47)"
- Section "How many devices, sensors and actuators can be integrated? (Page 48)"
- Section "Redundancy concept for PCS 7 (Page 52)"
- Section "Operational reliability concept of PCS 7 (Page 54)"

The sections below contain additional information regarding the actual selection of automation systems and the I/O components to be connected.

Additional information

- Section "How to copy objects from other libraries to the master data library (Page 287)"
- Section "Configuring distributed I/O devices on PROFIBUS DP for configuration changes in RUN mode (CiR) (Page 371)"
- **List of available components**
  A list of all modules that can be used for a PCS 7 version is available in the product overview *Process Control System PCS 7; Released Modules*.
- You can find information on transferring and updating license keys in the following documentation:
  - Function manual *Process Control System PCS 7; Service Support and Diagnostics*
  - Online help *SIMATIC; Automation License Manager*

4.8.2 Overview of the automation systems (AS 41x)

4.8.2.1 Introduction to automation systems

Components of an automation system for PCS 7 (AS 41x)

The automation system is available as a pre-assembled complete system. An automation system essentially consists of the following components:

- Module rack with 4, 9 or 18 slots
- Power supply
- S7-400-CPU
  Depending on CPU type:
  - Interface for Industrial Ethernet:
    integrated connection of the CPU and/or interface module
  - Interface for PROFIBUS:
    integrated connection of the CPU and/or interface module
  - Work memory:
    Integrated memory of the CPU or memory card

4.8.2.2 Single automation system for PCS 7

Overview

The following pre-assembled complete systems are available to be used as standard automation systems:

- The table below contains technical specifications of selected complete systems.
- You can find additional information about the possible equipment variations in the catalogs ST PCS 7 and/or CA 01.
- You can find information about the configuration limits in the documentation *Process Control System PCS 7; Licenses and Configuration Limits*.

Automation system with APL	AS 410 *)							AS RTX	AS mEC
	AS 410E	AS 414-3	AS 414-3IE	AS 416-2	AS 416-3	AS 416-3IE	AS 417-4		
Analog value measurements	50	50	100	200	400	400	500	300	300
Digital value measurements	150	160	250	450	800	800	1 000	600	600
PID controllers	30	35	50	75	150	150	180	200	200
Motors	40	40	75	100	200	200	350	150	150
Valves	40	40	75	100	200	200	350	250	250
SFC	15	15	15	40	100	100	200	100	100
Steps	150	150	150	400	1 000	1 000	2 000	800	800
Dosing	3	3	3	15	25	25	50	50	50
Digital inputs DI	200	200	350	600	1 200	1 200	1 700	1 200	1 200
Digital outputs DO	50	60	100	200	400	400	550	400	400
Analog inputs AI	100	100	175	300	600	600	800	600	600
Analog outputs AO	25	30	75	100	200	200	250	200	200
Process objects (PO)	200	200	350	600	1 200	1 200	1 800	1 200	1 200
Interfaces									
• MPI/DP	1	1	1	1	1	1	1	1	1
• DP	1	1	1	1	1		1	1	1
• DP modules (optional installation)		1			1	1	2		
• PN/IE (2 ports)	1		1			1			
• TCP/IP								2	1

*) see note "AS 410"

Note

AS 410

AS 410 is the preferred system for new plants with SIMATIC PCS 7. It includs a CPU 410 Process Automation.

The number of interfaces in one CPU 410 depends on the firmware version.

- One PN interface with FW V8.0.
- Two PN interfaces are supported as of FW V8.1 or higher.

You can find additional information about this automation system in the system manual *Process Control System PCS 7; CPU 410 Process Automation.*

4.8.2.3 Redundant automation system for PCS 7

Overview

The high availability automation systems are equipped in the following manner:

- With two CPUs = **...-2H**
  The redundant subsystems are housed in a rack.
- With only one CPU = **...-1H**
  These automation systems are employed if the redundant subsystems must be spatially separated, for example, due to safety reasons.

Detailed information

The following pre-assembled complete systems are available to be used as high availability automation systems:

- The table below contains technical specifications of selected complete systems.
- You can find additional information about the possible equipment variations in the catalogs ST PCS 7 and/or CA 01.
- You can find information about the configuration limits in the documentation *Process Control System PCS 7; Licenses and Configuration Limits*.

Automation system with APL	AS 410H *)				
	AS 410E	AS 412H	AS 414H	AS 416H	AS 417H
Analog value measurements	10	10	100	400	600
Digital value measurements	20	20	250	800	1 000
PID controllers	5	5	50	150	200
Motors	7	7	75	200	400
Valves	7	7	75	200	400
SFC	0	0	15	100	200
Steps	0	0	150	1 000	2 000
Dosing	0	0	3	25	50

Digital inputs DI	20	30	300	1 200	1 800
Digital outputs DO	10	10	110	400	650
Analog inputs AI	15	15	150	600	900
Analog outputs AO	5	5	50	200	350
Process objects (PO)	200	30	350	1 200	2 000
Interfaces					
MPI/DP	1	1	1	1	1
DP	1	1	1	1	1
PN/IE (2 ports)	1	1	1	1	1

*) see note "AS 410"

Note

AS 410

AS 410 is the preferred system for new plants with SIMATIC PCS 7:

- CPU 410-5H Process Automation (1 x or 2 x)
- The performance of the universal CPU can be scaled by the number of process objects.
- The number of interfaces in the AS 410H depends on the firmware version.

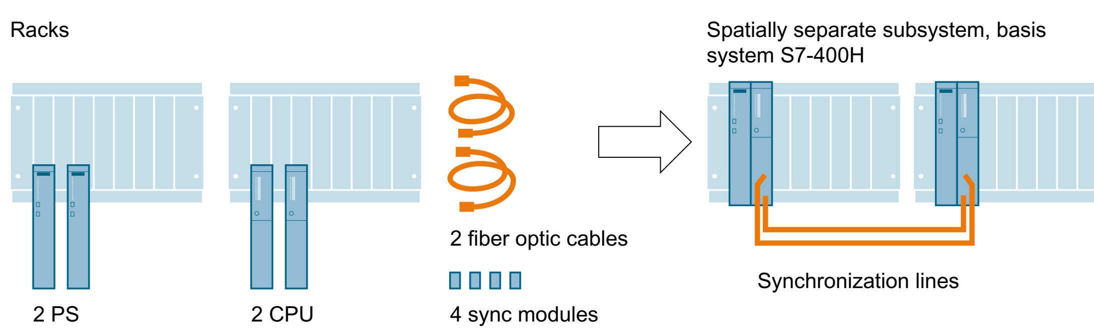
You can find additional information about this automation system in the system manual *Process Control System PCS 7; CPU 410 Process Automation.*

Rack UR2-H

The UR2-H is a compact, special rack with a split backplane bus and therefore suitable for configuring a complete high availability automation system.

Example configuration AS 410H with separate rack

If you are using separate racks for the AS, you can design a spatially separated automation system.



Synchronization modules

The synchronization modules link both of the CPUs. They are installed in the CPU and interconnected with fiber-optic cable. Two synchronization modules are installed in each CPU.

4.8.2.4 Fail-safe automation systems for PCS 7

Overview

The high availability automation systems are used as hardware for the failsafe automation systems AS 41xF and AS 41xFH.

The following complete systems can be used, depending on the type and configuration of the failsafe automation system:

- For fail-safe systems (F-systems AS 41xF): one AS 41x-x-1H each
- For failsafe and high availability automation systems (FH systems AS 41xFH):
  - Both subsystems on one rack: one AS 41x-x-2H each
  - Both subsystems on separate racks: two AS 41x-x-1H each

The safety functions are implemented by the F runtime licenses and programming tools/block libraries for failsafe user programs (F programs).

Additional information

The list above provides a short overview of the complete systems.

Detailed information about the possible equipment variations can be found in the catalogs ST PCS 7 and/or CA 01.

4.8.3 Limits of the CPUs for PCS 7 projects

You can find information on the limits of the most important performance specifications for the CPUs in the PCS 7 project in the installation manual *Process Control System PCS 7; Licenses and Configuration Limits*.

4.8.4 Default performance parameters of the CPUs for PCS 7 projects

The following tables show the default parameters regarding the performance of the CPUs for PCS 7 projects. These values are set as defaults for the configuration of a CPU with PCS 7 software.

These values are visible in HW Config in the CPU properties.

They suffice for typical applications but can be changed within limits as required for configuration.

AS 400 - default values of CPUs in PCS 7

The default parameters of a CPU type found in the properties of a newly inserted CPU in HW Config.

Parameter	CPU 412-3H	CPU 414-3	CPU 416-2 CPU 416-3	CPU 417-4
Cycle load from communication [%]	20			
OB 85 call at I/O access error	Only for incoming and outgoing errors			
Cycle monitoring time [ms]	6 000			
Minimum cycle time [ms]	0			
Process image (I + O each)	768 bytes		416-2: 2 048 bytes 416-3: 3 072 bytes	3 072 bytes
Clock memory	None			
Local data (priority classes):	(1-2, 9-12, 16, 24-28) : 758			
Local data (priority classes):	(3-6, 17-19, 29) : 256		(3-8, 13-15, 17-23, 29) : 256	
User local data area	16 384 bytes		16 384 bytes	32 768 bytes
Max. communication jobs	600		600	2 400
Monitoring time for finished message from modules [100 ms]	650			
Monitoring time for transferring parameters to modules [100 ms]	600			
Startup at POWER ON	Warm restart			
Report cause of STOP	On			
Acknowledgment-triggered messaging (QTM; SFB 33-35)	Off			
Number of messages in the diagnostic buffer	3 200			
Time synchronization	None			

AS 41xH - default values of CPUs in PCS 7 (except AS 410H)

Parameter	CPU 412-5H	CPU 414-5H	CPU 416-5H	CPU 417-5H
Cycle monitoring time [ms]	6 000			
Minimum cycle time [ms]	0			
Cycle load from communication [%]	20			
Process image (I + O each)	768 bytes			3 072 bytes
OB 85 call at I/O access error	Only for incoming and outgoing errors			
Clock memory	None			
Local data (priority classes):	(1-2, 9-12, 16, 24-28) : 1024		(1-2, 7-16, 24-28) : 1024	
	(3-6, 17-19, 29) : 256		(3-6, 17-19, 29) : 256	
	(7,8, 13-15, 20-23) : 0			
User local data area	16 384 bytes		32 768 bytes	
Max. communication jobs	600		2 400	
Monitoring time for finished message from modules [100 ms]	650			

Parameter	CPU 412-5H	CPU 414-5H	CPU 416-5H	CPU 417-5H
Monitoring time for transferring parameters to modules [100 ms]	600			
Startup at POWER ON	Warm restart			
Report cause of STOP	On			
Acknowledgment-triggered messaging (QTM; SFB 33-35)	Off			
Number of messages in the diagnostic buffer	3 200			
Clock: Synchronization	In the AS: As slave			
Test cycle time	90 min			
Passivation reaction	Channel-based			

AS 410H - default values of the CPUs in PCS 7

Parameter	CPU 410
Cycle monitoring time [ms]	6 000
Minimum cycle time [ms]	0
Cycle load from communication [%]	20
Process image (I + O each)	16 384 bytes
OB 85 call at I/O access error	Only for incoming and outgoing errors
Clock memory	None
Local data (priority classes):	(1-29) : 2048
User local data area	65 536 bytes
Max. communication jobs	10 000
Monitoring time for finished message from modules [100 ms]	650
Monitoring time for transferring parameters to modules [100 ms]	600
Startup at POWER ON	Warm restart
Report cause of STOP	On
Acknowledgment-triggered messaging (QTM; SFB 33-35)	Off
Number of messages in the diagnostic buffer	3 200
Clock: Synchronization	In the AS: As slave
Test cycle time	90 min
Passivation reaction	Channel-based

4.8.5 Components for high availability automation systems

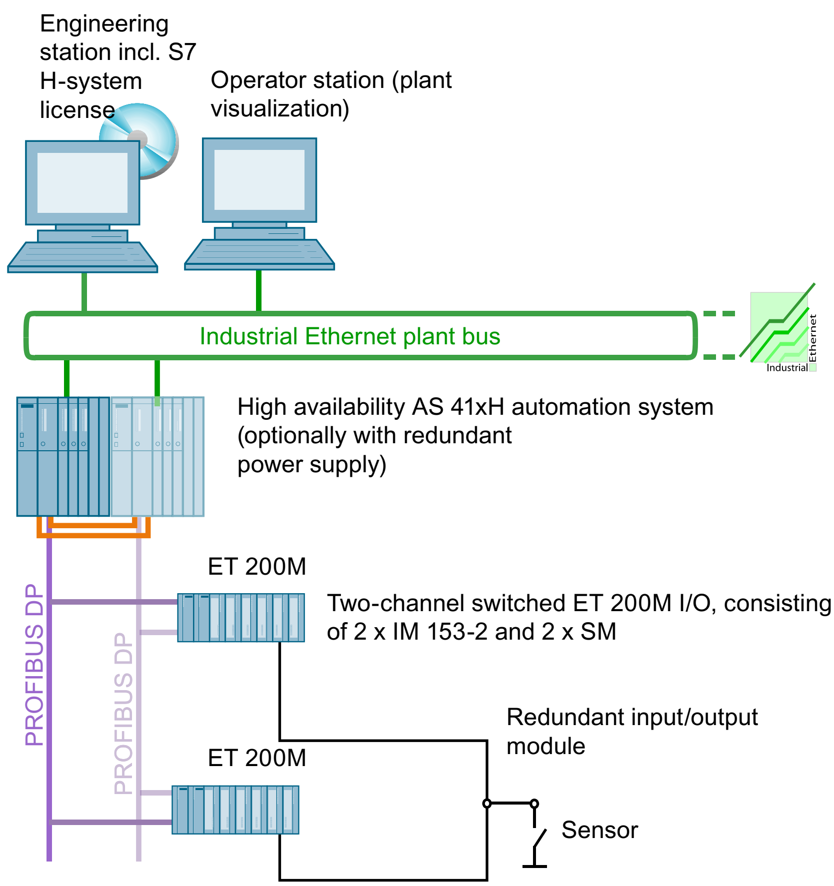
How the H system works

The automation system consists of two redundantly configured subsystems that are synchronized through fiber-optic cables. The two subsystems form a high availability automation system that operates according to the principle of active redundancy.

Active redundancy means that all the redundant equipment is permanently in operation and also takes part in acquisition of the process data. The active redundancy partner is responsible for executing the control task. The user programs loaded in both CPUs are fully identical and are run synchronously by both CPUs.

If the active CPU fails, the automation system automatically switches to the redundant CPU. The changeover has no effect on the ongoing process because it is bumpless.

Example configuration for an H system



Components in a Basic Configuration of a H System

The following components can be used to configure a complete high availability automation system with connected I/O:

- High availability automation system (AS 41x-x-2H) with interface modules for connecting to the Industrial Ethernet plant bus and the fieldbus based on PROFINET or PROFIBUS DP.
  - AS selection:
    You can find information about this in the section "Overview of the automation systems (Page 105)".
  - Connection to the system bus:
    You can find information about this in the section "Connecting network nodes to Ethernet (Page 69)".
  - Connection to the field bus:
    - You can find information about this in the section "Connecting PROFIBUS DP nodes (Page 76)".
    - You can find information about this in the section "Connecting field devices to PROFINET IO (Page 90)".
- Redundant Fieldbus for connecting distributed I/Os:
  - You can find information about this in the section "Layout of redundant PROFIBUS DP networks (Page 77)".
  - You can find information about this in the section "Configuration of a IO device with PROFINET (Page 89)"
- Distributed I/Os with IO modules:
  - e.g. ET 200M with IO modules (also with redundant IO modules)
    You can find information about this in the section "Overview of usable distributed I/O system ET 200 (Page 123)"

Connecting additional components

- PROFIBUS DP devices that can be configured non-redundant:
  You can find information about this in the section "Connecting non-redundant PROFIBUS DP devices to redundant PROFIBUS DP (Page 78)".
- Intelligent field devices to PROFIBUS PA:
  You can find additional information about this in the following sections
  - Connecting field devices to PROFINET IO (Page 90)
  - Connecting field devices to PROFIBUS DP (Page 79)
  - Configuration of redundant PROFIBUS PA networks (Page 82)
- Intelligent field devices to FOUNDATION Fieldbus:
  You can find information about this in the manual *Process Control System PCS 7; FOUNDATION Fieldbus*.

Mixed operation

Note

High availability and standard automation systems can be used in mixed operation.

Additional information

- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

4.8.6 Components for fail-safe automation systems

How the F system works

Fail-safe automation systems use their numerous safety functions to detect both process errors as well as their own internal errors. If an error should occur, the fail-safe automation systems automatically switch the affected part of a plant to a safe state.

The fail-safe automation systems based on AS 41x-H automation systems combine standard production automation and safety technology in a single system. They are certified by the German Technical Inspectorate (TÜV) and conform to safety requirement category SIL 1 to SIL 3 according to IEC 61508, requirement category AK 1 to AK 6 according to DIN V 19250/ DIN V VDE 0801 and categories 2 to 4 according to EN 954-1.

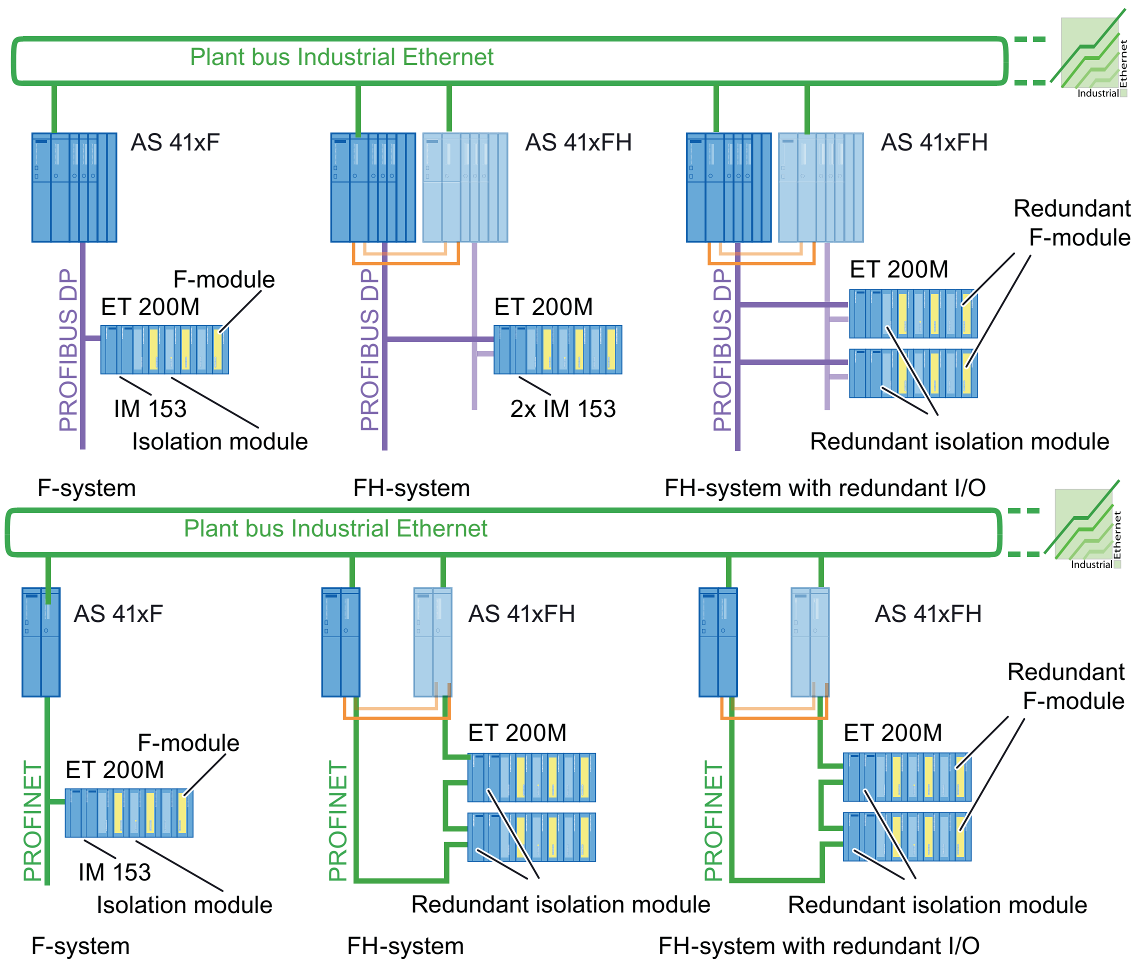
Safety mechanisms of the F System

You can find information about this in the section "Operational security of PCS 7 (Page 54)".

FH Systems

Fail-safe automation systems can be configured as single-channel (F system with one CPU) or as redundant (FH system). The redundancy of the FH systems is not relevant for failure safety. Redundancy is not used for detecting errors but rather to increase the availability of fail-safe automation systems.

Example configurations for F/FH systems



Components of the Basic Configuration of an F System

The following components can be used to configure a complete fail-safe automation system with connected I/O:

- F runtime license for editing fail-safe user programs
- Add-on package *S7 F systems* for configuring and programming the H system

- High availability automation system (AS 41x-x-1H) with interface modules for connecting to the Industrial Ethernet plant bus and the fieldbus
  - AS selection: you can find information about this in the section "Overview of the automation systems (Page 105)"
  - Connection to the system bus: you can find information about this in the section "Connecting network nodes to Ethernet (Page 69)".
  - Connection to the field bus: you can find information about this in the section "Connecting PROFIBUS DP nodes (Page 76)".
- Distributed I/Os with fail-safe components:
  - ET 200M with fail-safe IO modules (F modules)
  - Isolation module for protecting against overvoltage between standard S7-300 IO modules and fail-safe S7-300 IO modules in the ET 200M
  - ET 200S with fail-safe IO modules and fail-safe power modules
  - ET 200iSP with fail-safe IO modules (F modules)
  - ET 200pro with fail-safe IO modules (F modules)

  You can find information about this in the section "Overview of usable distributed I/O systems ET 200 (Page 123)"

Components for an FH System

The following high availability automation systems are utilized depending on the type and requirements and the configuration of the FH system:

- Both subsystems on one rack:
  AS 41x-x-2H
- Both subsystems on separate racks:
  AS 41x-x-1H (2x)

In addition to the configuration of an F system, all possible configurations of an H system can be used in combination: you can find information about this in the section "Components for high availability automation systems (Page 111)"

The *S7 H Systems* license must be installed in the engineering station in addition to the add-on package *S7 F Systems*.

Additional information

- Manual *SIMATIC Programmable Controllers S7 F/FH*
- Manual *S7-300 Fail-safe Signal Modules*

4.9 Selecting I/O components

I/O components

PCS 7 offers a wide range of options for connecting I/O devices and for recording and outputting process signals via sensors and actuators:

- Integration of central, analog and digital signal modules of the S7-400 automation system
- Integration of distributed I/O that is connected to the automation system via PROFIBUS DP or PROFINET. The following product series form the basis with an extensive range of signal and function modules:
  - ET 200SP HA
  - ET 200M
  - ET 200S
  - ET 200SP
  - ET 200iSP
  - ET 200pro
  - Compact Field Unit (CFU)
- Integration of intelligent field devices via a fieldbus:
  - PROFIBUS DP or PROFINET
    Direct integration of intelligent, distributed field devices and process devices
  - Via PROFIBUS PA or FOUNDATION Fieldbus (e.g. IE/PB-Link / Compact FF Link).
    - Redundant
    - Hazardous areas of zones 0, 1 or 2
  - HART devices via PROFIBUS DP or PROFINET

Signal and function modules for PCS 7

Note

PCS 7 only supports diagnostics for the signal and function modules listed in the product overview *Process Control System PCS 7; Released Modules*.

Other signal modules from the current range of S7-400 and S7-300 modules can be used.

- The use of these modules is the sole responsibility of the user.
- PCS 7 offers no support for these modules.

4.9.1 Use distributed or centralized I/O?

Using centralized I/O

Centralized I/O is primarily used for small applications or plants with a small, distributed structure in PCS 7.

Note

The following PCS 7 functions cannot be used with centralized S7-400 I/O modules:

- Configuration change in RUN
- I/O module redundancy
- Fail-safe I/O modules

Using distributed I/O

PCS 7 plants are for the most part configured with distributed I/Os. The main advantages are:

- Modularity and consistency
- Low cabling and commissioning costs
- Low space requirements
- No need for terminal boards, sub-distribution boards and hazardous area buffer stages
- Can increase availability using redundant configuration of signal modules
- Safe states by using fail-safe signal modules
- Can be expanded and parameters can be reassigned in CPU RUN
- Easy troubleshooting using self-diagnostics with detailed information

4.9.2 Which devices can be connected as distributed components?

Connecting field systems to PCS 7

PCS 7 is optimized for the integration of distributed field systems in the process control system and uses PROFIBUS technology to accomplish this. Alternatively, PROFINET can be used.

Devices that can be connected as distributed components

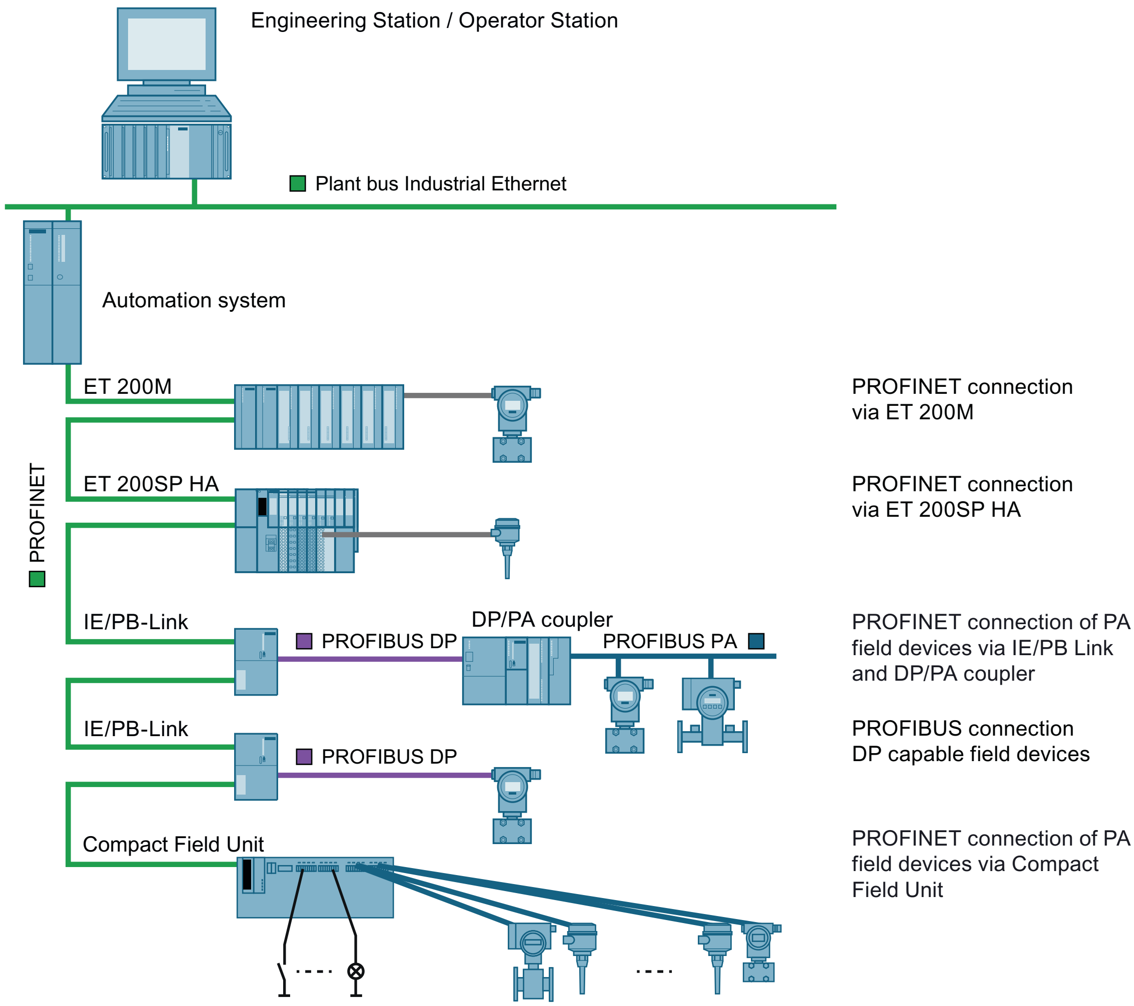
The table displays the following information:

- The field devices, sensors, and actuators that can be connected as distributed components in a PCS 7 plant
- The components used for communicating with these field devices, sensors, and actuators

Device	I/O	More information
Sensors and actuators	Direct connection to distributed I/O devices • ET 200SP HA • ET 200M • ET 200iSP • ET 200SP • ET 200S • ET 200pro • Compact Field Unit (CFU)	Overview of usable distributed I/O system ET 200 (Page 123) Fieldbus with PROFINET (Page 85)
Intelligent PROFIBUS DP field devices	Direct connection to PROFIBUS DP (DP master system)	
Intelligent PROFIBUS PA field devices	Direct connection to PROFIBUS PA and simultaneous coupling of PROFIBUS PA to PROFIBUS DP (DP master system) components for coupling to, for example: • PA Link • DP/PA coupler	Connecting field devices to PROFIBUS DP (Page 79)
	Direct connection to PROFIBUS PA and simultaneous coupling of PROFIBUS PA to PROFINET IO (PROFINET IO system) components for coupling to, for example: • Compact Field Unit	Connecting field devices to PROFINET IO (Page 90)
Intelligent FF field devices	Direct connection to FOUNDATION Fieldbus and simultaneous coupling of FOUNDATION Fieldbus to PROFIBUS DP (DP master system). Components for coupling to, for example: • Compact FF Link • FDC 157 coupler	Commissioning manual *Process Control System PCS 7; PCS 7 - FOUNDATION Fieldbus*
HART field devices	Direct connection to special I/O components of the distributed I/O devices • ET 200SP HA • ET 200M • ET 200iSP • ET 200SP	Connecting HART devices (Page 91)
Non redundant PROFIBUS DP devices	Indirect connection of a device to a redundant PROFIBUS DP	Connecting non-redundant PROFIBUS DP devices to redundant PROFIBUS DP (Page 78)

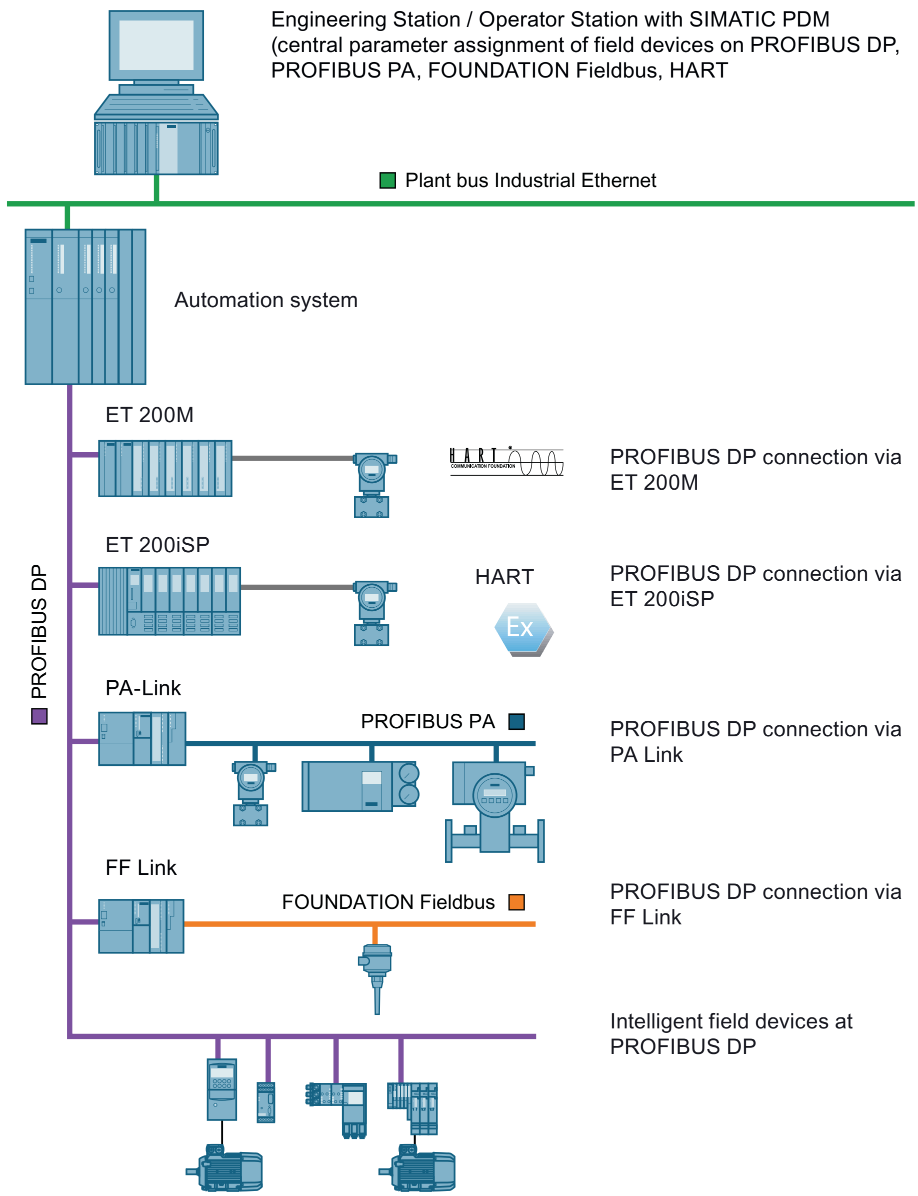
Example of an integration with PROFINET

The following picture demonstrates, as an example, integration in a non-redundant system using PROFINET.



Example of an integration with PROFIBUS

The following picture demonstrates, as an example, integration in a non-redundant system using PROFIBUS.



Additional information

- You can find information on redundant systems in the *Process Control System PCS 7; High Availability Process Control Systems* manual.
- You can find information on integrating the FOUNDATION Fieldbus in a PCS 7 system in the commissioning manual *Process Control System PCS 7; PCS 7 - FOUNDATION Fieldbus*.

4.9.3 Use in high availability or fail-safe automation systems?

Overview

The following table shows the automation systems (AS) in which distributed I/Os can be connected based on a selected ET 200 product line.

AS type With ET 200...	Standard (AS 400)	High availability (AS 400H)	Fail-safe (AS 400F)	Fail-safe and high availability (AS 400FH)
ET 200M	X	X	X	X
ET 200S	X	X (via Y-Link)	X	X (via Y-Link)
ET 200iSP	X	X	X	X
ET 200pro	X	X (via Y-Link)	X	X (via Y-Link)
ET 200SP	X	DP: not supported	X [1)]	DP: not supported
ET 200SP HA	X	X	X [1)]	X [1)]

X = Configuration possible

[1)] = No fail-safe I/O modules have been approved for this configuration in PCS 7. For more information, please refer *Process Control System PCS 7; Released Modules*

Activate system redundancy Typ R1 for distributed IO system

To activate the system redundancy Typ R1 for distributed IO system you use a license key. The license key must be transfered to SEC of the CPU for use. You can execute the activation without exchanging the SEC.

You activate the system redundancy Typ R1 for distributed IO system as an **Upgrade of the System Expansion Card for a CPU 410-5H.**
You can find additional information in the following document:
Process Control System PCS 7; Service Support and Diagnostics.

Additional information

- Section "Overview of usable distributed I/O system ET 200 (Page 123)"

4.9.4 Overview of usable distributed I/O system ET 200

Properties of the distributed I/O station ET 200

The following table provides an overview of the most important properties of the distributed I/O system from ET 200 used in PCS 7.

Property	ET 200M	ET 200iSP	ET 200S	ET 200pro	ET 200SP HA	ET 200SP
Protection level	IP20	IP30	IP20	IP65, IP66, IP67	IP20	IP20
Digital modules	x	x (with counter/ frequency measurement function)	x	x	x	x
Analog modules	x	x	x	x	x	x
Modules for motor starter	-	-	x	-	-	-
Controller and counter modules	x	-	-	-	-	-
Ex digital/analog modules	x (Analog module also for HART)	x	-	-	-	-
Fail-safe modules	x (+ isolation module)	x	x (+ ET 200S SIGUARD)	x	-	-
Redundant IO modules	x (PROFIBUS DP only)	-	-	-	x (shared termination points)	-
Modules have enhanced diagnostic capability	x	x	x	x	x	x
HART field devices can be connected	x (Configuration via PDM)	x (Configuration via PDM)	-	-	x (Configuration via PDM)	x (Configuration via PDM)
"Hot swapping" function in runtime	x (+ active bus module)	x	x	x	x	x
Configuration and parameter assignment	HW Config	HW Config and PDM	HW Config	HW Config	HW Config	HW Config
Configuration change in RUN (CiR)	For additional information, refer to the section "Can configuration changes be made in runtime? (Page 124)"					

Property	ET 200M	ET 200iSP	ET 200S	ET 200pro	ET 200SP HA	ET 200SP
Can be used in hazardous areas (Ex zone (Page 665))	x ET 200M: Zone 2 (+ Ex partition) Actuator/sensor/ HART: Zone 1	x ET 200iSP / HART: Zone 1, 2 RS485-iS coupler: zone 2 Actuator/sensor: zone 0	x Zone 2 (except motor starter)	-	x ET 200SP HA: Zone 2	x ET 200SP: Zone 2
Max. n modules per station (without interface modules)	n = 12	n = 32	n = 63	n = 16	n = 56	n = 64
Electrical bus connection (HF = High Feature; PN = PROFINET)	x (IM 153-2 HF for PROFIBUS connection; IM 153-4 PN for PROFINET connection)	x (IM 152)	x (IM 151-1 HF)	x (IM154-2)	x (IM 155-6 PN HA for PROFINET connection)	x (IM 156-6 PN HF for PROFINET connection)
Optical bus connection (HF = High Feature; FO and FC = Fiber optics)	x (IM 153-2 FO HF)	-	-	-	x (see released bus adapters)	x (see released bus adapters)
Bus connected via connection modules	x	x	x	x	x	x
Max. transmission rate in Mbps	DP: 12 PN: 100	1.5	12	12	100	DP: 12 PN: 100
Connecting non-redundant PROFIBUS DP devices to a redundant PROFIBUS DP	Y-Link	-	-	-	-	-
Integrating FF devices on the FOUNDATION Fieldbus	Compact FF Link	-	-	-	-	-

4.9.5 Can configuration changes be made in runtime?

Configuration in RUN

The following table provides an overview of the permitted configuration changes that can be made to the distributed I/O during ongoing operation (CPU RUN).

Permitted configuration changes

Table 4-1 **If you want use or have used a componet in a fieldbus system the following configuration changes are permitted (depent of the status of the plant).**

Components	Permitted configuration changes		
	Adding and removing	Assigning parameters	Configuration via SIMATIC PDM
PROFINET IO *)	• PROFINET IO • IO devices		
PROFIBUS DP; PROFIBUS PA	• PROFIBUS DP nodes • PA Link • DP/PA field devices		• DP field devices • PA field devices
PROFIBUS DP; FOUNDATION Field-bus	• PROFIBUS DP nodes • Compact FF link • FF field devices		• DP field devices • FF field devices
ET 200SP HA	• ET 200SP HA stations • Input/output modules	Input/output modules	Connected HART field devices
ET 200M (on PROFI-BUS DP only) **Requirement:** Interface module type: • IM 152-2 HF • IM 153-2 HF-FO	• ET 200M stations • Input/output modules	Input/output modules	Connected HART field devices
ET 200iSP	• ET 200iSP stations • Input/output modules	Input/output modules	HART field devices connected to HART modules
ET 200pro	• ET 200pro stations	-	-
ET 200S	• ET 200S stations	-	-
ET 200SP (on PROFI-BUS DP only)	• ET 200SP stations • Input/output modules	Input/output modules	Connected HART field devices
Compact Field Unit	• PA field devices • Compact Field Unit • components on free configurable chanels	free configurable chanels	• PA field devices

*) In order to use this hardware, CPU 410 firmware version V8.2 or higher is required.

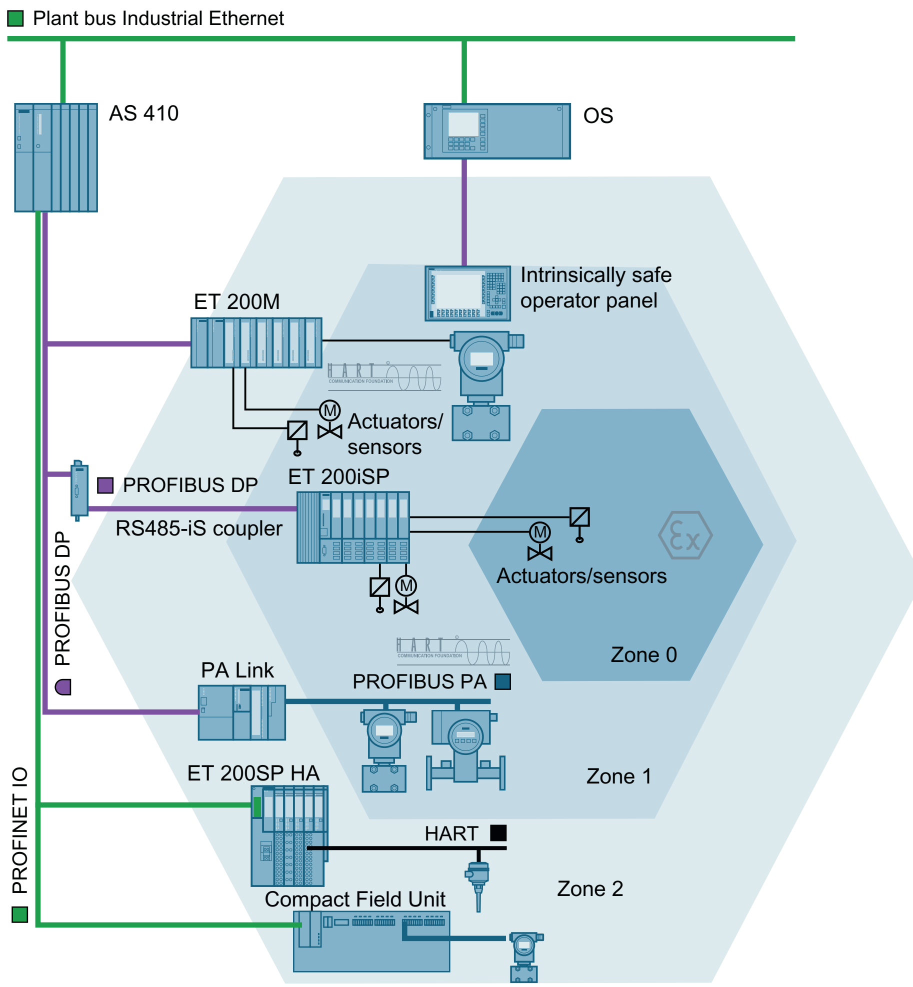
Additional information

- Section "Rules for configuration changes in RUN (CiR) (Page 158)"

4.9.6 How can distributed I/Os be integrated in the hazardous area?

Integrating I/O in hazardous areas

The following illustration shows an overview of the various options for integrating distributed I/Os in hazardous areas:



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Components	Use in hazardous areas
ET 200M	ET 200M can be operated in hazardous zone 2. The actuators/sensors can be located in hazardous zone 1 when the appropriate hazardous area I/O modules are used. Hot swapping of I/O modules is permissible in hazardous zone 2 with appropriate permission (e.g. fire certificate).
ET 200iSP	ET 200iSP can be installed directly in hazardous areas 1 or 2 (EEx de ib [ia/ib] IIC T4). Sensors/actuators also in Zone 0. Individual modules can be hot swapped under hazardous conditions.
ET 200SP HA	ET 200SP HA can be operated in hazardous zone 2. **The actuators/sensors are not released in hazardous zone 1 or 0.** Hot swapping of I/O modules is permissible in hazardous zone 2 with appropriate permission (e.g. fire certificate).
Compact Field Unit	Compact Field Unit and field devices on PROFIBUS PA can be operated in hazardous zone 2.
Field devices	Suitable field and process devices can be integrated directly into hazardous zones 1 or 2 via PROFIBUS PA. Sensors/actuators also in Zone 0.

Intrinsically safe operator panel

If required, an intrinsically safe PC operator panel (PCS 7 add-on) can be used in hazard zones 1 or 2. It can be connected to the operator station up to a distance of 750 m.

4.10 Preparation for efficient engineering

4.10.1 Planning objects/functions for efficient engineering

Functions for efficient engineering

The following table provides an overview of those objects/functions that are designed to help ensure efficient engineering. We recommend that you take these functions into consideration while planning the plant engineering with PCS 7.

Function	Brief description	Tool	Sections in this manual containing further information
Process control library	PCS 7 offers a library with a wide range of pre-configured and tested blocks, faceplate and symbols for graphic configuration of automation solutions. These library elements can contribute considerably to minimize engineering requirements and project costs. The comprehensive range of blocks includes simple logic and driver blocks, technological blocks with integral operation and signaling response such as PID controllers, motors or valves, and blocks for the integration of field devices.	Standard PCS 7 software	How are recurring technological functions supported? (Page 130)
Multiproject engineering	Multiproject engineering enables an extensive plant project to be divided into several subprojects based on technological factors. The subprojects can then be worked upon simultaneously by several project engineers. Advantages: • The individual projects can be added or removed from a multiproject at any time. • The subprojects in a multiproject are stored on a central server and moved to the local engineering stations for editing. • Once the subprojects are assembled back into the multiproject, the cross-project functions (such as compiling and downloading) are carried out for the entire plant.	Standard function of PCS 7	Configuring in a multiproject (Page 172)
Master data library	A custom library can be created for a project to improve efficiency.	Standard function of PCS 7	Objects of the master data library (Page 282)
Branching and merging projects	Branch & merge is a function for multiproject engineering and is used to separate and reassemble project parts based on technological factors. Charts or plant units can be copied into another project to be modified there.	Standard function of PCS 7	Branching and merging charts from a project (Page 176)

Function	Brief description	Tool	Sections in this manual containing further information
Importing configured plant data	Already configured plant data such as process tag lists or charts from the higher-level CAD/CAE world can be imported into the Engineering System and used for almost fully automatic generation of process tags.	Import/Export Assistant	Importable data and data formats (Page 129) Transferring the data from the plant engineering (Page 575)
Automatic generation of process tags	Based on the imported process tag lists and custom defined process tag types, a great many process tags (CFCs in PCS 7) can be generated automatically and stored in the correct location in the plant hierarchy.	Import/Export Assistant	Working with process tags and models (Page 579) Using process tag types (Page 185)
Exporting configuration data	During the configuration and commissioning, parameters optimized with PCS 7 can be exported back into the CAD/CAE world.	Import/Export Assistant	Working with process tags and models (Page 579)
Automatic expansion/ modification of hardware configurations	Station configurations can be exported from HW Config, modified and adapted outside the project, and then imported back in again. The symbolic names of the inputs and outputs are also exported or imported. This function can be used for efficient engineering of plants with repeatedly used hardware structures.	HW Config	Importing/exporting the hardware configuration (Page 599)
Creating and optimizing logical functions	Logic Matrix Editor for efficient engineering of plants.	Logic Matrix Editor	Configuring logical operations (Page 449)
Data exchange with plant engineering	Data exchange between PCS 7 and COMOS	Advanced Engineering System (AdvES)	Overview of data exchange (Page 575)

4.10.2 Importable data and data formats

Data import

The table supplies the following information:

- The task in which data can be imported
- The data formats that can be imported
- The application in which the data can be generated

Work phase in engineering	Potential import formats	Application for generation
Creating the process tags (CFCs in PCS 7)	Lists in the format: • csv	Application that can export lists in CSV format (e.g. MS Excel, Access)
Creating the hardware configuration	• cfg	HW Config (standard PCS 7)

Work phase in engineering	Potential import formats	Application for generation
Creating the OS pictures (non-dynamic screen elements)	Imported graphics in the format: • emf • wmf Imported graphic objects in the format: • emf • wmf • dib • gif • jpg • jpeg • ico	Any graphics application
Creating foreign language texts	• txt • csv	Text editors (e.g. MS Excel, Wordpad)
Creating the project data	• xml	SIMATIC Manager Version Cross Manager

Additional information

- Section "Import and reuse of plant data (Page 191)"
- Section "Overview of data exchange (Page 575)"

4.10.3 How are recurring technological functions supported?

Recurring technological functions are supported by the following functions in PCS 7:

- Templates
  Templates (standard types, standard solutions) are provided to support you in the configuration of a PCS 7 plant. They are contained in the *PCS 7 Advanced Process Library*.
- Type concept
  We also recommend that you group similar functions to improve the efficiency of the plant engineering. Similar functions are configured by using reusable objects (such as process tag types and models).

Templates

The PCS 7 library "PCS 7 Advanced Process Library" contains templates for the following technological functions:

- Controls for measured value displays
- Binary value acquisition with monitoring
- Analog value acquisition with monitoring
- Manual adjustment

- Fixed setpoint control
- Cascade control
- Ratio control
- Split range control
- Dosing
- Motor control manual/automatic
- Motor control (variable speed)
- Valve control manual/automatic
- Valve control continuous
- Sequential control systems

You can find information on the various blocks and their operation in the following documentation:

Function manual *SIMATIC; Process Control System PCS 7; Advanced Process Library*

Recommendation for configuring numerous process tags

Create a process tag list which includes all the process tags. Consider which process tags can be assigned to a process tag type. Use this list during the engineering to generate the CFCs with the corresponding process tags based on the process tag types with the import/export assistant.

The import file must have a specific structure. The precise configuration of this structure can be found in section"Creating/editing import files with the IEA file editor (Page 593)".

As preparation, you should, for example, create a process tag list that contains the following information:

Components	Measurement	Measurement	Motor	....
Block	1	2	1	
Plant area	Plant area 1	Plant area 2	Plant area 1	Plant area 1
Subarea	Dosing plant	Oil heating	Mixer	Gas heating
Type	3 (PT 100 - temperature measurement)	3 (method of measurement, e.g. square-root)	10	...
Property 1	Measuring range start (e.g. 263°K)	Measuring range start (e.g. 0 mA)	On	...
Property 2	Measuring range end (e.g. 473°K)	Measuring range end (e.g. 100 mA)	Off	...
Property 3	Limit 1: 300 K		Feedback in	...
Property 4	Limit 2: 320 K		Feedback out	...
Property 5	Limit 3: 390 K		Temperature sensor (type 1 - PT 100)	

Components	Measurement	Measurement	Motor	....
Property 6	Limit 4: 400 K			
Property 7	...			
Property ...	...			

Additional information

- Section "Overview of data exchange (Page 575)"

5 Introduction to the plant engineering with PCS 7

PCS 7 - The process control system for Totally Integrated Automation

As a process control system in the enterprise-wide automation network 'Totally Integrated Automation', SIMATIC PCS 7 uses selected standard components from the TIA modular system. Its uniform data management, communication and configuration offer an open platform for modern, future-oriented and economical automation solutions in all sectors of the process industry, production industry, and hybrid industry (mixture of continuous/batch processes and discrete production, e.g. in the glass or pharmaceuticals industries).

Within the TIA network, SIMATIC PCS 7 not only handles standard process engineering tasks, it can also automate secondary processes (e.g. filling, packaging) or input/output logistics (e.g. material flows, storage) for a production location.

By linking the automation level to the IT world, the process data become available throughout the company for the evaluation, planning, coordination and optimization of operational sequences, production processes and commercial processes.

Basic structure of a PCS 7 plant

The modular architecture of SIMATIC PCS 7 is based on selected hardware and software components from the standard range of SIMATIC programs. The PCS 7 plant can be incorporated into the company-wide information network using interfaces based on international industrial standards for data exchange - such as Ethernet, TCP/IP, OPC or OLE DB communication.

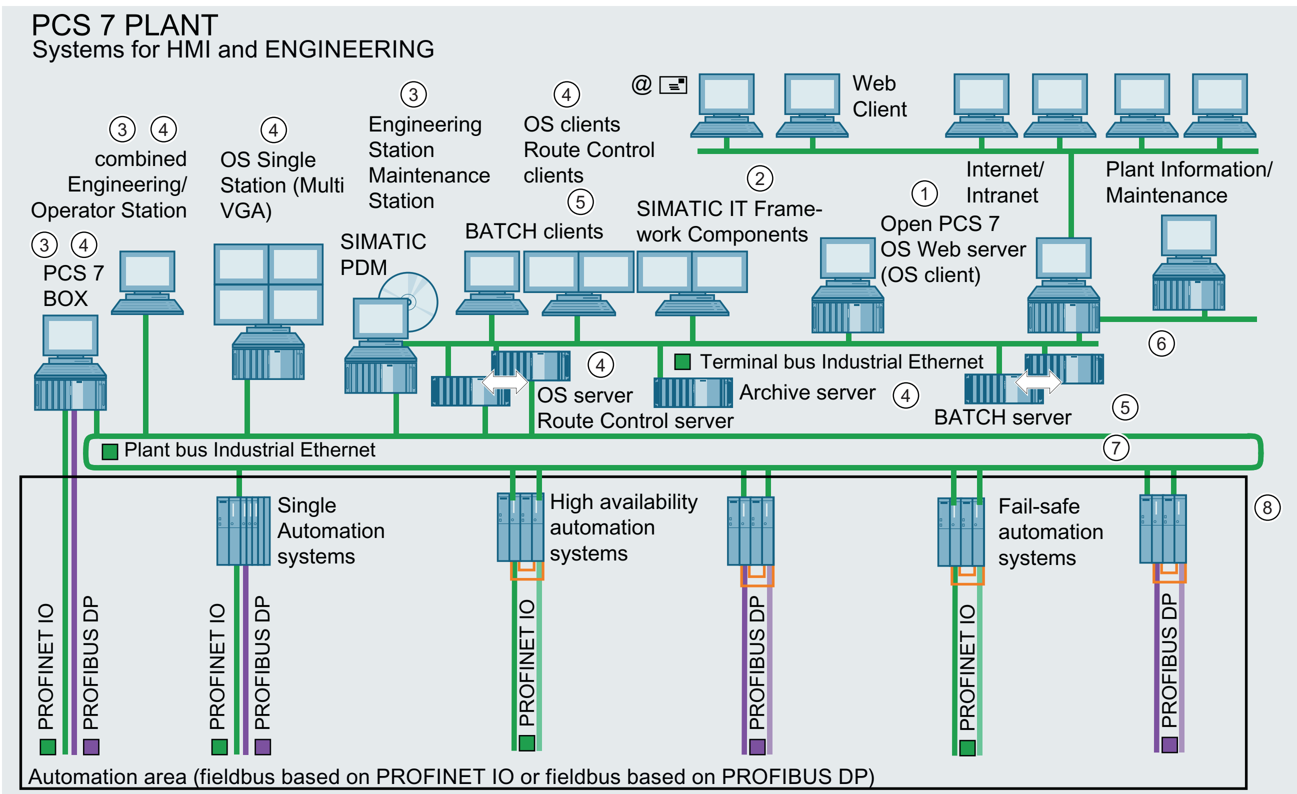


Figure 5-1 Basic of Systems for HMI and Engineering in a PCS 7 plant

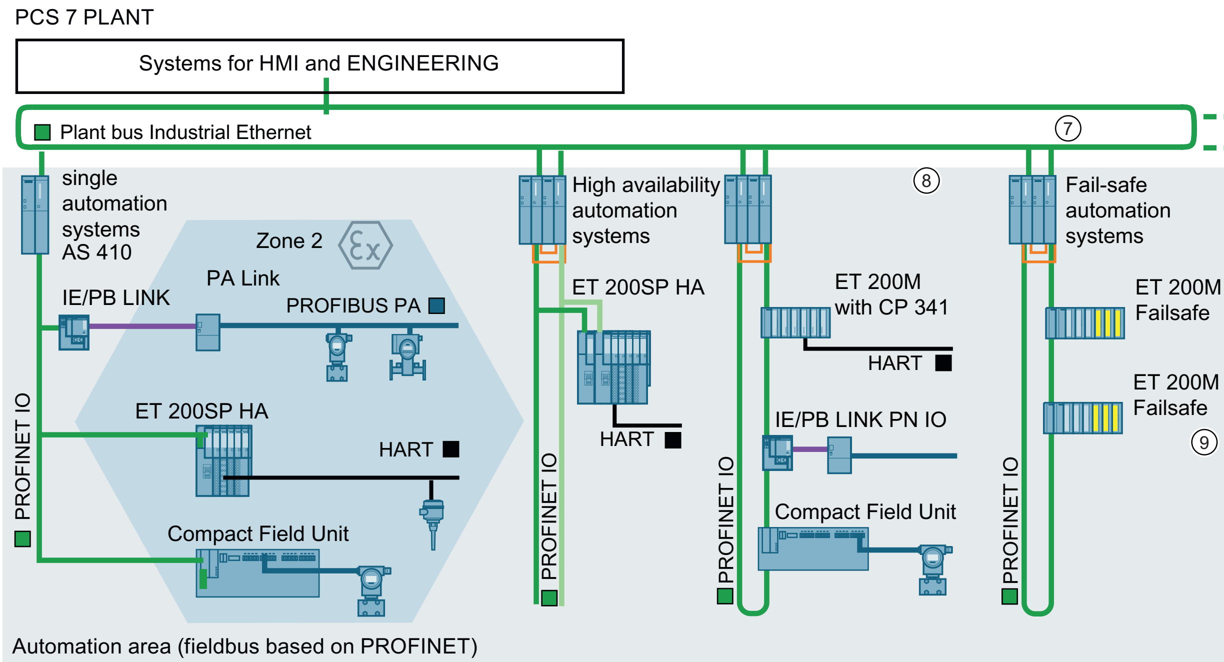


Figure 5-2 Basic of Automation area - fieldbus based on PROFINET

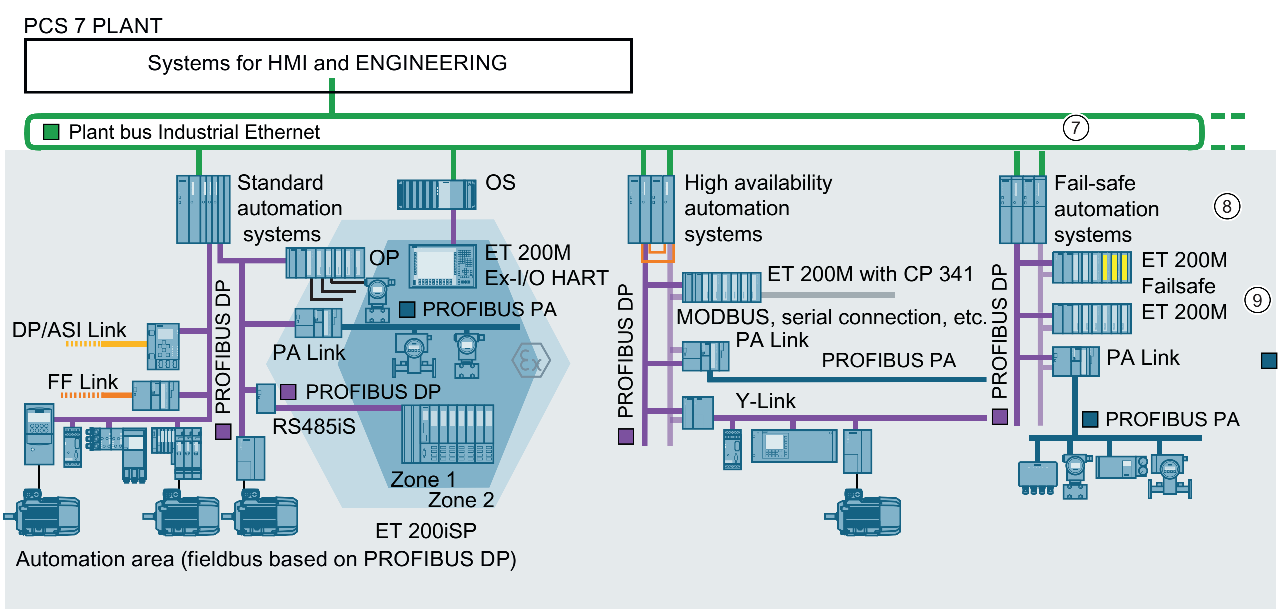


Figure 5-3 Basic of Automation area - fieldbus based on PROFIBUS DP

The system/components of PCS 7

No.	System/ component	Description	Sections in this manual containing further information
1	OpenPCS 7 station	PC station for data communication with external systems, does not require knowledge of the topology. Data is accessed via OPC/OLE DB event-driven or cyclically.	• Connecting to the IT world via OpenPCS 7 (Page 97)
	PCS 7 Web server	PC station for monitoring processes online around the world per intranet or Internet.	• Access to the PCS 7 OS via PCS 7 Web client (Page 99)
2	SIMATIC IT	SIMATIC PCS 7 can be integrated into the company-wide information network with SIMATIC IT.	• Connecting to the IT world - SIMATIC IT (Page 96)
3	Engineering station	PC station for centralized plant-wide engineering: • Configuration of the hardware • Configuration of the communications networks • Configuration of continuous and sequential process sequences using standard tools • Configuration of discontinuous process sequences (batch processes) with SIMATIC BATCH • Configuration of route controls with SIMATIC Route Control • Operator control and monitoring strategies • Compilation and downloading of all configuration data to all target automation system (AS), operator station (OS), BATCH station (BATCH) and Route Control station	• Configuration of the engineering station (Page 141) • Pre-configured systems of PCS 7 (bundle) (Page 101) • Planning objects/functions for efficient engineering (Page 128)
	Maintenance station	PC station for diagnostics of all PCS 7 components. The diagnostic status is represented by hierarchically structured diagnostic pictures and communicated to the user in diagnostic messages. The maintenance station can be designed as a single station or multiple station system. The maintenance station (in the single station) or the MS client (multiple-station system) is preferably operated on an engineering station.	• Diagnostics with maintenance station (Asset Management) (Page 641) • Additional service support and diagnostics (Page 645)
4	Operator station	PC station with human-machine interface for operating and monitoring of your PCS 7 plant in process mode The operator station can be designed as a single-station system or multiple-station system.	• Configuration of the operator stations (Page 142) • Pre-configured systems of PCS 7 (bundle) (Page 101)
	Route Control station	PC station for operation and monitoring of route controls for transporting materials The route control station can be designed as a single-station system or multiple-station system.	• Configuration of the Route Control stations (Page 146)
	Process Historian (archive server)	PC station for long-term archiving (external archive server). The Process Historian is a node on the terminal bus. The Information Server is the central reporting system.	• Configuration of the operator stations (Page 142)

No.	System/ component	Description	Sections in this manual containing further information
(3 + 4)	PCS 7 Box	Industrial PC that when used in conjunction with distributed I/O has the functionality of a PCS 7 process control system (engineering, automation, operator control and monitoring). PCS 7 BOX is used for small stand-alone systems or combined AS/OS stations that can be integrated in the PCS 7 network. It allows centralized engineering.	• Configuration of the engineering station (Page 141) • Configuration of the operator stations (Page 142) • Pre-configured systems of PCS 7 (bundle) (Page 101)
5	BATCH station	PC station for operation and monitoring of discontinuous process sequences (batch processes). A BATCH station can be designed as a single-station or multiple-station system with BATCH client/BATCH server architecture.	• Configuration of the BATCH stations (Page 144)
6	Terminal bus	The following components communicate via the terminal bus: • Server/Client (OS, BATCH, Route Control) and engineering station Note: Single-station systems in all systems (ES, OS, BATCH, Route Control) can be connected to the terminal bus.	• Communication within PCS 7 (Page 59) • Planning the management level with Ethernet (Page 66)
7	Plant bus	The following components communicate via the plant bus: • Server (OS, Route Control) and automation systems (AS) • Interchangeable automation system (SIMATIC connections)	• Communication within PCS 7 (Page 59) • Planning the management level with Ethernet (Page 66)
8	Automation system	The automation system performs the following tasks: • To acquire process variables • To process the data according to the instructions in the user program • To output control instructions and setpoints to the process • To supply data to the operator station for visualization • To detect operator commands on the operator station and their return to the process • Direct access to the Route Control station	• What are the criteria for selecting the AS? (Page 103)
9	I/O field bus	Connects classic and intelligent field devices. Intelligent field devices are connected by communication via PROFINET, PROFIBUS DP, PROFIBUS PA, HART or FOUNDATION Fieldbus. In addition, the following components can be integrated: • Simple actuators and sensors via an AS interface • Components in building automation via an *instabus EIB* • Components with a Modbus interface	• Planning the field level with PROFIBUS (Page 73) • Fieldbus with PROFINET (Page 85) • Which devices can be connected as distributed components? (Page 118) • Introduction to data links to other systems (Page 91)

Additional information - PCS 7 brochures

If you are interested in further introductory information about PCS 7, read the PCS 7 process control system brochure. Here, you can find all of the necessary information about the principles of communication and the range of features in SIMATIC PCS 7 as well as the possible technical applications and appropriate functions for implementing your automation tasks.

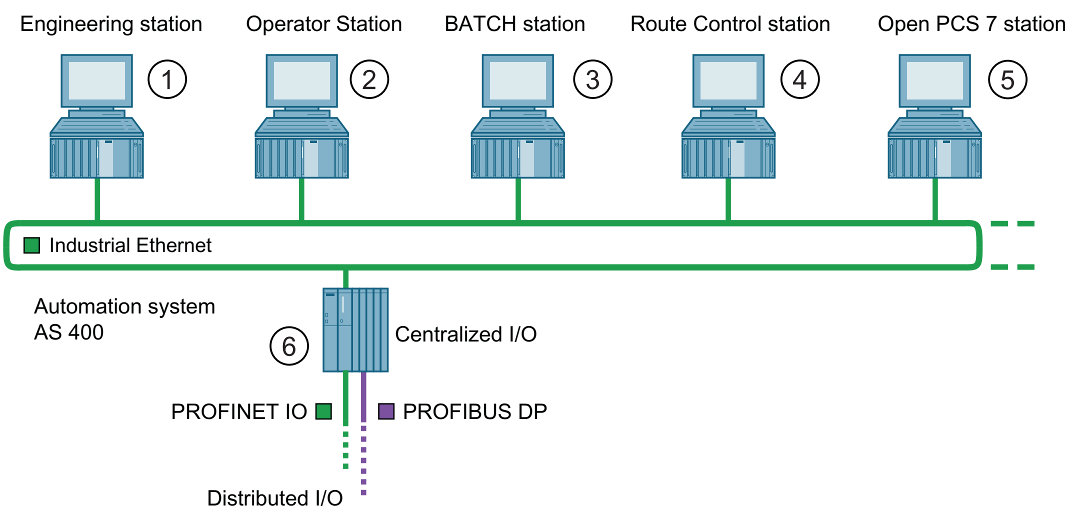
The following sections in this manual are based on the information in the PCS 7 brochures.

Structure of the PCS 7 plant 6

6.1 Basic configuration of the PCS 7 plant

Basic components

The following figure shows the basic components of a PCS 7 plant.



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Station	No. in figure	Function
Engineering station	1	The central engineering for all PCS 7 system components is performed on the engineering station: • Operator stations • Maintenance station • BATCH stations • Route Control stations • Automation systems • Centralized I/O • Distributed I/O The configuration data are downloaded to the PCS 7 system components when the engineering is completed. Changes can only be made on the engineering station. This is followed by a new download.
Operator station	2	On the operator station you operate and observe your PCS 7 plant in process mode. Complete diagnostics of a PCS 7 system is possible with the Maintenance Station. External archive servers are used to archive important process and plant data
BATCH station	3	On the BATCH station you operate and observe discontinuous process sequences (batch processes) in process mode.
Route Control station	4	On the Route Control station, you control and monitor material transports in process mode (route control).
OpenPCS 7 station	5	An OpenPCS 7 station enables you to access the PCS 7 data in the IT world.
Automation system	6	The automation system carries out the following tasks: • It registers and processes process variables from the connected central and distributed I/O and outputs control information and setpoints to the process. • It supplies the operator station with the data for visualization. • It registers actions on the operator station and forwards them to the process.

Additional information

- Section "Connecting network nodes to Ethernet (Page 69)"
- Section "Connecting PROFIBUS DP nodes (Page 76)"

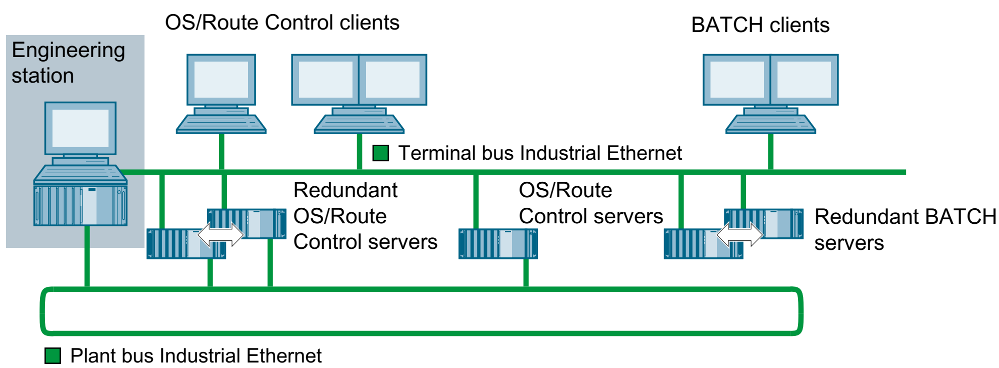
6.2 Configuration of the PC stations

6.2.1 Configuration of the engineering station

Overview

Engineering stations are PCs on which the PCS 7 engineering software for configuring a PCS 7 project is installed.

Connect an engineering station to the plant and terminal bus to download the configuration data to the PLC (OS, BATCH, Route Control, AS) and to test in process mode.



PC configuration options for the engineering station

The following PC configurations are possible for engineering stations in a PCS 7 plant:

- Engineering of a PCS 7 project on a single PC
- For small plants:
  - Combination of engineering station and operator station on a single PC
  - Combination of engineering station, operator station and automation system on a single PC. This solution is offered as the SIMATIC PCS 7 BOX.
- For large plants - PCS 7 project engineering with multiple engineering stations:

Configure	Method	Note
With common server (standard office network)	The engineering stations of the individual project editors work on the multiproject in a PC network.	A project editor works on a single project on a local engineering station.
Without a common server	• The multiproject is saved on a central engineering station and the cross-project connections are created. • The individual projects are moved to distributed PCs for engineering. • When the projects are completed, they are copied back to the central engineering station and the cross-project functions are executed in the multiproject.	This method allows distributed engineering (for example, at several locations).

Additional information

- Section "Connecting network nodes to Ethernet (Page 69)"
- You can find detailed information about configuring engineering stations and installing the operating system and PCS 7 engineering software in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*.
- Manual *Process Control System PCS 7; SIMATIC PCS 7 BOX*.

6.2.2 Configuration of the operator stations

Overview

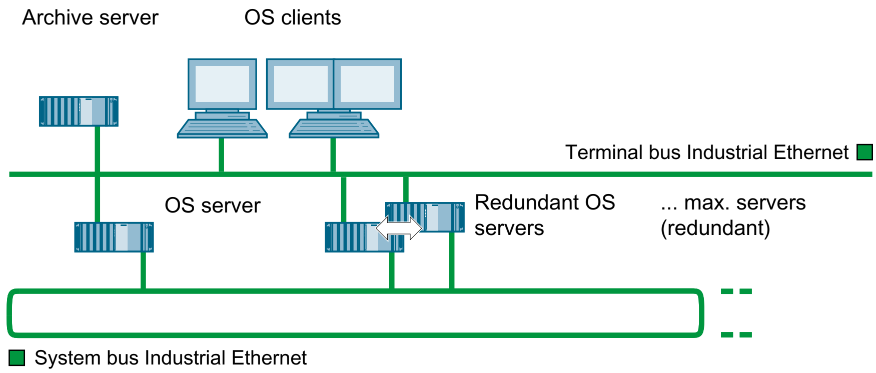
Operator stations are PCs on which the PCS 7 OS software is installed. The operator station is connected to the system bus to allow data communication with the automation system.

The architecture of the operator station is highly variable and can be flexibly adapted to a variety of plant sizes and customer requirements. The operator station can be configured as a single station or multiple station system with client-server architecture.

The OS server contains all the data of the operating and monitoring systems and the interrupt and measured-value archive. It establishes the communication connection to the automation systems. The OS servers make the process data available for the OS clients. The OS clients are used to operate and monitor the process mode. They access the data of one or more OS servers.

We recommend setting up a terminal bus (separate from the system bus) for data communication between OS clients and the OS server in multiple station systems. The process values archive can be stored on separate archive servers to improve performance.

To increase availability, operator stations can be set up redundantly.



Possible PC configurations for operator stations

The following PC configurations can be created for operator stations in a PCS 7 plant:

- OS as single station system on a single PC:
  The complete operator control and monitoring capability for a PCS 7 project (plant/unit) is located in one station. The OS single station system on the system bus can be used in parallel with additional single station or multiple station systems.
  Two OS single station systems can also be operated redundantly with the *WinCC/ Redundancy* software package.
  The operator station can also be used in combination with an engineering station and an automation system on a single PC. This solution is offered as the SIMATIC PCS 7 BOX.
- OS as a multiple station system with client-server architecture:
  The OS multiple station system consists of OS clients (operator stations) that are supplied with data (project data, process values, archives, alarms and messages) by one or more OS servers via a terminal bus.
  OS clients can access data on several OS servers simultaneously (multi-client operation).
  OS servers also feature client functions so that they can access data (archives, messages, tags, variables) on other OS servers. This allows process pictures on one OS server to be interconnected with tags on other OS servers (server-server communication).
  The *PCS 7 Server Redundancy* software package facilitates redundant operation of the OS servers.
  A maximum of 4 monitors can be connected to a station (OS client) using a multi-VGA card. Plant areas that have been split up in this way can be managed using 1 keyboard and 1 mouse.
- PCS 7 provides the option of using operator control and monitoring functions of the PCS 7 OS (single station or multiple station system) in process mode over the Internet or intranet. You can find additional informational on this in the section "Access to the PCS 7 OS via PCS 7 Web client (Page 99)" and in the manual *Process Control System PCS 7; Web Option for OS*.

Maintenance station (asset management)

An operator station (an OS area) can also be configured and used as a maintenance station. With the maintenance station, it is possible to call up information on the status of all PCS 7 components in hierarchically structured diagnostic pictures.

The maintenance station can be designed as a single station or multiple station system. The maintenance station (in the single station) or the MS client (multiple station system) is preferably operated on an engineering station.

Maintenance stations can also be configured redundantly to increase the availability.

You can find additional information on this in the section "Diagnostics with the maintenance station (asset management) (Page 641)" and in the manual *Process Control System PCS 7; Maintenance Station*.

PC station for long-term archiving (SIMATIC Process Historian)

SIMATIC Process Historian can additionally be used as an external archive server for long-term archiving in PCS 7.

The external archive server is a separate PC station that is a node on the terminal bus without connection to the system bus.

For additional information on this:

- Section "Configuring the SIMATIC and PC stations (Page 246)"
- System manual *SIMATIC; Process Historian Administration*
- System manual *SIMATIC; SIMATIC Information Server*

Additional information

- Section "Connecting network nodes to Ethernet (Page 69)"
- Section "How many operator stations are required? (Page 49)"
- You can find detailed information about configuring operator stations and installing the operating system and PCS 7 OS software in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*.
- Manual *Process Control System PCS 7; PCS 7 BOX*

6.2.3 Configuration of the BATCH stations

Overview

BATCH stations are PCs on which SIMATIC BATCH is installed.

The architecture of the BATCH station is highly variable and can be flexibly adapted to a variety of plant sizes and customer requirements. The BATCH station can be configured as a single-station or multiple-station system with client-server architecture.

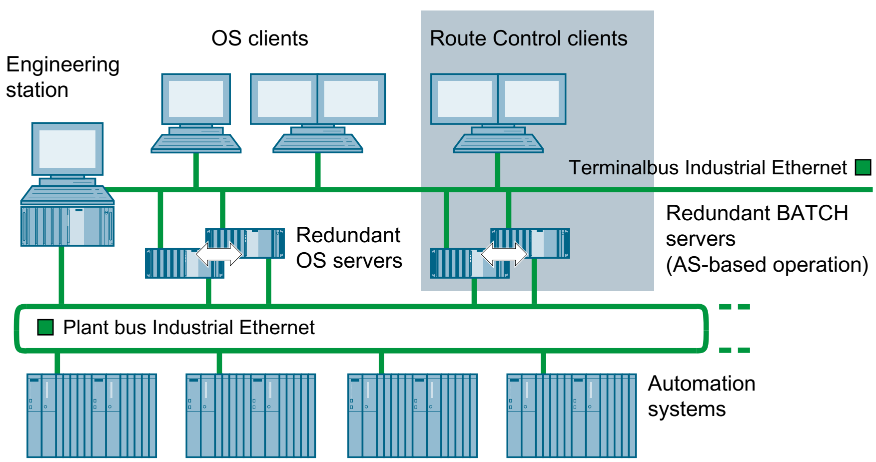
Typical batch process automation features one BATCH server and several BATCH clients that process the plant project together. BATCH servers can be configured redundantly to increase the availability.

BATCH servers and OS servers should always be operated on separate PCs. BATCH clients and OS clients can be operated on a common PC.

The communication of the BATCH station with OS and AS takes place depending on the type of operation:

- AS-based operation:
  Here, the BATCH station communicates with the operator stations via the terminal bus and with the automation systems via the plant bus. The BATCH station has a connection to each terminal bus and plant bus.
- PC-based operation:
  Here, the BATCH station communicates with the operator stations via the terminal bus. The BATCH station can only communicate with the automation systems via the operator station. The BATCH station only requires one connection to the terminal bus.

The following illustration shows a configuration with a BATCH multiple station system. The BATCH servers are in AS-based operation and possess a connection to the plant bus.



PC configuration options for BATCH stations

The following PC configurations can be created for BATCH stations in a PCS 7 plant:

- For small plants:
  - BATCH station and operator station as a single-station system on a single common PC
  - BATCH station separate from an operator station as a single-station system on a single PC
- For large plants:
  - BATCH station as multiple-station system with client-server architecture:
    It consists of one BATCH server and several BATCH clients (operator stations)
    BATCH clients and OS clients can be operated on separate PCs or on a common PC.
    BATCH servers can also be operated redundantly.
    A maximum of 4 monitors can be connected to a station (BATCH client) using a multi-VGA card. You can control all the plant areas that are split between the 4 monitors with a keyboard and/or a mouse.

Additional information

- You can find additional information about the configuration of BATCH stations and the installation of the SIMATIC BATCH software in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*.
- Manual *Process Control System PCS 7; SIMATIC BATCH*

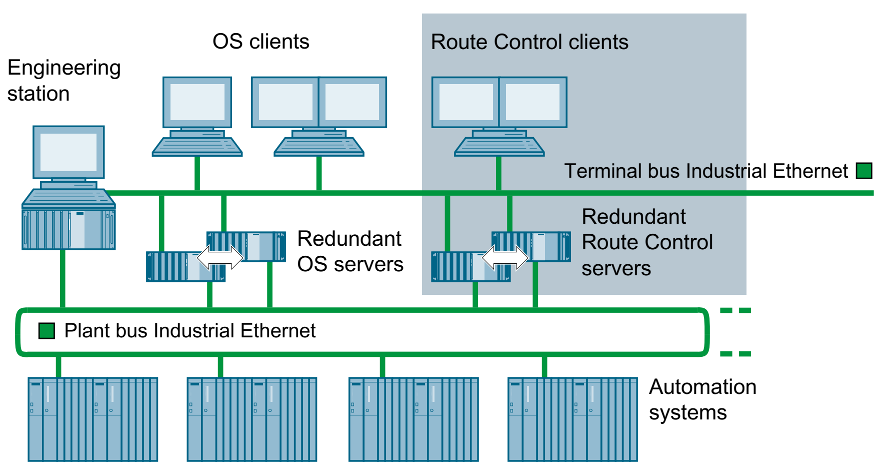
6.2.4 Configuration of the Route Control stations

Overview

Route Control stations are PCs on which SIMATIC Route Control is installed. Both the Route Control server and the Route Control client are connected to the terminal bus. The Route Control server is additionally connected to the system bus.

The architecture of the Route Control station is highly variable and can be flexibly adapted to a variety of plant sizes and customer requirements. The Route Control station can be configured as a single-station or multiple-station system with client-server architecture.

Typical route control features one Route Control server and several Route Control clients that operate the plant project in union. Route Control servers can be configured redundantly to increase the availability.



PC configuration options for Route Control stations

The following PC configurations are possible for Route Control stations in a PCS 7 plant:

- For small plants:
  - Route Control station and operator station as a single-station system on a single. common PC
  - Route Control station separate from an operator station as a single-station system on a single PC
- For large plants:
  - Route Control station as a multiple-station system with client/server architecture:
    It consists of one Route Control server and several Route Control clients (operator stations).
    Route Control clients and OS clients can be operated on separate PCs or shared PCs.
    Route Control servers can also be operated redundantly.

Additional information

- You can find detailed information about configuring Route Control stations and installing the operating system and SIMATIC Route Control software including the required license keys in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*.
- Manual *Process Control System PCS 7; SIMATIC Route Control*

6.2.5 Configuration of the OpenPCS 7 station

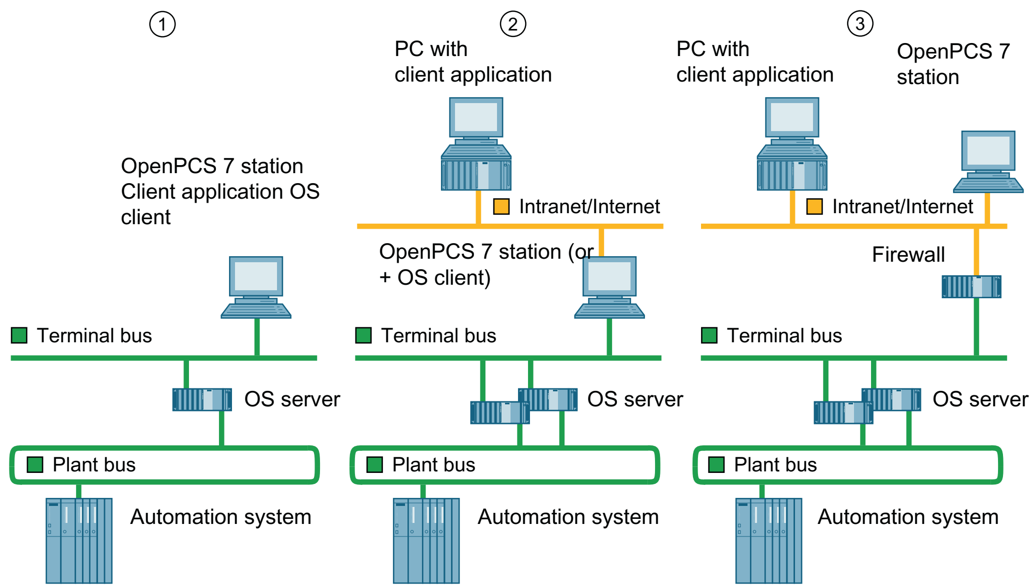
The OpenPCS 7 station is a PC on which servers for OPC or for OLE DB are installed. The architecture of the OpenPCS 7 station is variable and can be flexibly adapted to a variety of plant sizes and requirements.

The OpenPCS 7 station performs the following tasks:

- It provides the PCS 7 data of the automation process via the OPC or OLE DB interface.
- It allows the client applications (OPC or OLE DB) to access the provided PCS 7 data.

PC configuration options for the OpenPCS 7 station

The following PC configurations are possible for the OpenPCS 7 station in a PCS 7 plant:



No.	Configuration	Area of application
1	OpenPCS 7 station, OS client, and client applications (OPC or OLE DB) on a shared PC	Single station system: Recommended for small plants
2	OpenPCS 7 station and client applications (OPC or OLE DB) on separate PCs connected by an additional network (Internet/Intranet in the figure). With this configuration, the OpenPCS 7 station can also be installed on the following PC stations: • OS client • OS server • OS single station system	Multiple station system with client-server architecture: Recommended for medium-sized and large plants
3	OpenPCS 7 station and client applications (OPC or OLE DB) on separate PCs connected by an additional network (Internet/Intranet in the figure) and access the terminal bus of the PCS 7 plant protected by a firewall.	Multiple station system with client-server architecture: Recommended for medium-sized and large plants

Additional information

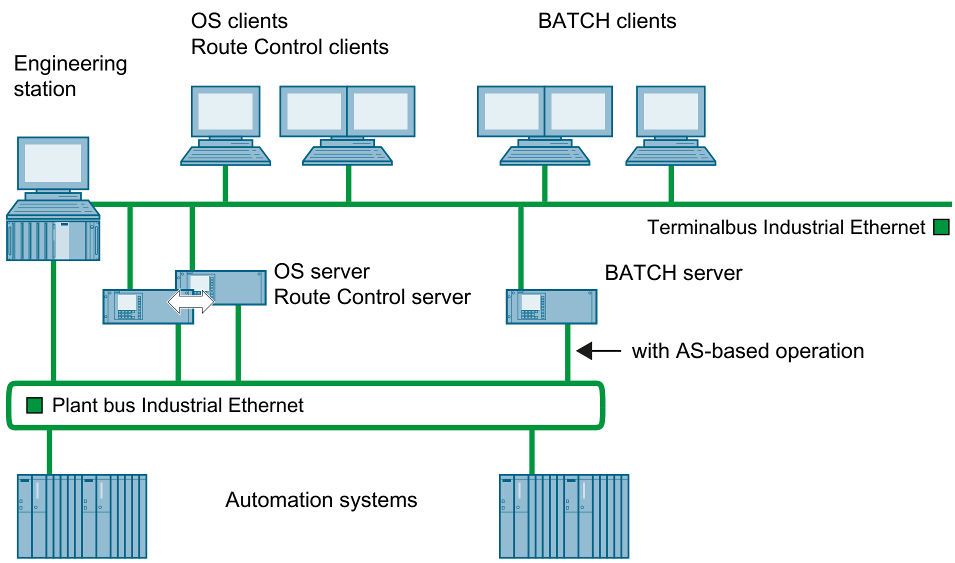
- Section "Connecting to the IT world via OpenPCS 7 (Page 97)"
- You can find information on installing the operating system in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*.
- *Process Control System PCS 7; OpenPCS 7* manual

6.3 Configuration of terminal bus and plant bus

6.3.1 Data paths via terminal bus and plant bus

Communication Paths

The following figure shows the communication paths and system bus using an example.



Legend for figure

Bus	Data communication or communication of the following processes	Communication between ...
Terminal bus	Download of the configuration data	Engineering station and the following stations: • Operator stations (OS server, OS clients) • BATCH stations (BATCH server, BATCH clients) • Route Control stations (Route Control server, Route Control client)
	Communication between the servers	• OS servers • BATCH servers (in PC-based operation) and BATCH relevant OS servers
	Transmission of data processed by the servers to the operator control and monitoring stations (clients)	• OS server and OS clients • BATCH server and BATCH clients • Route Control server and Route Control clients

Bus	Data communication or communication of the following processes	Communication between ...
Plant bus	Download of the configuration data	Engineering station and automation system
	Operating and monitoring of the processes	• Automation systems and OS Server, Route Control Server (CPU -> CP -> BUS -> network adapter (CP) -> O /RCS) • Optional: Automation systems and BATCH server (using BATCH servers in AS-based operation)
	Communication between automation systems (SIMATIC communication)	The automation systems (CPU -> CP -> BUS -> CP -> CPU)

6.3.2 Configuration of terminal bus and plant bus

Topology options

The system bus and terminal bus can be configured as follows:

- As Industrial Ethernet (10/100 Mbps and Gigabit)
- Bus, tree, ring, star or redundant ring structures

Information concerning Industrial Ethernet properties can be found in Section "Fields of application and parameters of the networks/bus systems (Page 60)".

Available SIMATIC NET components

	Purpose	Component of SIMATIC NET	Additional sections
PC (OS, BATCH, Route Control and ES)	Connection components for Ethernet	• CP 1613 • CP 1623 • CP 1628	Connecting network nodes to Ethernet (Page 69)
		• BCE with integrated Ethernet card	
		• BCE with desktop adapter network card	
AS	Connection components for Ethernet	• CP 443-1	
		• CPU with integrated Ethernet interface	

	Purpose	Component of SIMATIC NET	Additional sections
Connection path	Optical transmission path	• Glass fiber FO cable	
	Electrical transmission path	• ITP cable (Industrial Twisted Pair)	Planning the management level with Ethernet (Page 66)
		• TP cable (Twisted Pair)	Optical and electrical transmission media with Industrial Ethernet (Page 63)
		• Coaxial cable	
Network coupler	Optical and/or electrical transmission path	• SCALANCE X	Maximum transmission rate of the network / bus systems (Page 62)
	Electrical transmission path	• SCALANCE X	Planning the management level with Ethernet (Page 66)
		• Star coupler	Using switching technology with SCALANCE X (Page 67)
	Optical transmission path	• Media converter	Optical and electrical transmission media with Industrial Ethernet (Page 63)

Configuration of redundant buses

Information concerning redundant bus configuration can be found in Section "Configuring redundant Ethernet networks (Page 71)".

Additional information

Refer to the following documentation for additional information about network architecture, network configuration, network components and installation instructions:

- Product overview *Process Control System PCS 7; Released Modules*
  Contains the SIMATIC NET components which are enabled for a PCS 7 version
- Manual *SIMATIC NET NCM S7 for Industrial Ethernet*
- Manual *SIMATIC NET; Triaxial Networks*
- Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
- Operating Instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Configuration manual *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-400*
- Operating Instructions *SIMATIC NET; Industrial Ethernet Switches SCALANCE X-200*

6.4 Installation of the automation systems and connected I/Os

6.4.1 Configuration of the automation systems

Automation systems

The following automation systems can be configured by selecting hardware and suitable software:

Automation systems	Additional sections
• Standard automation systems	
• High availability automation systems (H systems)	Redundancy concept for PCS 7 (Page 52) Recommended use of components (Page 57)
• Fail-safe automation systems (F systems)	Operational reliability of PCS 7 (Page 54) Recommended use of components (Page 57)
• Fail-safe and high availability automation systems (FH systems)	Redundancy concept for PCS 7 (Page 52) and Operational reliability of PCS 7 (Page 54)

Available S7-400 components

Purpose	Components	Additional sections
Automation system	• AS 400H/F/FH	Overview of the automation systems (Page 105) Limits of the CPUs for PCS 7 Projects (Page 109) Default performance parameters of the CPUs for PCS 7 projects (Page 109)
High availability automation system	• AS 400H	Components for High availability automation systems (Page 111)
Fail-safe automation system	• AS 400F/FH	Components for fail-safe automation systems (Page 114)
Connection components for Ethernet	• CP 443-1 or • Ethernet interface of the CPU	Connecting network nodes to Ethernet (Page 69)
Connectivity device for PROFINET IO	• CPU 410-5H	Connecting PROFINET IO nodes (Page 358)
Connectivity device for PROFIBUS	• CP 443-5 Extended or • PROFIBUS DP interface	Connecting PROFIBUS DP nodes (Page 76)

SIMATIC PCS 7 Box PCs

The following SIMATIC PCS 7 Box PCs (PC bundles) with integrated AS are available for use in PCS 7:

- SIMATIC PCS 7 BOX RTX: BOX IPC with PLC WinLC RTX software
- SIMATIC PCS 7 AS RTX: MICROBOX IPC with PLC WinLC RTX software

The automation system integrated in this SIMATIC PCS 7 IPCs is a standard automation system.

Additional information

- Product overview *Process Control System PCS 7; Released Modules*
- Function manual *Process Control System PCS 7; High Availability Process Control Systems*
- Manual *SIMATIC Programmable Controllers S7 F/FH*
- Manual *S7-300 Fail-safe Signal Modules*
- Manual *Process Control System PCS 7; SIMATIC PCS 7 BOX*

6.4.2 Guide to the installation instructions for the products

Introduction

This section is an orientation for installation instructions in the individual product documentation.

Note

Information relating to **installation** in the project documentation manuals for SIMATIC components is also valid when PCS 7 is used. The few exceptions relating to installation are described in the section "Supplements to the installation instructions of the products for PCS 7 (Page 157)".

Information relating to **programming and parameter assignment** in the project documentation manuals for SIMATIC components is of limited validity when PCS 7 is used. PCS 7 offers many additional tools and functions. You should follow the procedures described in the section "Creating the PCS 7 Configuration" in this manual when programming and setting the parameters of the SIMATIC components.

Guide to the installation instructions

Components	**Information relating to installation can be found in the following product documentation (• Chapter ...)**
Communication	
Industrial Ethernet	Manual *SIMATIC NET; NCM S7 for Industrial Ethernet* Manual *SIMATIC NET; Triaxial Networks* Manual *SIMATIC Net Twisted Pair and Fiber-Optic Networks*
PROFINET IO	Manual *SIMATIC NET Industrial Ethernet/PROFINET Industrial Ethernet*
PROFIBUS	Manual *SIMATIC Net PROFIBUS Networks*
AS interface	Manual *SIMATIC NET; AS Interface – Introduction and Basic Information*
SCALANCE X	Manuals *SIMATIC NET; Industrial Ethernet Switches SCALANCE X*
CP 443-1	Device manual *SIMATIC NET; S7-CPs for Industrial Ethernet* *Part B4; CP 443-1*: • Installation and commissioning (steps 1 to 3)
CP 443-5 Extended	Device manual *SIMATIC NET; S7-CPs for PROFIBUS/Part B4; CP 443-5 Extended*: • Installation and commissioning (steps 1 to 2)
CP 1613 / CP 1623	Installation Instructions *SIMATIC NET; CP 1613* Operating Instructions (compact) *SIMATIC NET, CP 1623* Manual *SIMATIC NET; Time-of-day Functions of the CP 1613*
CP 1612	Installation instructions *SIMATIC NET; CP 1612*
CP 1512	Installation instructions *SIMATIC NET; CP 1512*
RS 485 repeater	Manual *SIMATIC; Diagnostic Repeater for PROFIBUS DP* • RS 485 repeater
PC stations	
PC stations (ES, OS, BATCH, Route Control, archive server, OpenPCS 7, PCS 7 BOX)	Manual *Process Control System PCS 7; PCS 7 - PC Configuration*: • Configurations • Configuration • Installation
Automation systems	
S7-400 (e.g. AS 41x)	Manual *SIMATIC; S7-400 Automation Systems; Configuration*: • Installing the S7-400 • Wiring the S7-400 • Commissioning Manual *Programmable Controller S7-400; CPU Data*: • Installation of a CPU 41x • Technical specifications

Components	Information relating to installation can be found in the following product documentation (• Chapter ...)
S7-400H (AS 41x-xH)	Manual *Process Control System PCS 7; High Availability Process Control Systems*: • High availability solutions in PCS 7 Manual *SIMATIC S7-400H High Availability Systems*: • S7-400H Installation Options • Getting Started • Installation of a CPU 41x-H • Using I/O on the S7-400H • Plant changes in runtime
S7-400F/FH (AS 41x-xH)	System Description *Safety Engineering in SIMATIC S7*: • Overview of fail-safe systems • Configurations and help with selections Manual *SIMATIC; S7-400 Automation Systems; Installation*:*Industrial Software S7 F/FH Systems; Configuring and Programming.* • Safety mechanisms Manual *SIMATIC S7-400H High Availability Systems*: • S7-400H Installation Options • Getting Started • Installation of a CPU 41x-H • Using I/O on the S7-400H
PCS 7 AS RTX	Function Manual *Process Control System PCS 7; SIMATIC PCS 7 BOX* • Installation of PCS 7 AS RTX • Commissioning and configuration of PCS 7 AS RTX
SIMATIC S7-mEC	Function Manual *Process Control System PCS 7; SIMATIC PCS 7 BOX* • Installation of PCS 7 AS RTX • Commissioning and configuration of PCS 7 AS RTX • Differences between SIMATIC S7-mEC and SIMATIC PCS 7 AS RTX
S7-400 Signal Modules	Manual *S7-400 Automation System; Module Data*: • Technical specifications
Distributed I/O	
ET 200SP HA	Manual *SIMATIC; Distributed I/O System ET 200SP HA* • Configuration options • Mounting • Wiring
ET 200M	Manual *SIMATIC; Distributed I/O System ET 200M* • Configuration options • Mounting • Wiring

Components	Information relating to installation can be found in the following product documentation (• Chapter ...)
S7-300 Signal Modules for Process Automation	Manual *SIMATIC; Distributed I/O System ET 200M; Signal Modules for Process Automation*: • Manual for hardware configuration and parameter assignment of components • Technical specifications
S7-300 Fail-safe Signal Modules	Manual *SIMATIC; Automation System S7-300; ET 200M Distributed I/O Device Fail-safe Signal Modules* • Manual for hardware configuration and parameter assignment of components • Technical specifications
S7-300 Signal Modules with Intrinsically-Safe Signals	Manual *SIMATIC; S7-300, ET 200M Ex I/O Modules*: • Manual for hardware configuration and parameter assignment of components • Technical specifications
FM 355 S FM 355 C	Manual *FM 355 and FM 355-2 Controller Modules*: • Controller settings • Installation and removal • Wiring
CP 341	Manual *SIMATIC; CP 341; Installation and Parameter Assignment*: • Basic principles of serial data transmission • Mounting • Wiring
ET 200iSP	Manual *SIMATIC; Distributed I/O Device ET 200iSP* • Configuration options • Mounting • Wiring and fitting
ET 200S	Manual *SIMATIC; Distributed I/O System ET 200S* • Configuration options • Mounting • Wiring and fitting
ET 200SP	Manual *SIMATIC; Distributed I/O System ET 200SP* • Configuration options • Mounting • Wiring and fitting
ET 200pro	Manual *SIMATIC; Distributed I/O System ET 200pro* • Configuration options • Mounting • Wiring and fitting
Compact Field Unit PA	Manual *SIMATIC; Distributed I/O System Compact Field Unit* • Description of the components • Installation • Wiring

Components	Information relating to installation can be found in the following product documentation (• Chapter ...)
PA-Link and DP/PA coupler	Manual *SIMATIC; Bus Couplers DP/PA-Link and Y-Link* • Description of the components • Installation • Wiring
Compact FF Link	Operating instructions *SIMATIC; Bus Couplers; Bus Link Compact FF Link* • Description of the components • Installation • Wiring
Y-Link	Manual *SIMATIC; Bus Couplers DP/PA-Link and Y-Link* • Description of the components • Installation • Wiring
Diagnostic repeaters	Manual *Diagnostic Repeater for PROFIBUS DP*: • Configuration options • Mounting • Wiring
DP/AS-i Link 20 E DP/AS-i LINK Advanced	Manual *SIMATIC NET; DP/AS I Link 20E* Manual *SIMATIC NET; DP/AS-INTERFACE LINK Advanced* • Description of the components • Installation • Wiring

6.4.3 Supplements to the installation instructions of the products for PCS 7

ET 200S diagnostics of load voltage failure

Note

The digital input/output modules of the ET 200S have no diagnostics in the event of load voltage failure. This means that when the load voltage supply fails no QBAD is reported on the channel drivers.

When there is no load voltage, outputs can no longer be switched by means of the application program or the last valid value is displayed at the inputs.

The following installation versions offer a remedy:

- Use digital input/output modules 24 V DC with power module PM-E DC 24 V:
  Because the entire station (IM 151 and power module) is supplied from one shared 24 V DC source, a failure of the power supply results in the failure of the station. This is reported in PCS 7 and causes passivation of all modules involved. All channel drivers are set to QBAD.
- Use of digital input/output modules with 120/230 V AC with power module PM-E AC 120/230 V:
  Monitoring of load voltage in the user program

6.4.4 Rules for Configuration in RUN (CiR)

Rules for DP slaves and PA slaves

Observe the following rules when configuring distributed I/Os using CiR:

- Plan for a sufficient number of junctions for spur lines or gaps when configuring the DP master system. Spur lines are not permitted for transmission rates of 12 Mbps.
- Terminate the PROFIBUS DP and PROFIBUS PA bus lines with active bus termination elements at both ends to ensure proper bus termination even while changing the configuration.
- We recommend that you install PROFIBUS PA bus systems using components from SpliTConnect product series to keep you from splitting up the lines.
- ET 200M stations and PA Links must always be installed with an active backplane bus. When possible install all the bus modules that will be required because the bus modules can not be installed and removed during operation.
- In ET 200M stations, you may only insert modules directly after the last installed module or remove the last module. Always avoid gaps between modules.
- Assemble the ET 200iSP stations fully with terminal modules and a termination module. Equip the ET 200iSP of the IM 152 with the required electronic modules right from the start. Install the reserve modules in the remaining slots right up to the termination module. Gaps between modules are possible only in a in high availability AS .

Rules for IO devices and PA slaves

Observe the following rules when configuring distributed I/Os using CiR or HCir:

- Plan for a sufficient number of junctions for spur lines or gaps when configuring the PROFINET IO system. Spur lines are not permitted for transmission rates of 100 Mbps.
- We recommend that you install PROFIBUS PA bus systems using components from SpliTConnect product series to keep you from splitting up the lines.
- In IO-Device stations, we recommend to insert modules directly after the last installed module or remove the last module.

Additional information

For differences between CiR and HCir, refer to the *Process Control System PCS 7; CPU 410 Process Automation* manual.

7 Basic concepts of engineering

Overview

Below you will find an introduction to the basic mechanisms of engineering with PCS 7. The functions of PCS 7 which offer efficient configuration are at the forefront:

- Central, plant-wide engineering (Page 162)
- Setup of projects with the PCS 7 wizard (Page 164)
- Distributed engineering (Page 169)
- Type definition, reusability and central editing of engineering data (Page 181)
- Import and reuse of plant data (Page 191)
- Free assignment between hardware and software (Page 193)
- Deriving the picture hierarchy and OS areas from the PH (Page 194)
- Generating block icons (Page 196)
- Generating operator texts (Page 196)
- Basic concepts of the PCS 7 message system (Page 198)

7.1 Central, plant-wide engineering

Central engineering with the SIMATIC Manager

The SIMATIC Manager is the central starting point for all engineering tasks.

The PCS 7 project is managed, archived and documented there.

All the applications of the engineering system are accessible from the SIMATIC Manager.

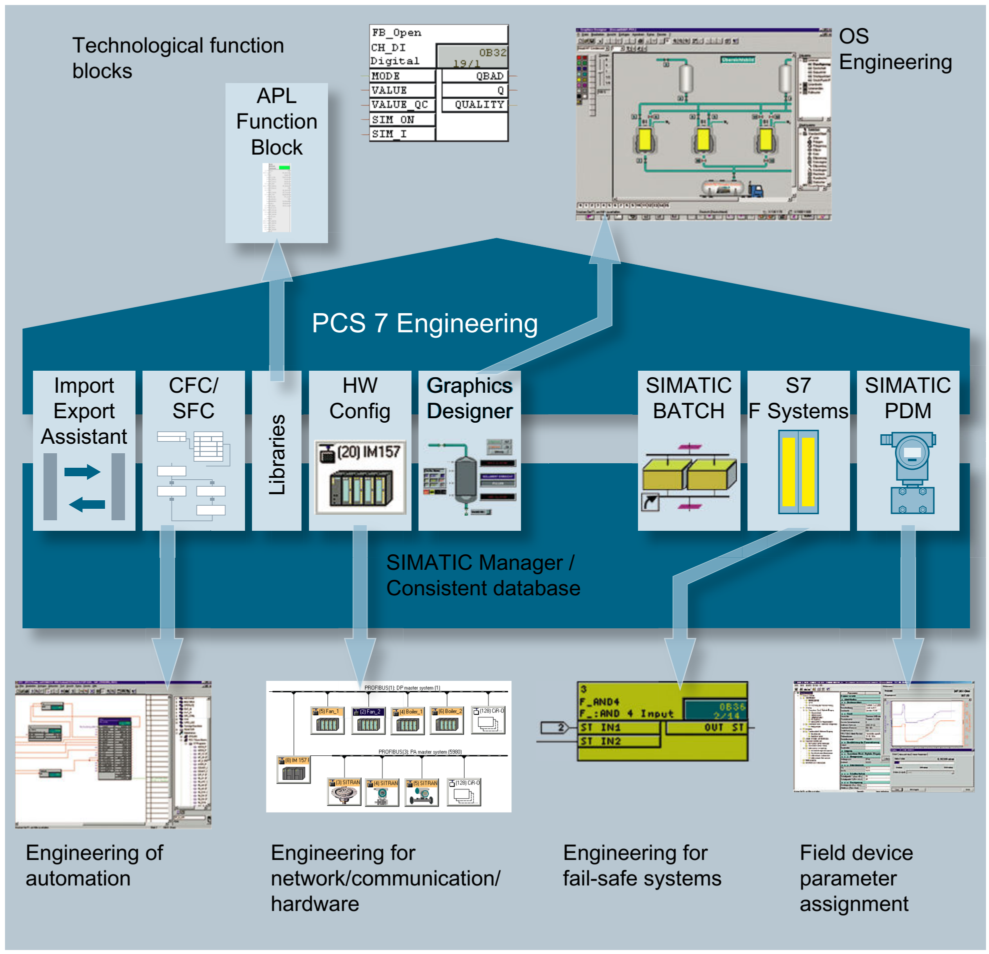
If there is a connection between ES, OS, BATCH, Route Control and AS, the configuration data can be transferred to the target systems from the SIMATIC Manager and then tested online.

Engineering system

The engineering system is structured on matching applications, facilitating the central, project-wide engineering of all the components on a PCS 7 plant:

- Configuration of the hardware and field devices (HW Config, SIMATIC PDM)
- Configuration of the communications networks (NetPro)
- Configuration of continuous and sequential process sequences (CFC, SFC)
- Configuration of discontinuous process sequences - batch processes (SIMATIC BATCH)
- Configuration of route controls (SIMATIC Route Control)
- Design of the operator control and monitoring strategies (WinCC Graphics Designer)

- Configuration of the alarm system (Configuring the PCS 7 message system, OS Project Editor, Alarm Logging)
- Compilation and downloading of all configuration data to the target automation system (AS), operator station (OS), maintenance station (MS), BATCH station (BATCH) and route control station



Integrated database

Thanks to the engineering system's integrated database, data which has been entered once is available throughout the system.

Additional information

- Section "PCS 7 applications and how they are used (Page 223)"

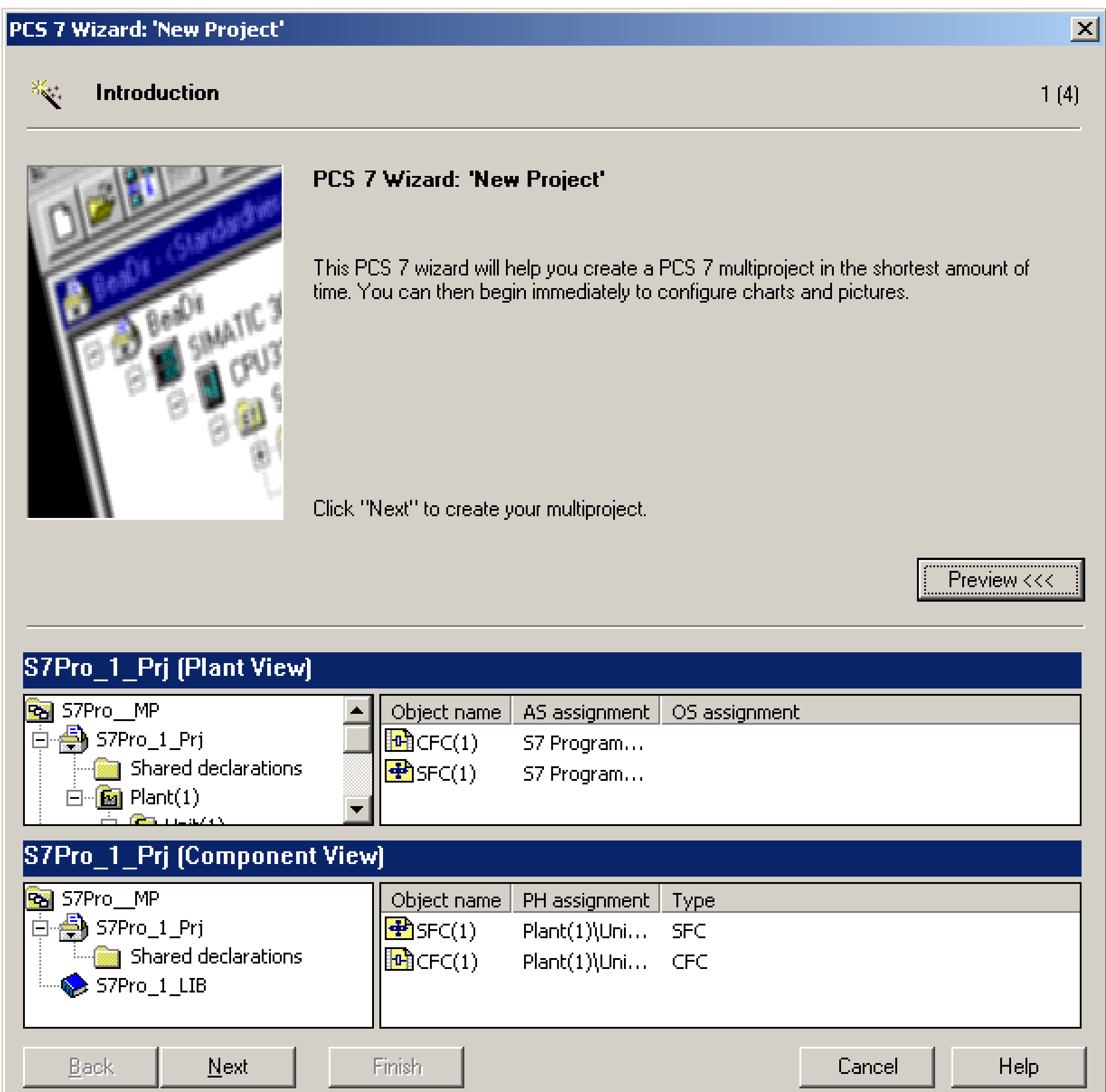
7.2 Creating projects and access protection

7.2.1 Setup of projects with the PCS 7 "New Project" wizard

PCS 7 "New Project" Wizard

The PCS 7 "New Project" wizard enables you to create a new PCS 7 project. You can create all the requisite objects automatically via dialog boxes.

Start the PCS 7 "New Project" wizard in the SIMATIC Manager.



In the following you can find out what benefits the PCS 7 wizard can offer you.

PCS 7 "New Project" wizard options

You can select the following via dialog boxes:

- Which CPU you wish to use
- Which AS objects (CFC, SFC) and OS objects (PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, OpenPCS 7) you wish to create
- Whether PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, or OpenPCS 7 should be a single station, multiple station or redundant multiple station system
- What you new project should be called
- Where the project should be stored (project path)

Check the structure of your project beforehand in a preview. Then start to complete the project.

Result

In multiproject engineering a multiproject containing a subordinate project is created in the SIMATIC Manager in accordance with the preview (see figure above). The preview is adapted in line with the selected settings and shows you the structure which has been created by the PCS 7 wizard.

There is also a master data created with the following content:

- in the plant hierarchy:
  separate folders for process tag types, models and shared declarations
- in the component view:
  an S7 program with the folders for source files, blocks and charts
  a folder for shared declarations

Additional information

- Section "How to create a new multiproject with the PCS 7 Wizard (Page 233)".

7.2.2 Expanding the projects with the PCS 7 "Expand Project" wizard

PCS 7 "Expand Project" Wizard

The PCS 7 "Expand Project" wizard enables you to expand an existing PCS 7 project to include further pre-configured SIMATIC 400 stations or SIMATIC PC stations. You can create all the requisite objects automatically via dialog boxes.

Start the PCS 7 "Expand Project" wizard in the SIMATIC Manager.

Options for inserting pre-configured stations

You can select the following via dialog boxes:

- Whether you wish to create a SIMATIC station and/or a PC station (without integrating hardware)
- Which CPU you wish to use
- Which AS objects (CFC, SFC) and OS objects (PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, OpenPCS 7) you wish to create
- Whether PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, or OpenPCS 7 should be a single station, multiple station or redundant multiple station system
- Where the project should be stored (project path)

You can check the structure of your project beforehand in a preview.

Result

An additional SIMATIC 400 station or SIMATIC PC station is created for OS/BATCH/Route Control/OpenPCS 7 in the selected project (in accordance with the preview).

Additional information

- Section "How to expand a project with pre-configured stations using the PCS 7 wizards (Page 237)".

7.2.3 Protecting projects/libraries with access protection

Introduction

We recommend that you protect your projects and libraries against unauthorized access and log all access actions.

Note

In order to use this functionality, SIMATIC Logon needs to be installed.

Access via project password

As of PCS 7 V7.0, you have the option of assigning a project password to provide access protection for projects and libraries. These projects and libraries can then only be opened and edited by Windows users with one of the following user roles:

- Project administrator
- Project editor
- Users who authenticate themselves using the project password

Setting up the authorizations

The project administrator defines the project editor and the project password. The administrator is entitled to activate and deactivate access protection.

The project administrator can assign Windows users to one of the two user roles.

Functions for setting access protection

You can make the following access-protection settings for each project or library in the SIMATIC Manager. Synchronization is possible across an entire multiproject.

Function	Description	Can be executed with user role
Activating access protection (including defining a project password)	• Activates access protection for a particular project or library This project or library may only be opened and edited by Windows users who are assigned the roles of project editor or project administrator. • Specifies the project password You can specify a project password for each project or library	Project administrator
Deactivating access protection	Deactivates access protection for a particular project or library	Project administrator
Managing users	Specifies the project administrators and project editors	Project administrator
Synchronizing access protection in the multiproject	Specifies the project administrators and project editors globally for all projects and libraries in a multiproject	Project administrator
Displaying the change log	Opens the change log	Project administrator Project editor
Removing access protection and change log	Removes the access protection and deletes the change log of a password-protected project or library	Project administrator

Change log

The following events can be logged, for example, in a change log when access protection is activated:

- Activating/deactivating/configuring access protection and change logs
- Opening/closing projects and libraries
- Downloading to target systems (system data)
- Operations for downloading and copying blocks
- Changing parameters in test mode
- Activities for changing the mode of the CPU (e.g. STOP of the CPU)
- CPU memory reset

You can have the change log displayed, add comments to it and export it.

Functions for setting the change log

You perform the following change log functions in the SIMATIC Manager.

Function	Description	Can be executed with user role
Activating the change log	Activates the change log for projects or libraries with access protection	Project administrator
Deactivating the change log	Deactivates the change log for projects or libraries with access protection	Project administrator
Displaying the change log	Displays the content of the change log. Comments can be added.	Project administrator Project editor

Additional information

- Section "How to provide projects/libraries with access protection (Page 239)"
- Section "How to document changes in the change log (Page 624)"
- Section "How to document changes in the ES log (Page 621)"
- Manual *SIMATIC Logon; SIMATIC Electronic Signature*
- Online help for *change log*

7.3 Distributed engineering

PCS 7 offers the following options for working with several project engineers:

- Configuring in a multiproject (Page 172)
- Branching and merging charts from a project (Page 176)

If the project data is located on a central server, it can be exchanged between engineering stations via the network (for example, a project-specific block library):

- Configuration in the network (Page 178)

7.3.1 Apply working methods in engineering

Multiproject engineering

You can use multiproject engineering if you wish to have several project teams work in parallel on complex projects. Multiproject engineering can be used to configure plants in a flexible and time-saving manner.

- For the configuration, divide the entire automation project (multiproject) into technological projects. Create the projects within a multiproject on a central engineering station. Make all shared objects available in the master data library. Projects and master data library are managed on the central engineering station.
- Engineers move the projects to other engineering stations for distributed configuration.
- Once the projects have been processed and returned to the multiproject, cross-project data can be synchronized with the support of the system.

Note

Using distributed engineering stations

- Only those project components (AS, OS) which are actually necessary for the respective editing should be moved to a distributed engineering station. This ensures that the other objects of the multiproject remain available for use.
- Only entire user projects can be moved to a distributed ES.

You can find additional information on this in the section "Configuring in a multiproject (Page 172)".

Branching and merging charts from a project

If it is necessary for several project engineers to work on an AS or OS, you can split the projects.

- The distribution within the project is made according to technological aspects (for example, unit with the relevant charts is copied to a different project).
  Existing cross-chart interconnections are automatically replaced with textual interconnections.
- To merge each project, the parts are copied back after the editing into the original project. Any charts with the same name are replaced following a prompt for confirmation. The textual interconnections are then reestablished.

Note

Use in multiproject engineering

This division option can be applied independent of the multiproject engineering or in addition to the multiproject engineering. In this case, the specific project can remain at its storage location. It is opened and edited by several engineering stations via a network.

In the context of multiproject engineering, the master data library forms the basis for working separately on the charts from a project.

You can find additional information on this in the section "Branching and merging charts from a project (Page 176)".

Configuration in the network (multi-user engineering)

If several project engineers are working from their engineering stations on one project that is available on a central server or on a PC with a shared drive, they can also work on specific parts of the project at the same time.

You can find additional information on this in the section "Configuration in the network (Page 178)".

Note

The central network server is an engineering station. If this engineering station is used only for project storage and not for configuration work, you do not need a license key for it.

7.3.2 Specifying the project structure for configuration

To edit an automation project as efficiently as possible, you need to consider the individual circumstances of the project and the existing engineering environment.

Specifying the design of the engineering project

Basically, you create an engineering project with a project-specific or station-specific design. In practice, a combination of the two is often the best option.

Remember to define the plant-specific conditions for the design of the engineering project. Examples for this are:

- Number of project engineers
- Number of available engineering stations (subject to compliance with the PCS 7 ES system requirements)
- Networking of the engineering stations
- Complexity of the project
- Duration/expense of the configuration

Project-specific design

In this scenario, each specific project contains, for example, one AS and one OS or all AS and OS that a project engineer should edit.

This is why both AS objects, such as CFC and SFCs, and OS objects, such as pictures and reports, are contained in the plant view of the project.

Advantages

- It can be configured and tested completely with AS and OS in the project.
- The mode of operation is the same during configuring and commissioning.
- Complete plant units can be copied, including update of the OS objects.
- There is a uniform view in the plant hierarchy that includes the AS and OS in a single project.

Note

Points to note

- Detailed know-how of the sequence steps is required to implement a distributed organization (removal of specific AS or OS from a single project) at a later date.
- The project should be structured as specifically as possible from the start.

Station-specific design

In contrast to the project-specific design, all AS and OS in this case are stored separately (distributed) in individual projects.

There are therefore no OS objects in the AS project, and no AS objects in the OS projects.

Advantages

- The distributed structure ensures maximum flexibility in the assignment of the individual projects to the project engineers and also offers the best performance in editing speed.
- Engineering stations can be added or removed during commissioning, allowing a quick response to changes in staff availability.

Note

Points to note

- Tests of AS and OS during the configuration are executed on separate computers (insofar as distributed stations are available).
- Parts of the plant hierarchies (PH) of individual projects that have been kept redundant have to be updated again after the editing.
- It is not possible to copy complete plant units including the update of the OS objects.

7.3.3 Configuring in a multiproject

Introduction

The multiproject functions of SIMATIC PCS 7 are based on the permanent availability of all included projects. If a permanent network connection is not available, the single projects should be removed from the multiproject network for distributed editing. Reasons for this are, for example, that not all PC stations are permanently available in the network or that the projects are purposely edited outside the network (contract award to engineering office/system integrator, for example).

The removal or reintegration of the individual projects is performed via the following system functions:

- Remove for editing
- Reapply after editing

Advantages

- No unexpected delays or waiting periods occur because of missing projects.
- During the distributed editing, the project cannot be accidentally accessed (for example, by the execution of cross-project functions).

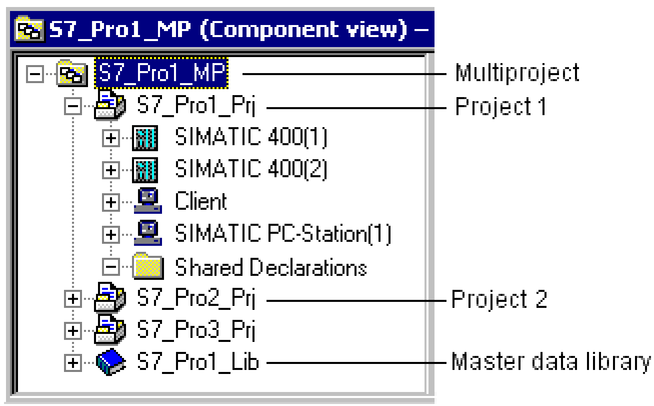
Points to note:

- In working with NetPro, already configured connections can generate warning messages owing to the missing communication partners. For the duration of the project splitting, new connections can only be created unspecified via references.
- Long waiting periods can occur if one of the included components cannot be reached, for example during the opening of the multiproject or while working with NetPro.
- For the compilation of an OS server, all relevant projects (AS projects and corresponding OS projects) must be assembled in a central location.

- The master data library must be managed as local backup.
- The individual projects must be archived locally.

Structure of the multiproject

The multiproject is a structure at a level above the projects within the SIMATIC Manager. It comprises all the projects, the master data library, as well as the subordinate objects (AS, OS, programs, charts, etc.) for an automation solution.



Rules for distribution to the projects

Split the automation solution in such a way that all the automation systems and operator stations which **one** project engineer has to edit are contained in a single project. The following rules apply:

- A project in a multiproject may only be edited by one project engineer at any given time.
- The smallest possible unit of a project is an AS or an OS.
- Only complete projects may be moved to a distributed engineering station.
- Move objects (AS, OS) to a distributed engineering station only in the form which is actually necessary for editing. This means that all other objects within the multiproject are available for editing on the central distributed engineering stations.
- An OS server must contain all the plant hierarchies of the automation systems assigned to it.
- The respective communication partners must be available for cross-project actions. Examples of this include the configuration of a SIMATIC connection or OS compiling.
- System performance is highest if the project parts relevant for each project engineer are available locally on the distributed engineering station.

Rules for multiproject engineering with SIMATIC BATCH

NOTICE
Rules for distributed engineering on distributed engineering stations For multiproject engineering with SIMATIC BATCH, distributed engineering on distributed engineering stations including testing is only possible when certain conditions are met and the additional steps are taken. You can find additional information on this topic on the Internet (https://support.industry.siemens.com/cs/ww/en/view/23785345).

Rules for the external archive server in multiproject

Note

Only one external archive server (Process Historian) can be configured in a multiproject.

When using a redundant Archive Server, there may only be one PC station for the Archive Server itself in the multiproject and one more for the redundant PC station of the Archive Server.

After the distributed projects of a multiproject have been merged, no more than one external Archive Server may be present in the multiproject.

Operating-system requirements

Note

Please note the following:

- In distributed engineering for large projects, one of the server operator systems which are approved for PCS 7 in the existing version must be installed for work in the network on the **Central engineering station**.
- The **distributed engineering stations** can use one of the operating systems that are approved for PCS 7 in the existing version.
  You can find additional information about approved operating systems in the document *PCS 7 Process Control System; PCS 7 Readme*.

Recommended procedure at a glance

To enable you to work successfully with the multiproject, familiarize yourself with the multiproject in the section "Working with projects in the Multiproject" on the online help for *STEP 7*. We recommend the following procedure for working with PCS 7.

Step	Description
1	Create the multiproject with a project and the master data library on the central engineering station (using the PCS 7 "New Project" wizard).
2	Insert further projects and store the multiproject master data on the central engineering station.
3	Move the projects, which are contained in the multiproject, and the master data library to the distributed engineering stations.
4	Distributed editing of the projects
5	Moving the distributed projects back to the central engineering station
6	Executing cross-project functions on the central engineering station

Note

While cross-project functions are executed, all the projects involved must be physically present in the multiproject on the central engineering station, and they may not be being worked on.

In accordance with this procedure, the configuration process is also described in the section "Conducting the PCS 7 Configuration".

Re. step 3 - Recommended time for moving for the purposes of distributed editing

There is no particular point in time at which the projects should be moved to the distributed engineering stations. We recommend that you at least execute the following steps on the central engineering station **beforehand**:

- Create the multiproject with the individual projects
- Create the AS and PC stations for OS, BATCH, Route Control and OpenPCS 7 below the individual projects
- Create the structure of the plant hierarchy
- Compile the master data library with the objects which have to be used jointly in the projects

In accordance with this procedure, the configuration process is also described in the section "Conducting the PCS 7 Configuration".

Re. step 6 - Cross-project functions

The cross-project functions ensure that you can handle a multiproject virtually like a single project in the SIMATIC Manager. This allows you to archive the multiproject along with all the projects and master data library, for example, or to save it in a different location.

In addition, there are cross-project functions which, after distributed editing, ultimately have to be executed in the multiproject on the central engineering station. They include:

- Merging cross-project subnets and connections to textual references
- Configuring the new cross-project (S7) connections between AS and OS
- Compiling all the components contained in the PCS 7 plant (AS, OS, BATCH, Route Control, etc.) and downloading them automatically to the CPUs in the correct order
- For each OS client: Downloading server data from all corresponding OS servers
  The download of the server data is performed only once. Thereafter, the server data is updated automatically every time an OS client is started in process mode.
- Creating/updating block icons
- Creating/updating the diagnostic screens

Note

While cross-project functions are executed, all the projects involved must be physically present in the multiproject on the central engineering station, and they may not be being worked on.

Additional information

- Section "How to expand the multiproject by adding new (empty) projects (Page 235)"
- Section "How to expand a project with preconfigured stations using the PCS 7 wizards (Page 237)"
- Section "Introduction to distributing the multiproject (multiproject engineering) (Page 306)"
- Section "Merging projects after distributed editing (multiproject engineering) (Page 569)"
- Section "Additional PH functions in a multiproject (Page 275)"
- Online help for *STEP 7*

7.3.4 Branching and merging charts from a project

Branching project charts

Branching and merging in projects involving several project engineers is also possible at chart level (S7 program). The distribution within the project is made according to technological aspects (for example, unit with the relevant charts is copied to a different project). Existing cross-chart interconnections are automatically replaced with textual interconnections.

On completion of editing, the parts are copied back into the original project. Any charts with the same name are replaced following a prompt for confirmation. The textual interconnections are then reestablished.

Use in multiproject engineering

Note

This division option can be applied independent of the multiproject engineering or in addition to the multiproject engineering.

In the context of multiproject engineering, the master data library forms the basis for working separately on the charts from a project.

Recommended procedure at a glance

Step	Description
1	Copy a technological part of the project (individual chart, several charts) to a different project. **Result**: The copy contains textual interconnections to all the sources that do not lie within the copied sections.
2	Edit the copied section separately (add, delete, modify blocks and charts).
3	Copy the edited technological section back to the original project. **Result**: The system first deletes the charts with the same names from the original project. There are textual interconnections in all the charts which await data from the deleted charts. Thereafter, the system copies the charts from the other project.
4	Close all the textual interconnections. **Result**: The interconnections are closed in the charts that were edited in the other project and copied back to the original project as well as in charts in which textual interconnections arose as a result of deleting charts.

Note

Always copy the charts in the component view.

If you copy a chart in the plant view, a copy of the chart in the target folder is created instead of being replaced.

Rules for editing on distributed engineering stations

- In the case of permanent network availability, project parts can be moved for editing to the distributed engineering stations and nevertheless remain simultaneously in the multiproject.
- At the project end, the project engineer must be ensured access to the components of the multiproject at all times.
  The following are examples of required, functional components:
  - Network connections (for example, consider limitations due to the operating system)
  - Network components (for example switches, routers)
  - PCs (including the necessary approvals and permissions)

Advantages

- An OS server can be compiled with the data from automation systems of other projects at any time.
- All used program parts are contained in the master data library, which can be accessed via the network.
- Simple archiving of the entire project including all distributed single projects is possible on the engineering server.
- A largely distributed station project structure and its distributed organization is the configuration option that promises the highest performance in cases where there is permanent network availability.

Points to note

- If, contrary to expectation, a project is not available in the network, this can lead to long delays and waiting times.
- In executing cross-project functions, the project engineers must coordinate with each other to ensure that work in not being carried out at that time on one of the included projects. Otherwise, conflicts can arise.

Additional information

- Section "Configuration by several users (textual interconnections) (Page 427)"

7.3.5 Configuration in the network

Application

If several project engineers are working from their engineering stations on one project that is available on a central server or on a PC with a shared drive, they can also work on specific parts of the project at the same time.

The following scenarios are possible in multi-user engineering:

- Several project engineers working on the CFCs or SFCs of an AS:
  - Editing different charts from different chart folders.
  - Editing different charts from the same chart folder.
  - Working on the same chart.

Note

The central network server is an engineering station. This ES can be used as follows:
- As project storage only In this case, you do not need License Keys on this ES.
- For configuration in the project. In this case, you need License Keys on this ES.

- Several project engineers working on the following objects of an operator station:
  - Edit various process pictures of an OS.
  - Edit various reports of an OS.
  - Edit various scripts of an OS.

Edit different charts from different chart folders

Different charts from different chart folders can be edited separately by several project engineers on different engineering workstations. In this scenario, the work performed by individual engineers generally does not conflict with the work of others.

Edit different charts from the same chart folder

Different charts from the same chart folder can be edited separately by several project engineers on different engineering workstations. It is unlikely that work performed by one engineer conflicts with the work of others. However, conflicts cannot be completely ruled out, since all charts access the same resources such as the symbol table, run sequence, etc..

The following conflict situations can occur:

- If one project engineer makes changes offline and other project engineers are working in test mode, when they next enter test mode, the engineers receive the message that the chart must be recompiled and loaded into the target system. The project engineer is now responsible for deciding whether or not to activate the test mode. This may make more or less sense depending on the offline changes; project engineers should come to agreement in this regard.
- If, following the message that the data is being used by another application, a value for monitoring is logged on or off in test mode, this is not stored in the session log. The next time that test mode is started, the logging on or off must be repeated.
- If the values monitored in test mode are no longer updated as a result of offline changes (e.g., because a block was deleted), the system displays "#" characters on a red background at the corresponding connections instead of the values.
- Any compilation initiated by an project engineer while another engineer is editing parameters in test mode will be rejected with a message stating that the data is currently in use by a different application (access conflict).

Working on the same chart

Mutual interference may occur when several project engineers work on the same chart. **This procedure is therefore not recommended**. If a chart has already been opened by a project engineer, each additional project engineer will be informed of this when opening this chart.

Behavior for different actions

As a basic rule, in the event of an access conflict, the action with the highest priority is always executed. In this case, the lower priority action is canceled. A short read action has a low priority, and all other actions have a higher priority.

Type of action	Read/write action	Response
Short read actions (with no resource allocation) are:	• Open charts • Open run sequence • Open dialog boxes	If additional short read actions are executed in parallel, no conflicts should occur. If a short or long write action is executed in parallel, this can lead to an access conflict, in other words, the short read action is canceled.
Short write actions (with no resource allocation) are:	• Instantiation, parameterization, interconnection, etc. • Close dialog boxes with OK	If a short or long write action is executed in parallel, this can lead to an access conflict for whichever action was started later.
Long read actions (with resource allocation) are:	• AS-OS data transfer (OS compilation)	If an access conflict does not occur immediately when the long read action is triggered, for example, because a write action is already being executed in parallel, this action is executed with no access conflict.
Long write actions (with resource allocation) are:	• Optimizing the run sequence • Compile • Download	If an access conflict does not occur immediately when the long write action is triggered, e.g. because a write action is already being executed in parallel, this action is executed with no access conflict.

Additional information

- Section "Configuration by several users (textual interconnections) (Page 427)"
- Online help on *CFC*

7.4 Type definition, reusability and central editing of engineering data

Introduction

Plant engineering gives rise to plant parts, functions or program sections which only differ from one another in a few respects.

In the interests of working efficiently, create basic elements (units, program sections, etc.) which can be reused repeatedly and which only have to be supplied with the current parameters.

Possible basic elements for reuse

Basic elements	Description
Block type (Page 182)	A block type is a program section that can be inserted into a CFC. A block instance is created. Block types are located in the PCS 7 Advanced Process Library. It contains blocks for activating a motor or valve, for example. You can also create your own block types or adapt block types from the PCS 7 Advanced Process Library in line with the needs of your plant.
SFC type (Page 183)	An SFC type is a sequential controller which can be configured in the SFC and inserted into a CFC. An executable SFC instance is created.
Process tag type (Page 185)	A process tag type is a CFC (which may also contain SFC types) which is configured for a specific process control function for the basic automation of a process engineering plant. Process tags can be created from process tag types using the Import/Export Assistant (IEA) or in the CFC editor.
Control module type (Page 471)	A control module type is a CFC (which may also contain SFC types) which is configured for a specific process control function for the basic automation of a process engineering plant. Using the Advanced Engineering System or the CFC Editor, instances, the control modules, can be created from the control module type. A control module type has the following advantages compared to a process tag type: • Instance-specific changes to the instance, the control module, are not lost during synchronization of type and instance. • The control module type can include optional blocks. When instances (control modules) are created, you can determine which of these optional blocks should be inserted into each instance.
Model (Page 187)	A model may comprise even larger units, such as a sub-plant. It consists of hierarchy folders with CFC/SFCs, pictures, reports and additional documents. Replicas can be created using the Import/Export Assistant (IEA).

Project-specific catalog profile

A project-specific catalog profile can be created using the supplied hardware catalog (in HW Config: PCS 7_Vx.y).

Configure the hardware efficiently using the catalog profile which is adapted to suit your needs. You can find additional information about this in the section "Defining a project-specific catalog profile (Page 316)".

7.4.1 Using block types, faceplates and block icons

Block type

Block types are precompiled parts of programs used to process recurring functions which can be inserted in CFCs. The block type creates a block instance to which you can then assign parameters and can interconnect. The block type determines the characteristics for all the instances of this type.

You can adapt block types to your project requirements, e.g. adapt operator texts or make parameters visible/hidden. To ensure that there is only one version of a block type used throughout a project, store all the block types centrally in the master data library (Page 188) and adapt them prior to instantiation.

Note

Store the block types in the master data library. This means that you can be sure that only one version of a particular block type (with a type name) is used throughout the entire project.

Different versions of blocks in different programs can lead to conflicts if the programs are to be controlled and monitored by one OS. This happens if variables of the same block type (identical type name) possess the same structure.

Possible block types

The following block types can be stored in the master data library:

- Blocks types from the control system libraries
- Block types from the libraries of suppliers
- User-created block types from CFCs

Centralized configuration

If the interface description and/or system attributes of a block type are changed, and it is imported into the CFC data storage system, it overwrites (updates) an existing block type of the same name. All the block instances of this type are also changed to correspond to the new block type.

The central type modifiability relates to FBs and FCs.

Before the central change is executed, a warning appears referring to the consequences and containing information about the old and new block types, for example name, date of the last interface change.

Changing the type centrally can have an unwelcome impact upon block instances. Interconnections and parameter-assignments can be lost. In this case you have to adapt the corresponding block instances yourself.

Central type modifications are logged, and this log is displayed automatically after updates. You can also call up this log at a later point in time via the menu command **Options > Logs: Block Types....** If block instances need to be adjusted, the log help to minimize the workload and the risk of error.

Type/instance concept - central configuration

The advantage of the type-instance concept is the capability of centralized modification. This enables subsequent changes to be made centrally to the block type, SFC type, process tag type and model and then to be applied to all instances and replicas.

Note

Refer to the online helps for the *CFC*, *SFC* and *IEA* to find out which type changes the instances and replicas support.

Faceplates and Block Icons

Controlling and monitoring a block instance in process mode on the OS requires a corresponding faceplate. The faceplate contains the graphic representation of all elements of the technological block intended for operator control and monitoring. The faceplate is depicted in a separate window in the OS and is opened via a block icon (typically placed in the OS overview display).

There is a *faceplate* for every technological block type in the *PCS 7 Advanced Process Library*. Block icons are generated automatically by means of a menu command. You can also create and adapt faceplates and block icons yourself.

Additional information

- Section "How to adapt blocks to specific projects (Page 290)"
- Manual *Process Control System PCS 7; Advanced Process Library*
- Manual Process Control System PCS 7; *Programming Instructions for Blocks*
- Online help on *CFC*

7.4.2 Use of SFC types

SFC type

SFC types allow sequential control systems to be defined as reusable templates. An SFC type is a sequential control system which can be configured in the SFC editor and inserted into a CFC. An executable SFC instance is created. SFC instances appear in the CFC as blocks with an interface corresponding to the block instances.

To run an SFC instance, both the SFC type and the SFC instance must be compiled and downloaded into the automation system.

To ensure that only one version of an SFC type is used throughout a project, store all SFC types centrally in the master data library (Page 188) and adapt them prior to instantiation.

You can define characteristics (control strategies, setpoints, parameter, note texts, position texts, etc.), for SFC types which can be used in the sequencers. A control strategy is specified by operation or by a higher-level controller (e.g. SIMATIC BATCH).

Note

You cannot assign SFC types to a hierarchy folder in the plant view because they are not relevant to execution.

Possible SFC types

You can also store the following SFC types, for example, in the library/master data library:

- User-created SFC types
- SFC types from the SFC library

Centralized configuration

Modifications to the interface of the SFC type are transferred to the SFC instances.

The following changes take effect automatically in SFC instances following the compilation and downloading of the AS.

- Change to the topology (step/transition sequence, changed jump target)
- Change to the step configuration
- Change to the transition configuration

The SFC visualization is only updated following the compilation and downloading of the OS.

Additional information

- Section "How to create an SFC type (Page 506)"
- Manual *SFC for S7; Sequential Function Chart*

7.4.3 Using process tag types

Process tag type

A process tag type is a CFC (which may also contain SFC types) which is configured for a specific process control function for basic automation, such as fill-level control, which occurs repeatedly in the PCS 7 plant. A number of process tags can be copied from a process tag type in one operation with the aid of the Import/Export Assistant on the basis of an import file. The process tags are then adapted in line with the requisite, specific automation task and interconnected accordingly.

Store the process tag type centrally in the master data library (Page 188). Adapt the process tag type before deriving process tags.

Sources for process tag type

The following process tag types can be stored in the master data library:

- Templates from the *PCS 7 Advanced Process Library*
- Standardized process tag types from the control system libraries, for motors, valves, PID controllers, for example.
- User-created process tag types from CFCs

Generating the process tags

Process tags can be created from process tag types during import with the Import/Export Assistant. Each line in an import file creates a process tag in the target project. The process tags retain the assignment to the process tag type.

Centralized configuration

Changes are made to the process tag type via the "Create/modify process tag type" wizard. The changes made to the process tag type in the wizard are automatically synchronized with the existing process tags of this type in the project.

The following changes can be made to the process tag type using the wizard:

- Parameter, signal connection points and messages which are not present on the process tag type are deleted from the process tags. The corresponding attributes are reset.
- Parameter, signal connection points and messages which have been newly defined on the process tag type are added to the process tags. The corresponding attributes are set.
- Categories which have been changed on the process tag type are corrected on the process tags.

If the changes cannot be synchronized automatically, for example, because not all process tags of the project were available at the time of the automatic synchronization, the synchronization can be started again with a menu command in the "Update Process Tags" wizard.

Inconsistencies between the process tag type and the process tag which cannot be synchronized automatically are displayed in the log.

Note

Any changes made directly in the CFC of the process tag type are not applied to existing process tags of this type with the "Create/Modify Process Tag Type" wizard!

This includes the following changes:

- Add/remove blocks
- Interconnection changes
- Parameter changes

In this case, you must delete the affected CFCs beforehand and then perform a new import for the changed process tag type using the Import/Export Assistant.

You can no longer change the names of the blocks for an existing process tag type or for process tags derived from it. Otherwise, import/export is no longer possible.

Note

Ensure that all the projects are available in the multiproject for the synchronization of the process tags.

Using process tag types

'Fill-Level Control' process tag as a basis for creating a process tag type:

In the following example, the process tag is a CFC (with additional attributes) for signal acquisition, signal pre-processing, automation and operator control & monitoring of the fill-level control system function.

The CFCs consists of the following aspects:

- There is a fill-level sensor affixed to a boiler. It converts the fill level of 0 to 1500 l to a current of 4 - 20 mA.
- The signal cable is connected to a channel on an analog input module. The signal has a name which is listed in the signal list for your plant. This unconditioned signal is accessed by the automation blocks via the name of the signal.
- A driver block for inputting analog values (CH_AI) converts the unconditioned signal into a preprocessed signal (0 to 1500 l).
- A controller block (CTRL_PID) determines a manipulated variable of between 0 and 100 % from the setpoint and the actual value supplied by the fill-level sensor.
- A driver block for outputting analog values (CH_AO) converts the signal into the unconditioned signal and transmits it to an analog output module.

- On the analog output module a control is connected via a 4 - 20 mA current lead. The valve is closed at 4 mA and fully open at 20 mA. The valve is part-opened at values in-between.
- The controller block has the following elements in the OS:
  - A faceplate
  - Archive tags for setpoint and actual values
  - Alarms if the upper or lower fill-level limits are passed

Following completion of the test, a process tag type can be created with the Import/Export Assistant from the process tag which is defined in this way.

Additional information

- Section "Creating process tags from process tag types (multiproject) (Page 474)"

7.4.4 Using models

Model

Models are used to define more complex functions than process tag types (through to plant sections), and store these as reusable templates. A model consists of hierarchy folders with CFC/SFCs, pictures, reports and additional documents. A number of replicas can be copied in a single transaction from a model with the aid of the Import/Export Assistant on the basis of an import file. The replicas are then adapted in line with the requisite, specific automation task.

Note

You can only create models in a multiproject.

Store the models centrally in the master data library (Page 188). Adapt the model before creating replicas.

Creating replicas

The blocks for importing/exporting parameter descriptions, interconnection descriptions and messages are prepared in the charts for a model. After the model is linked to an import file, the model is imported with the Import/Export Assistant. The generated replicas are assigned the parameters, interconnections, and messages of the model.

Each line in an import file creates a replica in the destination project. The replicas retain the assignment to the model.

Centralized configuration

You can use the "Create/Change Model" wizard to make changes to models.

If you modify models or the I/O points of a model that already have replicas, a message is displayed indicating this since the import data no longer matches the model data.

Using the "Create/Change Model" wizard, check the consistency of the model with the assigned import file as well as the replicas for changes in the IEA identification.

Note

The block names may no longer be modified for an existing model or for a replica of a model. Otherwise, import/export is no longer possible.

Additional information

- Section "How to create a model (Page 518)"
- Online help for the *IEA*

7.4.5 Using the master data library

Master data library

When you use the PCS 7 Wizard to create a multiproject, a master data library is created automatically. The master data library is used for storage of the master data of the project for all projects of a multiproject. When you move projects from the multiproject to distributed engineering stations for editing, you must also transfer the master data library so that all project engineers have an identical database available.

The master data library helps you to ensure that a defined version of types is reused. The master data library is automatically archived together with the multiproject.

Contents of the master data library

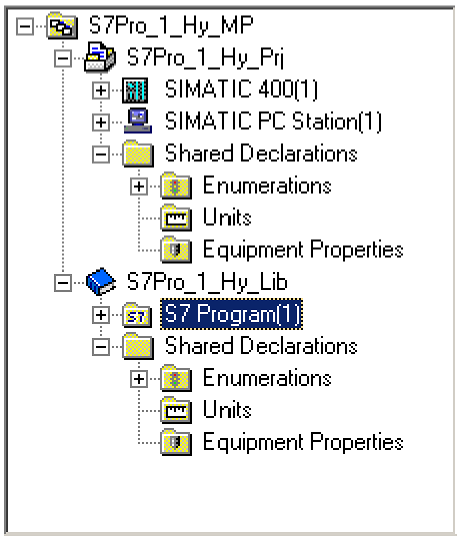
Those objects used in projects or those objects specially adapted for the projects are stored in the master data library. This includes, for example, the following elements:

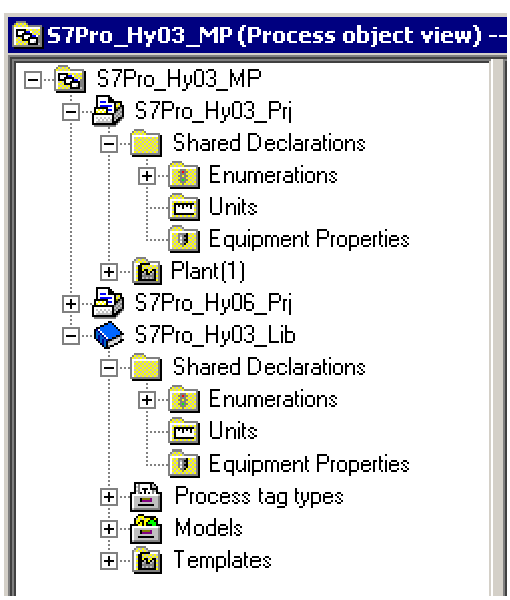
- Block types
- SFC types
- Process tag types
- Models
- OS pictures
- OS reports
- Shared Declarations (enumerations, units of measure, equipment properties)

In addition, the following objects can be included in the master data library.

- Objects from the *PCS 7 Advanced Process Library*
- Objects from libraries of suppliers
- User-created objects

The following figures show examples.





Additional information

- Section "How to create a master data library (Page 285)".

7.4.6 Using project-specific catalog profiles

Project-specific catalog profile

Depending on the process tag types, models, etc. that you save for specific projects in the master data library, you can create a project-specific catalog profile for the hardware configuration. This means that all project editors use the same hardware components. If you move the projects, which can be found in the multiproject, to the distributed engineering stations for editing, the project-specific catalog profile must be moved as well.

"PCS 7_Vx.y" hardware catalog

The basis for each project-specific catalog profile is the "PCS 7_Vx.y" hardware catalog in HW Config with the latest versions of all the modules and components which are approved for PCS 7.

Note

For additional information about the modules approved for use in PCS 7 and their versions, refer to the product overview *Process Control System PCS 7; Released Modules*.

Create a new catalog profile in HW Config and use drag-and-drop to move the required components from the "PCS 7_Vx.y" hardware catalog to the new catalog profile. You can assign any name to the catalog profile.

Additional information

- Section "Defining a project-specific catalog profile (Page 316)".

7.5 Import and reuse of plant data

Import/export interfaces

All the essential applications of the PCS 7 engineering system have import/export interfaces. The use of these import/export interfaces has the following advantages:

- Plant-planning data can be synchronized with control-system engineering data. This is how control system engineering and plant engineering can be independently edited at the same time.
- Data from the engineering system can be exported as a template, be effectively duplicated and adapted in an external program (such as MS Excel) and then be imported back into the engineering system. This allows you to optimize the configuration of recurring or similar plant information.

Note

You can find information on data exchange between PCS 7 and COMOS in the section "Overview of data exchange (Page 575)".

Import/export of plant data

What?	Import/export	Where?	Additional sections
Process tag lists or charts	You can import already configured plant data such as process tag lists or charts from the higher-level CAD/ CAE world into the engineering system and use these for the almost fully automatic generation of process tags, for example. You can export parameters which have been optimized with PCS 7 back into the CAD/CAE world.	Import/Export Assistant (IEA)	How to exchange data with MS Excel/Access (Page 595)
Hardware configurations	You can export hardware configurations from HW Config and continue to edit them externally on the basis of existing plant information. They are then imported back into the HW Config. The symbolic names of the inputs and outputs are also exported/imported.	HW Config	Importing/exporting the hardware configuration (Page 599)
Plant pictures	You can import existing plant pictures into the Graphics Designer for creating OS pictures (e.g. as background pictures). This applies to pictures which do not contain any dynamic screen elements.	Graphics Designer	Configuration manual *Process Control System PCS 7; Operator Station*
Project data	Control system project data which has already been configured can be exported from the engineering system to be synchronized with planning data in the CAD/ CAE world. Format of the export file: *.xml	SIMATIC Manager	Planning objects/functions for efficient engineering (Page 128)

Data formats for importing/exporting plant data

You can find additional information on importing and exporting plant data in the section "Importable data and data formats (Page 129)".

Further import/export functions

What?	Import/export	Where?	Additional sections
Process tag types (process tags)	A number of process tags can be created/updated with the aid of the Import/Export Assistant on the basis of a process tag type and an externally adaptable import file with process tag information.	Import/Export Assistant (IEA)	Creating process tags from process tag types (multiproject) (Page 474)
Models (replicas)	A number of replicas of the model can be created/updated with the aid of the Import/Export Assistant on the basis of a model and of an externally adaptable import file with parameters and interconnection information.	Import/Export Assistant (IEA)	How to create replicas of models (Page 523)
I/Os and messages	Texts which are of relevance to the operator and which are created in PCS 7 can be compiled outside PCS 7 (e.g. for plant operators in their mother tongue). Export the texts which are of relevance to the operator to a text file. The texts are compiled in an ASCII editor or MS Excel and then be imported back into PCS 7. Formats: *.tx" or *.csv When changing languages, you can select any of the languages which were specified during import into the project. • Change of language for "Title and Comments" - > only for the selected object • Change of language for "Display texts" - > for the entire project).	SIMATIC Manager	How to import/export blocks, I/Os and messages (Page 296)
Import/export of complete table contents	All the editable fields for parameters, signals and messages can be exported in the process object view. You can then edit them externally (e.g. change parameters and interconnections) and then import them again. Format: *.csv This means that existing plant parts or copied units, for example, can be supplied externally with changed parameter values and interconnections without having to use the Import/Export Assistant.	SIMATIC Manager	How to import/export blocks, I/Os and messages (Page 296)
Import/export of picture objects	Information relating to OS image objects (e.g., type of object or interconnection information) can be exported into a CSV file during OS configuration. You can then edit this information externally in MS Excel (e.g., change tag interconnections) and then import it back into WinCC.	WinCC Explorer: Graphic Object Update wizard	Configuration manual *Process Control System PCS 7; Operator Station*

7.6 Free assignment between hardware and software

Decoupling hardware and software configurations

The connection between hardware and software configuration can be based on the symbolic names of the signals.

- In HW Config, configure the hardware structure and assign the symbolic names for the inputs and outputs of the modules and the field devices set during the planning stage.
- You create the CFCs/SFCs for the process tags during the software configuration. You interconnect the inputs and outputs to and from the process with these symbolic names.

During compilation, hardware and software assignment takes place on the basis of identical symbolic names. The individual project engineers do not have to worry about system-internal addresses (absolute addresses, e.g. O 4.0, I 1.1).

Consequently, the configuration of hardware and software is decoupled. The software can be created before the hardware is defined, and vice versa. The CFC/SFCs only have to be assigned to the correct automation systems immediately prior to compilation and downloading.

Symbol table

PCS 7 can compile the symbolic names into the requisite absolute addresses provided the symbolic names have been assigned to the absolute addresses. This happens in PCS 7 during hardware configuration or when a hardware configuration is imported.

Example

For example, you can assign the symbolic name MOTOR_751_ON to the operand A 4.0 in the symbol table and use MOTOR_751_ON as an address in a source statement.

Recommendation for PCS 7

Work with symbolic names in PCS 7 projects. A symbolic name enables you to work with informative descriptions instead of absolute addresses. By combining short symbolic names and detailed comments, you will satisfy the need both to create an effective program and to provide good program documentation.

Symbolic names can also make it easier for you to tell whether the elements of the program match the components of the PCS 7 plant.

Additional information

- Section "How to assign symbols to input and output addresses (Page 325)".

7.7 Deriving the picture hierarchy and OS areas from the plant hierarchy

Derive picture hierarchy from the plant hierarchy

The OS picture hierarchy for the operator on the OS can be derived completely from the configured data of the plant hierarchy.

This involves inserting the pictures, which are meant to visualize the process for the operator, into the plant hierarchy (PH) in accordance with the configuration of your PCS 7 plant. You can insert one picture per OS for each hierarchy folder in the PH.

Inserting pictures in the plant hierarchy serves to create a picture hierarchy. Once the OS is compiled, the Picture Tree Manager has the same hierarchy for further editing.

Recommendation: Allow for the required picture hierarchy when you create the PH.

Requirement

Note

When you use the "OS Compilation" function, the structure of the plant hierarchy is only copied into the Picture Tree Manager if the option "Derive picture hierarchy from the plant hierarchy" is activated in the general PH settings in the SIMATIC Manager.

Deactivate this option once you have adapted the picture hierarchy in the Picture Tree Manager and if you do not wish to overwrite the picture hierarchy the next time you compile the OS.

Deriving OS areas from the PH

OS areas can be defined to reflect the plant structure which you have created in the plant hierarchy (PH). This means, for example, that in the case of large plants, you can assign operators to specific sections of the plant. In this case, plant operators only view and operate the areas in process mode for which they have user permissions. Only messages which are of relevance to this area are displayed.

In general, a unit within the PH corresponds to an OS area.

In the general PH settings you can decide which hierarchy level of the PH should count as the OS area. Define an area identifier for each hierarchy folder within this level. The default setting for the area identifier corresponds to the name of the hierarchy folder in the PH.

If you assign an area identifier to a hierarchy folder, the area identifier is also applied to all lower-level hierarchy folders and objects.

When the OS is compiled, the OS areas are transferred to the Picture Tree Manager for further editing. The hierarchy levels are always displayed in the Picture Tree Manager starting with the hierarchy level that has been defined as the OS area.

Recommendation: Take the required OS areas into consideration when structuring the PH, and specify the area identifiers.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*
- Online help *Help on PH, IEA and PO*

7.8 Generating the block Icons and operator texts

7.8.1 Generating the block icons

Generating block icons

Block icons are used for operator control and monitoring of plants or units in process mode. The block icons are required for block instances, which can be controlled and monitored, from the CFCs.

You can specify whether to create block icons for each of the process pictures on the PCS 7 OS and whether to store them in this process picture.

You can define the following settings in the plant view or in the process object view before compiling the OS:

- Select the "Derive block icons from the plant hierarchy" option for each process picture.
- If you select a "Multiproject", "Project" or "Hierarchy folder" object and then execute the "Create/Update Block Icons" function, the block icons are automatically inserted into the process pictures in accordance with the plant hierarchy and linked to the corresponding process tag.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*

7.8.2 Generating the operator texts

Generating units and operator texts

Faceplates, which display the following block information, are used to display the process to the operator in process mode.

- Measured values
- Operating limits
- Units
- Operator texts

These texts are already included in the block types you use for a CFC.

The unit and operator texts are only displayed in the language that is stored for the block types, irrespective of the current language selection.

The unit and operator texts for block types from the supplied libraries (for example *PCS 7 Advanced Process Library*) are only available in English.

You can change unit and operator texts (e.g. translate them into a different language) in the CFC in the properties for the block type or block instance.

Additional information

- Section "How to import/export I/Os and messages (Page 296)"
- Configuration manual *Process Control System PCS 7; Operator Station*

7.9 The PCS 7 message system

7.9.1 Basic concept of the message system

The PCS 7 message system

The PCS 7 message system informs the operator of events which occur in the process and control technology. The events are displayed individually to the operator in signal lists and via a group display on the PCS 7 OS (OS client). Operator actions are contained in another list.

Message classes

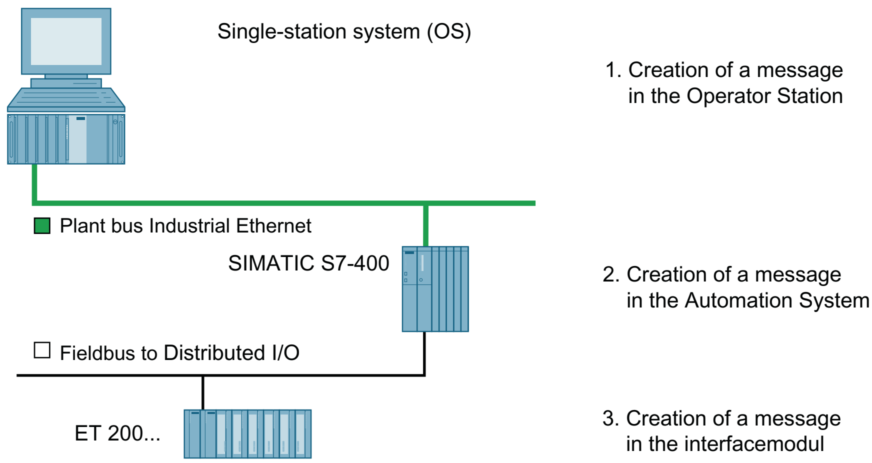
You can find the classes of the messages in the process control system below:

Message classes	Description
Process messages	Process messages indicate process events that take place in the automated process, such as limit value violations of measured values and operational messages. • Process messages are predefined for the blocks and therefore do not need to be configured. However, if necessary, message texts and a message priority can be changed in the CFC block object properties, centrally in the list of process objects or by means of import and export. • Operational messages are a subgroup of process messages. They signal process variables which serve to evaluate a technological variable, such as an elapsed-time counter.
	Note: When using the "User-configurable message classes" function, observe the information in section "User-configurable message classes (Page 203)".
Process control messages	I&C system messages are generated when SIMATIC PCS 7 detects and signals errors in its own components (AS, OS, etc.). Such errors range from failure of a component to a wire-break signal for a connected I/O module. Process control messages are generated by the driver blocks in PCS 7 and do not have to be configured.
Operating messages	Operating messages are generated when an operator controls process variables, for example, changes the operating mode of a controller. Operating messages are generated automatically when you use the faceplates which are provided by the PCS 7 libraries. If you configure faceplates according to the manual entitled *Process Control System PCS 7; Programming Instructions for Blocks*, PCS 7-compatible operating messages are also possible for your own blocks.

Origin of a message

Messages can originate in different locations within the control system depending on the configuration. The time stamp of the message is influenced by where it originates.

The illustration below shows an example with a distributed I/O, ET 200M.



Explanation of the picture

Events which originate in the AS (2) or in the ET 200... (3) are transmitted as individual messages to the OS via the system bus. The message is transmitted along with the corresponding time stamp. The messages appear in chronological order, with the time they occurred, in the signal lists of the OS.

The table below shows the places of origin and the allocation of the time stamp.

Place of origin	Configuration of the message text	Assignment of the time stamp	Messages
Operator station (OS)	In the "Alarm logging" editor in WinCC Explorer	In the operator station	Process control messages from the OS, linking non-S7 systems
Automation system (AS)	On the block types in the project library or on the block types within the CFCs	In the automation system	Process and control technology messages from SIMATIC stations
Distributed I/O (e.g. ET 200M)	On the block instances of the driver block within the CFCs	In the distributed I/O by the interfacemodul (if the high-precision time stamp is activated)	Selected events for initial value acquisition in the event of a plant failure

"Loop-in-alarm" function

Process and control technology messages from technological blocks which are visualized on the OS feature the "loop-in-alarm" function. You can use this function to select the faceplate for this process tag straight from the message list.

Help button

We can also configure the help button for the messages from the technological blocks. This can be activated as follows::

1. Open WinCC explorer
2. In the shortcut menu, select "Properties". The "Project Properties" dialog box opens.
3. Select the "Options" tab
4. Select "Help available in Runtime"
5. Click "OK"

Result

In the Runtime, when you click on the "incoming alarm list" button, you will see a help icon available.

7.9.2 Configuring messages

Configuring for Operator Station (OS)

New messages and the corresponding message text can be configured for the operator station in "Alarm Logging" (WinCC Explorer). There you can also specify which event (binary value, bit within an integer value, etc.) is to trigger the message.

Configuration for the automation system (AS) and distributed I/Os

You configure messages for the automation system (AS) and distributed I/Os when you create CFCs or in the process object view.

When a block with message response is used in a CFC, specific message texts with the associated message class are preset via a default setting. These messages are transmitted when the corresponding event occurs. You can adapt these message texts and their attributes to your particular needs as follows:

- Messages from a block type:
  First you copy the required block to the project library and change the message there.
- Messages from an individual block instance:
  You change the message in the process object view or directly in the block instance in the CFC.

Recommendation: Create a master data library at the start of configuration. Change the messages on a block type at the start of configuration. If CFCs are already created in the project, import a block type. Consequently, the operator texts are adapted in all the instances (exception: instances which have already been changed manually).

Additional information

The message configuration is described in detail with step-by-step instructions in the configuration manual *Process Control System PCS 7; Operator Station*. The section below provides a brief summary of the individual features provided by PCS 7 for configuring a convenient message system.

7.9.3 Important aspects of message configuration

Important aspects of message configuration

When using the "User-configurable message classes" function, refer to the information in the section "User-configurable message classes".

The following table summarizes the most important aspects of configuring messages.

Aspect	Description	Possible configurations
Message text	If you use a block with message capability in the CFC, for example, the "Dose [FB63]" block, specific message texts with the associated message class are preset as defaults. You have the opportunity to adapt these message texts and their attributes to your particular needs:	• Language for display devices • Modification of the message texts on the block type and block instance
Auxiliary value	You can update messages with current information from the process, for example, by inserting associated values into certain places in the message text. The message block analyzes the associated value and inserts the corresponding process value at the specified place in the message text. This entails inserting a block with the following information into the message text: @<Number of the associated value>[<element_type>]<Format_information>@ You can find the possible associated values for the individual block instances in the online help on the block from the PCS 7 libraries.	Addition of associated values into the message texts on the block type and block instance
Extended event text	On the basis of a standard message, such as "too high", the plant operator is unable to tell at first glance what exactly is "too high". Therefore, you can add supplementary information, such as "reactor fill level", to the event text. The block comment is used for this. By prefixing a keyword ($$BlockComment$$) to the event text, the block comment is copied to the event text of the message. The event texts are already prepared like this in the *PCS 7 Advanced Process Library* blocks. They only adapt the block comments individually for each block instance.	• Expanding the event texts to include block comments on the block type and block instance
Message number	Each message which is configured in the ES is automatically assigned a unique message number in Alarm logging during the compilation of the PCS 7 OS. An 8-bit range is reserved within these message numbers for creating a unique cross-reference to the corresponding AS. This serves to ensure that several AS can be monitored from an OS and that the messages are also assigned to the correct AS.	• No configuration required

Aspect	Description	Possible configurations
Assignment of message numbers	When you create a project with the PCS 7 wizard, a message number range is defined (which can then be changed). You can select between the following processes: • Assigning message numbers which are unique for the entire CPU (a requirement for assigning message priorities) • Assigning message numbers which are unique for the entire project Using the "Assigning message numbers which are unique for the entire CPU" option, programs can be copied 1:1 without message numbers changing.	Specifying the message number concept
Message priority	By default, the current message always appears first on the message list. This setting can be changed. A priority can be assigned to every message (0 = lowest, 16 = highest). The assignment serves to ensure that the message line in the overview area always displays the message that meets the following criteria: • Not yet acknowledged • Highest priority In addition, the plant operator can sort message lists in process mode according to priority in ascending or descending order. **Note**: Message priorities can only be specified if you defined the message number range as "CPU-oriented unique".	Specifying the priority of messages on the block type and block instance
Location of the error in the message text	In the event of an error, the driver blocks in the distributed I/Os transmit a message with the following information about the location of the error to the OS: • Number of the DP master system to which the module is connected • Rack in which the module is installed, or station number • Module slot number in the rack • Message text from the MOD_D1_TXT or MOD_D2_TXT text library By assigning a slot and channel number, this serves to specify the channel of a module which triggers the message. Message-text configuration: Enter the message texts directly into the IM_DRV block which is placed in the CFC. The message texts (origin) for diagnostic events on HART and PA field devices are pre-configured with "field device". We recommend that you adapt the pre-configured message text to suit your configuration requirements.	• Concept of the driver blocks

Additional information

- Section "How to configure messages in the SFC (Page 505)"
- Configuration manual *Process Control System PCS 7; Operator Station*

7.9.4 Configuring the PCS 7 message system

7.9.4.1 User-configurable message classes

Message system

As of PCS 7 V8.0 SP1, it is possible to influence the appearance of limit violations at the block in process control in the group display and in message lists. The "User-configurable message classes" function is available for this purpose.

The fixed assignment of limit violations at the block and the appearance in group displays and message lists is canceled.

In addition, each message class is assigned its own importance. The importance specifies the order in which messages should be displayed in group displays and message lists.

For a multiproject and all projects contained therein, it is possible to use either the classic message system or the message system with the "User-configurable message classes" function.

The requirement for using this function is that CPU-wide unique assignment of message numbers is set for all automation systems.

The difference as compared to the classic message system is that the message classes are configured in SIMATIC Manager. All other configurations involving the message system remain unchanged.

Note

When you use the "User-configurable message classes" function, document the message class configuration.
Make this documentation available to the operator.

Message classes

Up to 6 message classes can be configured when using the "User-configurable message classes" function.

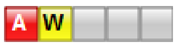
The following table lists the differences:

Classic message system		**Message system using "User-configurable message classes" function**
Message class	**Message type**	**Message class**
Alarm	Alarm high	Alarm high
	Alarm low	Alarm low
Warning	Warning high	Warning high
	Warning low	Warning low
Tolerance	Tolerance high	Tolerance high
	Tolerance low	Tolerance low

Appearance in group displays in process control

Each message class can be assigned to only one button. Assignment is restricted to the first four buttons.

Group displays are presented in the following table by way of example:

Classic message system	Message system using the "User-configurable message classes" function
	

Appearance in expanded status display in process control

The expanded status display uses the importance set in the "Configure message classes" tab.

Appearance in expanded process control analog display

The expanded analog display uses the color and importance set in the "Configure message classes" tab to represent the analog value.

Appearance in block icons and faceplates in process control

Refer to the *Process Control System PCS 7; Advanced Process Library* manual for information on this subject.

Appearance in message lists in process control

The differences regarding the appearance in message lists are documented in the following table:

Message list	Classic message system	Message system using the "User-configurable message classes" function
Incoming list Acknowledged list Outgoing list List of messages to be hidden List of hidden messages	The sequence of messages in the message lists depends on the time (date/time) when the message occurred. The most recent message can be displayed at the top or bottom depending on the setting in the "Sorting of the message pages" area of the "Message display" tab in the WinCC project in the OS project editor.	The sequence of messages in the message lists first depends on the importance of the message and then on the time (date/time) when the message occurred. The most important message and the most recent message can be displayed at the top or bottom depending on the setting in the "Sorting of the message pages" area of the "Message display" tab in the WinCC project in the OS project editor.

The "Priority" column is not shown in message lists in the message system when the "User-configurable message classes" function is used.

Appearance in the one-line message line in the process control overview

The differences in appearance are documented in the following table:

Classic message system	Message system using the "User-configurable message classes" function
Messages are displayed on the basis of their priority.	Messages are displayed on the basis of their importance.

Horn configuration

When you convert a PCS 7 project with the "Classic message system" to the message system using the "User-configurable message classes" function, you must configure the horn again.

Configuring the message system when using the "User-configurable message classes" function

You activate the function in the "Configure PCS 7 message system" dialog box.

You open the dialog box by selecting the menu command **Options > PCS 7 message system > Configure...** in SIMATIC Manager.

The message classes are configured **only** in this dialog box.

<table>
<tr><th>Step</th><th>Explanation</th><th>Where?</th></tr>
<tr><td>1</td><td>Configure message classes</td><td rowspan="2">"Configure PCS 7 message system" dialog box
Additional information on this can be found in the following section.</td></tr>
<tr><td>2</td><td>Assign message classes to the buttons in the group display</td></tr>
<tr><td>3</td><td>Assign the desired message class to the messages of a block type or block instance</td><td>At the block type or at the block instance
At the block type, the message class is assigned in the message dialog box for the block type.
Instance-specific assignment is possible in the message dialog box at the block in the CFC.</td></tr>
</table>

Additional information on configuration can be found in the online help for the dialog box.

Import/export of configuration data of the PCS 7 message system

You can import and export the settings in the "Configure PCS 7 message system" dialog box.

To do so, use the menu commands **Import...** and **Export...** in the **Options > PCS 7 Message system** menu in SIMATIC Manager.

7.9.4.2 Specifying message colors for individual columns

Appearance of the columns in the message windows

You can specify that message colors are displayed only for individual columns in the process control message lists.

Information on configuration can be found in the following chapter "How to configure the PCS 7 message system".

7.9.4.3 How to configure the PCS 7 message system

Introduction

You carry out the configuration in the "Configure PCS 7 message system" dialog box.

The configuration is valid for all projects in a multiproject.

You can import and export the settings in the "Configure PCS 7 message system" dialog box. You can find additional information on this topic in the section "User-configurable message classes (Page 203)".

Requirement

Message number assignment is unique across the entire CPU.

Procedure

1. Open SIMATIC Manager.
2. Open the multiproject/project.
3. Select the multiproject.
4. Select the menu command **Options > PCS 7 message system > Configure...** .
   The "Configure PCS 7 message system" is displayed.
5. Configure the message classes, group displays, display colors, message blocks and message lists in the tabs:
   – "Configure message classes"
   – "Group display assignment"
   – "Display of the columns in the message windows"
   – "Display of the message blocks"
   – "Configure message lists"
6. Compile the OS.
7. Download all OS servers and OS clients.

Note

Do not make any changes to the WinCC project in the Alarm logging editor.

Enabling priority-based alarming might impact the performance for changing the process pictures on the OS client depending on the number of block icons.

Additional information

Additional information on configuration can be found in the online help for the dialog box.

7.9.5 Show and hide messages automatically in process mode

Introduction

You can use the function "Show and hide messages automatically" in process mode for the following options:

- For process states such as startup, shutdown.
  This happens through the configuration of the "STRep" block in CFCs.
  The configuration is described below.
- For messages from message-capable blocks of the system charts:
  This happens through the connection of the digital system charts to the plant hierarchy.
  You can find additional information about this in the section "How to configure the automatic display and hide of messages from system charts (Page 278)".

Show/hide messages automatically in process mode

Use the "Show and hide messages automatically" function in the following situations (process status), for example:

- You wish to suppress messages when you start up a part of the plant (flurry of messages).
- You wish to automatically hide messages which are generated when a part of the plant is shut down.
- You wish to automatically hide messages from a part of the plant which is not in operation.

Configuration of the "STRep" block

Use the "STRep" block from the *PCS 7 Advanced Process Library* for this function. The "STRep" block is used to hide/show messages for process states such as startup, shutdown, etc. Interconnect the status inputs of the "STRep" block to a logic that determines the process states. All the blocks which are controlled by this "STRep" are combined in a group under an identifier. This means that several "STRep" blocks can be used, if necessary.

The process states are transferred to the OS and then suppressed in the OS by means of a configured assignment of messages to process states.

Automatic showing and hiding in process mode does not affect message generation in the automation system.

Overview of configuration steps

Step	What?
1	• Inserting the "STRep" block into a CFC • Interconnecting the control signal for a process status (for example, starting up a part of the plant) to a status input of the "STRep" block (state1 to state32) A status input represents a status for showing and hiding messages. You can find additional information about this in the section "How to configure automatic displaying and hiding of messages in process mode (Page 463)".
2	Creating shared declarations
3	Assigning blocks in the process object view for groups.
4	Assigning messages from blocks in groups, which you wish to hide, to the status in the process object view.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*

7.9.6 Acknowledgment concept and acknowledgment-triggered reporting (ATR)

Acknowledgment concept

PCS 7 uses a central acknowledgment concept. When a message is acknowledged on an OS, this acknowledgment is transferred to the reporting block in the AS. From there it is forwarded centrally as an acknowledged message to all the operator stations which are being supplied.

Acknowledgment-triggered reporting (ATR)

If events that trigger messages change their status in very quick succession, this can trigger a message surge. The overview of the plant status can no longer be sufficiently ensured.

By configuring the "acknowledgment-triggered reporting (ATR)" function, you can suppress the repeated reporting of "fluttering" signals until the operator acknowledges them. While an unacknowledged message remains in the OS, the resending of signal changes for this message is suppressed in the AS.

The following can be accomplished with ATR:

- The pending messages remain manageable.
- The communication load is reduced.

Configuring acknowledgment-triggered reporting (ATR)

You can activate acknowledgment-triggered reporting (ATR) for a specific AS in the object properties of the CPU.

Note

Configure the same message method for **all** automation systems of a multiproject (standard message procedure or acknowledgment-triggered reporting).

Do not mix both methods within a multiproject. Otherwise the operator cannot recognize the message procedure that generated the message. This could lead to false conclusions being drawn.

Additional information

- Section "How to activate acknowledgment-triggered reporting (ATR)" (Page 339)"

7.9.7 Time stamp with high precision

Introduction

Events frequently have to be read in with high-precision timing during initial value acquisition following the failure of part of plant with a subsequent flurry of messages:
Even if there is a large number of messages, the message which led to the failure of the unit (initial value) must be clearly identifiable.

High-precision time stamps

High-precision time stamps allow extremely accurate time stamping of an incoming event: If two sensors from two stations on different PROFINET IO or PROFIBUS DP chains are connected to different automation systems and are activated at the same time, the time stamps of these signal changes may not differ by more than a maximum of 1 ms, 10 ms to 30 ms (depending on the hardware used). This assumes time synchronization of all the devices connected to the plant bus.

Additional information

- Section "Configuring the hardware of high-precision time stamps (Page 338)"
- Function Manual *Process Control System PCS 7; High-Precision Time Stamping*
- Function Manual *Process Control System PCS 7; High-Precision Time Stamping by use of ET 200SP HA*

7.9.8 Acoustic/optical signaling

"Horn" function

In addition to the visual display of messages and alarms, acoustic or optical signaling may be necessary for certain messages. In PCS 7 OS, the "Horn" function is available for this purpose with the following options:

- You can connect a **signal module** with a PCI interface in the OS. Up to four different external sensors, for example, four horns or four different lamps, can be controlled for different message classes. One device (for example a horn) can be deactivated using an acknowledgment input. The three other devices remain activated as long as an assigned control signal is applied (for example, a signal of a message class is activated). Connecting a signal module allows an additional lifebeat monitoring (watchdog function).
- You can use a **standard sound card** that is installed in the OS. The acoustic signal is produced by a WAV file, which continues to be played until the message is acknowledged. If several alarms are pending at the same time, all WAV files are played at the same time. The sound card does not allow the implementation of lifebeat monitoring.

Signal modules and sound cards can be operated together.

Additional information

- You can find more detailed information on the function and installation of signal modules in the manual *Process Control System PCS 7; WinCC Basic Process Control*.
- You can find more detailed information on configuring the horn in the configuration manual *Process Control System PCS 7; Operator Station*.

8 Configuration of the PCS 7 engineering system

8.1 Central starting point - The SIMATIC Manager

SIMATIC Manager

The SIMATIC Manager is the central starting point for all engineering tasks. The PCS 7 project is managed, archived and documented there. All the applications of the engineering system are accessible from the SIMATIC Manager. If there is a connection between ES, OS, BATCH, Route Control and AS, the configuration data can be transferred to the target systems from the SIMATIC Manager and then tested online.

Views in SIMATIC Manager

The SIMATIC Manager provides the following three views which allow for optimum editing depending on the task at hand.

Note

One major feature of these views is that the objects they contain exist only once.

View	Purpose
Component view (Page 213)	In the component view, you organize the projects of the multiproject, create hardware components and start the hardware configuration of the automation systems, bus components, process I/O, and PC stations.
Plant view (Page 216)	The plant view function is used to arrange and depict the plant according to technological aspects. Arrange the automation, operator control and monitoring functions hierarchically in the plant view. The structures for the PCS 7 OS in process mode are derived from this plant hierarchy (for example, OS areas, picture hierarchy).
Process object view (Page 218)	The process object view provides a universal view of the process tags. It visualizes the plant hierarchy in combination with a tabular view of all aspects of the process tag / object (for example, parameters, signals and messages). In the process object view, all the data of the basic control throughout a project can be displayed in a process control-oriented view. The multiproject collects the data contained in all of the projects.

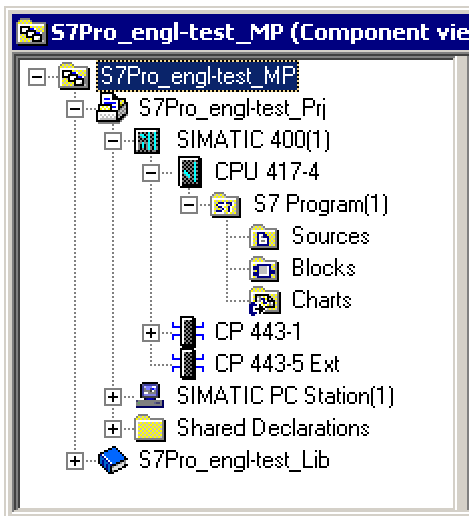
Changing from one view to another

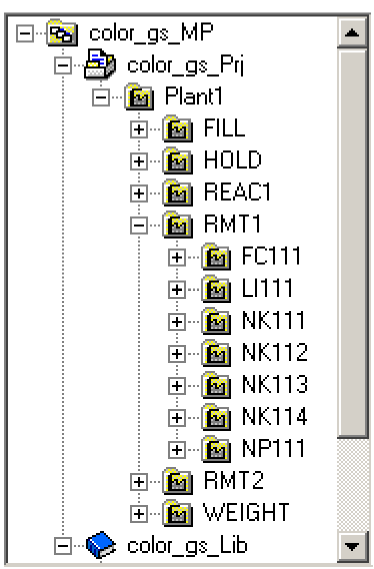
Use the SIMATIC Manager menu command **View > [Name of view]** to switch between the views.

Structure of a PCS 7 project

Similar to the directory structure of the Windows Explorer with its folders and files, the PCS 7 multiproject is organized into projects, folders, and objects. The multiproject is at the top of the object hierarchy and represents all the data and programs of an automation solution. Folders may contain objects which in turn may contain other folders and objects.

The examples in the following figures shows the most important folders of a multiproject in the component and plant views:





Object-oriented working

In SIMATIC Manager the different object types are linked directly to the application required to process it. The associated application is also started once an object opens.

8.2 The component view

Component view

The component view is used to manage the multiproject and the projects it contains. In addition, it can be used to carry out the following functions:

- Creating the hardware components
- Setting up the hardware configuration
- Setting up and testing the AS configuration
- Starting configuration for the OS or maintenance station
- Setting up the BATCH configuration
- Starting the Route Control configuration
- Running cross-project functions

Multiproject engineering

Use the component view to carry out the following functions in the multiproject:

- Split up the multiproject technologically for distributed editing
- Merge the projects back into the multiproject after distributed editing
- Run the cross-project functions after the projects have been synchronized

Hardware configuration

Working in the component view, you configure the hardware of the automation systems, the bus components, and the process I/O. In the component view, you create the following objects below the projects:

- SIMATIC S7-400 stations (AS)
- SIMATIC PC stations, for example For engineering station (ES).

Double-click on "Hardware" for the selected station to access the HW Config application. Use HW Config to add additional hardware components (for example, CP, ET 200M) or software applications (server or client) to the stations and set the hardware component parameters.

Note

After you have completed hardware configuration, you then work mainly in the plant view and in the process object view.

AS configuration

The objects in the component view are identified as components according to their importance (for example, S7 program, station, OS, PLC/AS (CPU), chart folder).

In the component view, you organize the block types and SFC types by copying them from the master data library to the chart folders of the AS in which they are used. Only then are they available in the catalog for CFC/SFC configuration.

Operator station configuration

Starting the component view, you begin configuration of the operator station for process mode. The WinCC Explorer starts after selecting the OS with the context menu command **Open object**.

Refer to the configuration manual *Process Control System PCS 7; Operator station for more information*.

Maintenance station configuration

You start the configuration of the maintenance station, which is similar to the configuration of the operator station, from the component view.

For more information, refer to the *Process Control System PCS 7; Maintenance Station* manual.

BATCH configuration

Start the batch control configuration from the component view. Open the BATCH configuration dialog with the menu command **Options > SIMATIC BATCH**.

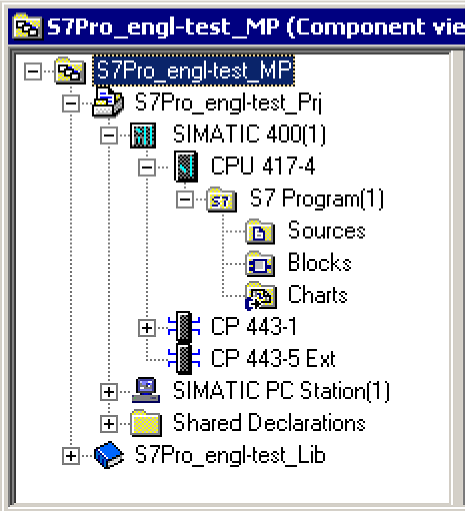
Refer to the configuration manual *Process Control System PCS 7; SIMATIC BATCH* for more information.

Route Control configuration

Start the configuration for route control from the component view. Open the Route Control configuration dialog boxes with the **Options > SIMATIC Route Control** menu command.

You can find more information on this topic in the configuration manual *Process Control System PCS 7; SIMATIC Route Control*.

Other available functions

<table>
<tr><th>Component view</th><th>Selection of important functions</th></tr>
<tr><td>
</td><td>

- Creating a New Multiproject with the PCS 7 Wizard (Page 233)
- Expanding a multiproject by adding new (empty) projects (Page 235)
- Expanding a project with pre-configured stations using the PCS 7 wizards (Page 237)
- Inserting the SIMATIC stations (Page 246)
- Inserting the operator station or station maintenance (Page 250)
- Inserting the BATCH stations (Page 253)
- Inserting the Route Control station (Page 254)
- Inserting the engineering station (Page 249)
- Distributing the multiproject for distributed editing (multiproject engineering) (Page 306)
- Merging projects after distributed editing (multiproject engineering) (Page 569)
- Running cross-project functions
- Compiling - downloading

</td></tr>
</table>

Offline or online?

The component view can be switched between the following states:

Component View > Offline	This view of the project structure visualizes the project data on the engineering station. The offline view is set as the default when you create a new project. In the offline view, the complete data on the engineering station is displayed for the S7 program (offline).
Component View > Online	This view of the project structure visualizes the project data on the target system (CPU). In the online view, the data on the target system are displayed for the S7 program (online). You use this view for access to the target system.

8.3 The Plant View

Plant hierarchy

In the plant view, you structure the project according to technological aspects. In the process you hierarchically organize automation, operator control and monitoring functions into the hierarchy levels plant, unit or function. Name the relevant hierarchy folder according to its technological significance. Arrange the following in the hierarchy folder:

- CFC and SFCs for the AS
- Pictures and reports for the OS
- Additional documentation such as unit descriptions, process tag sheets or planning documents (from Word, Excel, etc.)

The resulting project structure is the plant hierarchy.

Additional Aspects

Please observe the following aspects of the plant view:

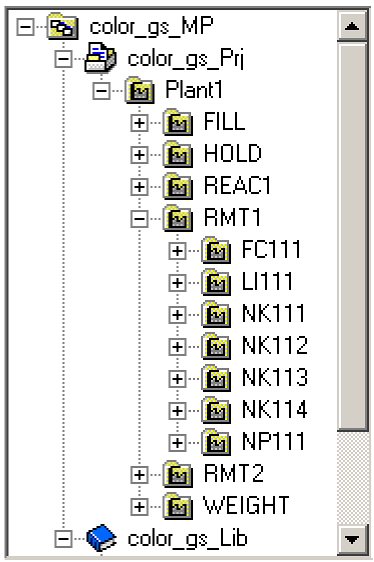
- The technological objects (plants, units, functions, ...) can be handled as a single entity (for example, when copied).
- The technological objects can be used to work independent of a fixed hardware assignment.
- The OS areas and the image hierarchy for the OS are derived from the plant hierarchy.
- The plant hierarchy is the basis for the plant-oriented identification of process objects. The hierarchy path forms the plant designation (higher level designation HID). It can used to specify the folders that contribute to the naming scheme.
- You insert and position the process pictures in the plant view. The block icons of the blocks used in the process picture can be generated automatically from the plant hierarchy.

Master data library

The master data library contains the project master data you created for use in the single projects of the multiproject, for example:

- Block types
- SFC types
- Process tag types
- Models
- OS pictures
- OS reports
- Additional documents

Other available functions

Plant view	Selection of important functions
	**Plant hierarchy** • Settings and properties of the PH (Page 263) • Inserting Additional Hierarchy Folders (Page 267) • Inserting Objects in the Hierarchy Folder (Page 268) • Rules for Copying and Moving within the PH (Page 269) • Checking the Consistency of the PH (Page 273) • Additional PH functions in a multiproject (Page 275) • Specifying the AS/Os assignment (Page 270) **Master data library:** • Creating the master data library (Page 285) • Copying library objects to the master data library (Page 287) • Working with process tag types (Page 300) • Working with Models (Page 302)

AS-OS assignment

An OS must be assigned an AS in the plant view of each hierarchy folder. This AS-OS assignment has the following consequences in the component view:

- All CFC and SFCs inserted in the plant view are stored in the chart folder of the assigned AS.
- All pictures and reports inserted in the plant view are stored in the folder of the assigned OS.

8.4 The process object view

Process object view

You use the process object view when you require details of process tags and CFCs and want to edit their attributes and aspects. Working with the process object view is ideal when you want to assign the same parameters, comments or interconnections for large volumes of objects.

Advantages of the process object view

Compared with the plant view, the advantage of the process object is that all modifiable attributes of an object can be edited. All editable aspects are consistent and presented in a practical form for the user.

Jumps to CFC, SFC, HW Config, WinCC Explorer allow editing of aspects that can not be edited directly in the process object view (such as module parameter assignments, picture contents).

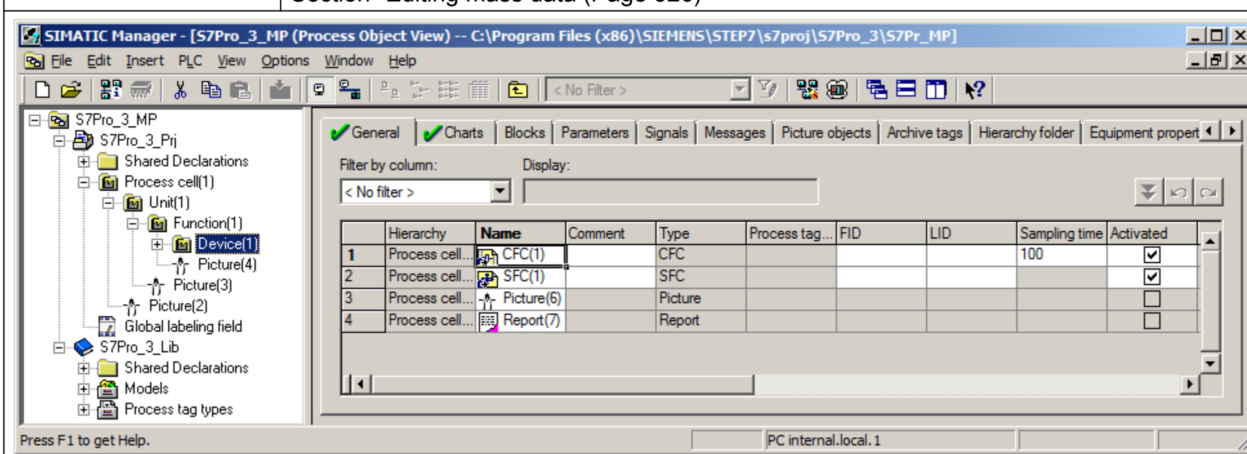
The context menu of the process object view contains functions which can be used to reverse or repeat any changes you have made.

Configuration

On the left, the process object view displays the plant hierarchy (tree). On the right, you see a table of the underlying objects along with their attributes (contents window).

The tree displays the same objects as in the plant view. In addition, the process object view of the tree also shows the CFCs, SFCs, OS pictures, OS reports and additional documents.

Process object view	Selection of important functions:
	Section "Editing mass data (Page 526)"



Displayed attributes of the process objects

In the contents window, you see the attributes of the objects organized according to the following aspects.

Tab	Purpose
General	Here, you can see all the underlying process objects (process tags, CFCs, SFCs, OS pictures, OS reports, or additional documents) for the plant unit currently selected in the tree along with general information on the objects.
Charts	Here, you can see all charts contained in the multiproject, including charts without PH assignment and beyond project boundaries. The list contains SFC charts and SFC types in addition to CFC charts. No PH assignment is shown for SFC types in the table. The "Charts" tab can be selected when the multiproject, project, or a PH folder is selected.
Blocks	Here, the block properties of the blocks in all subordinate CFCs are display for the plant unit currently selected in the tree. SFC instances are also identified as blocks here.
Parameters	Here, you see all the I/O points of the process tags and CFCs displayed in the "General" tab that were selected explicitly for editing in the process object view (S7_edit = para).
Signals	Here, you see all the I/O points of the process tags and CFCs displayed in the "General" tab that were selected explicitly for editing in the process object view (S7_edit = signal).
Messages	Here, you see the corresponding messages for all the process tags, CFCs and SFCs displayed in the "General" tab.
Picture objects	Here, you see all the picture links that exist in WinCC for the process tags and CFCs displayed in the "General" tab.
Archive tags	Here, the existing interconnected WinCC archive tags are displayed with their attributes for all process tags, CFCs, SFCs shown in the "General" tab. The attribute that are relevant for PCS 7 (subset of all attributes defined in the tag logging) are displayed.
Hierarchy folder	Here, the hierarchy folders of the PH are display (one line for each hierarchy folder) for the plant unit currently selected in the tree.
Equipment properties	Here, the equipment properties are displayed for the projected selected in the tree. These equipment properties are instances of equipment properties types that have been configured in the shared declarations (one line for each equipment property). The attributes are entered in the instance when a type is changed.
Shared declarations	Here, you can edit the attributes of the types, enumerations, units of measure and equipment properties contained in the multiproject.

Creating additional technology objects

In the process object view, you can create the following technological objects in addition to editing the attributes of objects:

Object	Purpose
Hierarchy folder	Expand the plant hierarchy by adding objects such as plant, unit, and function within a project.
CFC/SFC	Create empty CFCs and SFCs that can then be further edited with the appropriate editors.
Additional document	Create empty or import available additional documents, for example, MS Excel or MS Word if the relevant application is installed.
Picture	Create empty pictures that can then be further edited with the Graphics Designer.
Report	Create empty reports that can then be further edited with the page layout editor.
Equipment properties	Create equipment properties of the units and change their properties.

Object	Purpose
Process tag (from library)	Insert process tags from the catalog of process tag types in the master data library. You can drag the process tag type to a hierarchy folder in the process object view or in the plant view. This creates a process tag in this hierarchy folder.
Access protection	Activate access protection to restrict the access to the selected project by certain users.

Offline or online?

The process object view can be switched between the following states:

Process object view > Offline	This view visualizes the project data on the engineering station. The offline view is set as the default when you create a new project. In the offline view, the complete data on the engineering station is displayed for the S7 program (offline).
Process object view > Online	In test mode (online), additional columns are displayed in the "General", "Parameters" and "Signals" tabs, with which you can test and commission the process tags and CFCs online on the CPU (target system).

Additional information

- Section "Editing mass data (Page 526)"
- Online help for *PH, IEA* and *PO*

8.5 Correlations between the views

Correlations between the views

Since the component view and the plant view/process object view represent different aspects of the same objects, certain functions affect these objects in all views:

- "Deleting objects" deletes them in all three views.
- Newly created objects in the plant view/process object view are also created in the AS/OS assigned to the hierarchy folder in the component view.
- Creating new objects in the component view has no effect on the plant view/process object view.

Tip: If the plant hierarchy exists, you should only edit objects in the plant view or in the process object view. The component view is then only used to create and edit the automation systems and PC stations, for example, operator stations.

8.6 Cross-view functions and how to use them

Working with units (plant view)

You can perform the following functions during plant-wide engineering:

- Copying an entire unit, containing the charts for the AS and pictures for the OS.
- Deleting a unit along with all the objects belonging to the unit.
- Moving a unit to other devices (AS and OS).

The cross-device relationships (PH, OS, AS) are managed by the ES.

Copying a SIMATIC Station (CPU) in the Project (Component View)

When you copy a SIMATIC station, the hardware properties of the station are copied 1:1. The following is retained in the associated program folder:

- All interconnections between global addresses
- All interconnections between runtime groups
- All interconnections between the charts

The plant hierarchy (PH) is retained. All the charts involved in the copy function now exist twice in the PH (original and copy with a different name).

Copying a SIMATIC Station (CPU) from Project to Project (Component View)

If you copy a SIMATIC station from one project to another, the hardware properties of this station are copied 1:1. The following is retained in the associated program folder:

- All interconnections between global addresses
- All interconnections between runtime groups
- All interconnections between the charts

The station is assigned a new name.

Connections between stations copied across project boundaries are retained and are consistent if the relevant subnets between the stations are also copied.

The plant hierarchy associated with the copied station is set up in the destination project. If the station in the source project has connections with the PH then these are also set up in the destination project. Use these functions when configuring a PH or during the application of an existing PH in the destination project with the same name.

Copying an S7 Program (Component View)

In the SIMATIC Manager, you can copy an entire S7 program within a project or to another project. The following is retained when a program folder is copied:

- All interconnections between global addresses
- All interconnections between runtime groups
- All interconnections between the charts

8.7 PCS 7 applications and how to use them

Overview

PCS 7 includes the following applications and options which you can use to configure the PCS 7 plant:

Application	Purpose
HW Config	Configuring the hardware Hardware configuration displays the hardware structure of a station or a PC station. With HW Config, you specify the racks and their slot assignments according to the actual structure of the station; you configure and assign parameters to the modules, and configure the distributed I/Os.
NetPro	Configuration of networks and connections Using NetPro, you can configure, make parameter assignments, and document the network configuration for your plant extremely simply and clearly.
CFC	Configuring continuous processes CFC (Continuous Function Chart) is a graphic editor that can be used in conjunction with the STEP 7 software package. It is used to create the entire software structure of the CPU from ready-made blocks. When working with the editor, you place blocks on function charts, assign parameters to them, and interconnect them.
SFC	Configuring sequential control systems SFC (Sequential Function Chart) is a tool for creating a sequential control system. With this application, you can create and commission technological sequential control systems.
SCL	Programming blocks SCL (Structured Control Language) is high-level programming language for programmable controllers. Along with high language elements, it also contains typical elements of the AS as a language element: • Inputs • Outputs • Timers • Memory bit • Block calls SCL supplements and expands the STEP 7 programming software with its programming languages LAD, FBD and STL.
Graphics Designer (WinCC)	Editing of process pictures In the Graphics Designer, you edit the mimic diagrams that the operator displays and uses for process control on the operator station. PCS 7 provides a function which you can use when creating process pictures that automatically inserts all block icons (clear, graphical representations of process tags) into the process picture. You can also insert other graphic objects and define the dynamic attributes of the objects. For example, you can visualize the current state of a valve so that the operator immediately sees whether the valve is "open" or "closed".

Application	Purpose
Tag Logging (WinCC)	Archiving process values Tag logging is used to archive process values and includes the following functions: • Creation of archives • Assignment of the process values to the archives
Alarm Logging (WinCC)	Archiving messages and alarms Alarm Logging is used for the following functions in the processing of messages and alarms: • Receiving messages from processes • Preparing and displaying messages in process mode • Acknowledgments by the operator • Archiving
Report Designer (WinCC)	Design of the layout for printouts of process values or messages. The Report Designer provides functions for creating and outputting reports. You can adapt the supplied standard layouts individually. The Report Designer provides the required editors.
OpenPCS 7	Connection to the works management level New PCS 7 data important for the works and enterprise management level is constantly being produced in a production process. OPC/OLE DB provides you with access to this data. This package allows you to use the data from the higher control levels and create your own statistical information and evaluations.
SIMATIC BATCH	Automation of batch processes (discontinuous processes) With the SIMATIC BATCH software package, you can configure process cells with recipe-oriented control strategies with exacting requirements. In this way complex tasks with alternating process sequences can be edited.
SIMATIC Route Control	Automating of route controls Using the SIMATIC Route Control software package, you control and monitor material transports in process mode (route control).
SIMATIC PDM	SIMATIC PDM is a software package for configuration, parameter assignment, commissioning, and maintenance of devices (for example, transducers) and for configuring networks. SIMATIC PDM allows simple monitoring of process values, alarms, and status information of the device.
Version Cross Manager	Comparing project versions You use the Version Cross Manager to perform the following comparisons: • Compare versions of projects and libraries with graphic display of differences • Compare versions of two S7 programs for differences relating to the programming • Compare versions of two CFC/SFCs • Export project data in XML format
Version Trail	Create versions You use Version Trail to create versions of multiprojects, projects and libraries. Additional features of Version Trail are automatic archiving and automatic readback.

Application	Purpose
S7 F systems	This supports you when configuring an S7-400F/S7-400FH. The "S7 F systems" add-on package supports: • The configuration of the F I/O with HW Config. • The creation of the safety program by providing an F library with F modules and the integration of fault detection capabilities in the safety program.
Import/Export Assistant	Tool for fast engineering of mass data (for example, importing process tag types and models).
PCS 7 Advanced Process Library	The PCS 7 libraries include blocks and functions for use in PCS 7 plants.
Hardware catalog	The hardware catalog "PCS7_Vx.y" contains all approved devices and modules (the latest version in each case).
DOCPRO	Using DOCPRO, you can create and manage plant documentation.
SFC Visualization	SFC visualization of the Operator System allows sequential control systems configured with the SFC editor to be represented and operated in the same way as on the engineering system. This does not involve any extra configuration effort.

Implementing the PCS 7 Configuration 9

9.1 Overview of configuration tasks

Introduction

The basic activities described below are arranged in a practical order that you can follow to achieve a rational workflow during configuration.

Depending on the requirements of your project, some of the steps in configuration are mandatory and others are optional. From the table below, you can see which configuration tasks are necessary and which are options.

Overview of configuration tasks

Configuration tasks	Mandatory	Optional
Setting up the PC station (see manual *Process Control System PCS 7; PCS 7 - PC Configuration*)	X	-
Creating the PCS 7 project (multiproject)	X	-
Creating the SIMATIC stations (AS 41x)	X	-
Creating the SIMATIC PC stations	X For engineering station and operator stations	X When a station is used for: • Maintenance station • SIMATIC BATCH • SIMATIC Route Control • OpenPCS 7 • Process Historian
Creating the plant hierarchy	X	-
Creating the master data library	X	-
Distributing the multiproject for distributed editing (multiproject engineering)		X For distributed editing by several project engineers
Configuring hardware (AS, I/O)	X	-
Creating network connections	X	-
Creating the SIMATIC connections	X	-
Configuring the following AS functions:	X	-
• Creating CFCs	X	-
• Configuring SIMATIC connections	-	X
• Configuring the link to the I/O (driver blocks)	X	-

Configuration tasks	Mandatory	Optional
• Creating process tags from process tag types	-	X When editing mass data in the multiproject
• Creating sequential control systems (SFC)	-	X
• Creating models	-	X When editing mass data in the multiproject
Configuring OS functions Described in Configuration Manual *Process Control System PCS 7; Operator Station*	X	-
Configuring the maintenance station Described in configuration manual *Process Control System PCS 7; Maintenance Station*	-	X When a maintenance station is used
Configuring BATCH functions Described in the configuration manual *Process Control System PCS 7; SIMATIC BATCH*	-	X When using SIMATIC BATCH
Configuring the Route Control functions Described in Manual *Process Control System PCS 7; SIMATIC Route Control*	-	X When using for use with SIMATIC Route Control
Configuration of the archiving functions on the external archive server Described in the *Process Control System PCS 7; Operator Station* Manual:		X When using the SIMATIC Process Historian
Configuring the connection to the works management level (OpenPCS 7 and SIMATIC IT)	-	X When interfacing PCS 7 to the management level
Merging projects after distributed editing (multiproject engineering)	-	X For distributed editing by several project engineers
Executing cross-project functions (multiproject engineering)	-	X For distributed editing by several project engineers
Compiling and downloading to the target systems	X	-

Described procedures

The creation of the configuration as described in the following sections is structured according to this procedure. The PCS 7 project must be created by multiproject engineering as a prerequisite to handling all topics. The PCS 7 project is subdivided into several projects, subjected to distributed editing, and then finally merged back into the multiproject for cross-project functions.

Note

With the procedure described here, you have full system support. You can, of course, follow a different procedure, however you then lose some or all the support provided by PCS 7.

9.2 Overview of changes that require a complete download of the AS or OS data

Introduction

Certain changes/updates in the configuration or project require a subsequent complete download of the AS or OS.

However, a complete download represents a significant intervention in process operation with PCS 7 because it requires a CPU STOP for a complete download of the AS, for example.

The description is intended to help you to decide whether or not it is feasible to make specific changes while a complete AS or OS download is not possible at the time in the plant.

Modification scenarios

- Changes in the project and engineering without software update
  The following description provides an overview of these changes.
- Software updates without utilization of new functions
  For more information, refer to the section "Important notes on software updates without utilization of new functions" in the *Process Control System PCS 7; Software updates without utilization of new functions* Manual.
- Software updates with utilization of new functions
  For more information, refer to the section "Requirements of new PCS 7 functions" in the *Process Control System PCS 7; Software updates with utilization of new functions* Manual.

Overview of the complete AS download

The following changes cause the capability to download changes to be lost and force you to perform a complete AS download in CPU STOP mode.

- Block structure changes, e.g. changes to interfaces, adding messages.

  Note

  TCiR changes in the CPU RUN mode

  To execute TCiR changes of block structure and interfaces in the CPU RUN mode, CPU 410 with firmware V8.1 is required.

- Changes in HW Config
  - CPU parameters
  - HW changes in the central rack
  - Changes to PROFIBUS DP that do not allow "Change-in-Run" (CiR).
  - Enabling/disabling CiR capability
- When the DB and FC numbers were compressed during compilation using the **Tools > Settings > Compile/Download... > Option: "Compress"** menu command.

- When a modified program was downloaded to a different CPU prior to the download of changes, for example, for debugging purposes. In this case, the time stamp no longer matches the time stamp of the original CPU.
  Exception:
  If you use the "Download to test CPU" option in the "S7 Download" dialog, the download identifier and comparison time stamp are retained. You can thus still transfer the program to the original CPU by downloading changes.
- If you resort to an archived program that is not the original from the most recent download (time stamp comparison).

Overview of the complete OS download

The following changes require a complete OS download.

Following these changes, you can no longer use the "Download changes" function. Once you have performed the complete download, the "Download changes" function will be available again.

- The OS was renamed
- A complete OS compilation was performed
- The path to the target computer was changed
- The master OS to standby OS assignment was changed
- The configuration of redundant OS servers was changed
- The project properties of the OS were changed
- Hotkeys were changed in the OS
- The data of newly added OS servers was downloaded to existing OS servers

9.3 Setting up the PC Stations

Settings on all PC stations

In order to configure, download, and test all automation systems (AS) and PC stations (such as OS and BATCH) from a central engineering station (ES) in a PCS 7 project, you must make the following settings on **all** PC stations:

- Specify the communication modules for communication via the terminal bus and plant bus
- Set/check the access points and operating mode for communication modules on the plant bus

Make these settings on the central engineering station first.

Additional information

- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.4 Creating the PCS 7 project

9.4.1 Overview of defaults and individual steps

Overview of configuration tasks

This overview shows you the individual steps for creating and setting up a PCS 7 project:

What?	Where?
Making the Default Settings for the PCS 7 Project (Page 232)	SIMATIC Manager
Creating a New Multiproject with the PCS 7 Wizard (Page 233)	PCS 7 "New Project" Wizard (in the SIMATIC Manager)
Expanding a multiproject by adding new (empty) projects (Page 235)	SIMATIC Manager
Expanding a project by adding pre-configured stations (Page 237)	PCS 7 "Expand Project" Wizard (in the SIMATIC Manager)
Expanding a project by adding additional objects (Page 239)	SIMATIC Manager
Configuring Access Protection for Projects/Libraries (Page 239)	SIMATIC Manager (with SIMATIC Logon)

9.4.2 How to set the defaults

Procedure

1. Open the SIMATIC Manager and select the menu command **Options > Customize...**.
   The "Customize" dialog box opens.
2. Check the path information under "Storage location for projects/multiprojects" and "Storage location for libraries" in the "General" tab.
   If you want to use a specially configured project drive instead of the default path, "SIEMENS \STEP7\S7Proj" under "Storage location for projects/multiprojects", specify the new path.
3. Ensure that backups (images) are loaded.
4. In the "Language" tab, set the language and the mnemonics with which you want to work.
5. In the "Date and Time" tab, set the desired format and specify if the module should show the local time of the programming device / PC (for UTC system time -> convert to local time).
6. In the "Wizards" tab, check if the "PCS 7" option is set.
   This setting is required to be able to later start the "New Project" and "Expand Project" PCS 7 wizards.
7. In the "Message Numbers" tab leave the default setting " Always prompt for setting" or select " Always assign unique message numbers CPU-wide".

8. In the "Archive" tab, you can select the archiving program you want to use (for example, PKZip) and the paths for archiving/retrieval.
9. Click "OK".
   The dialog box is closed.

You enter all other settings the first time you create the PCS 7 project with the PCS 7 "New SIMATIC Manager Project" wizard. You can change these settings later in the "Settings" dialog box.

Note

You can have to restart the SIMATIC Manager for some of the settings, for example, when changing the language.

Additional information

- Online help for the "Settings" dialog box

9.4.3 How to create a new multiproject with the PCS 7 Wizard

PCS 7 "New Project" Wizard

Use the PCS 7 "New Project" wizard to create a new PCS 7 project as a multiproject. The multiproject contains the following components:

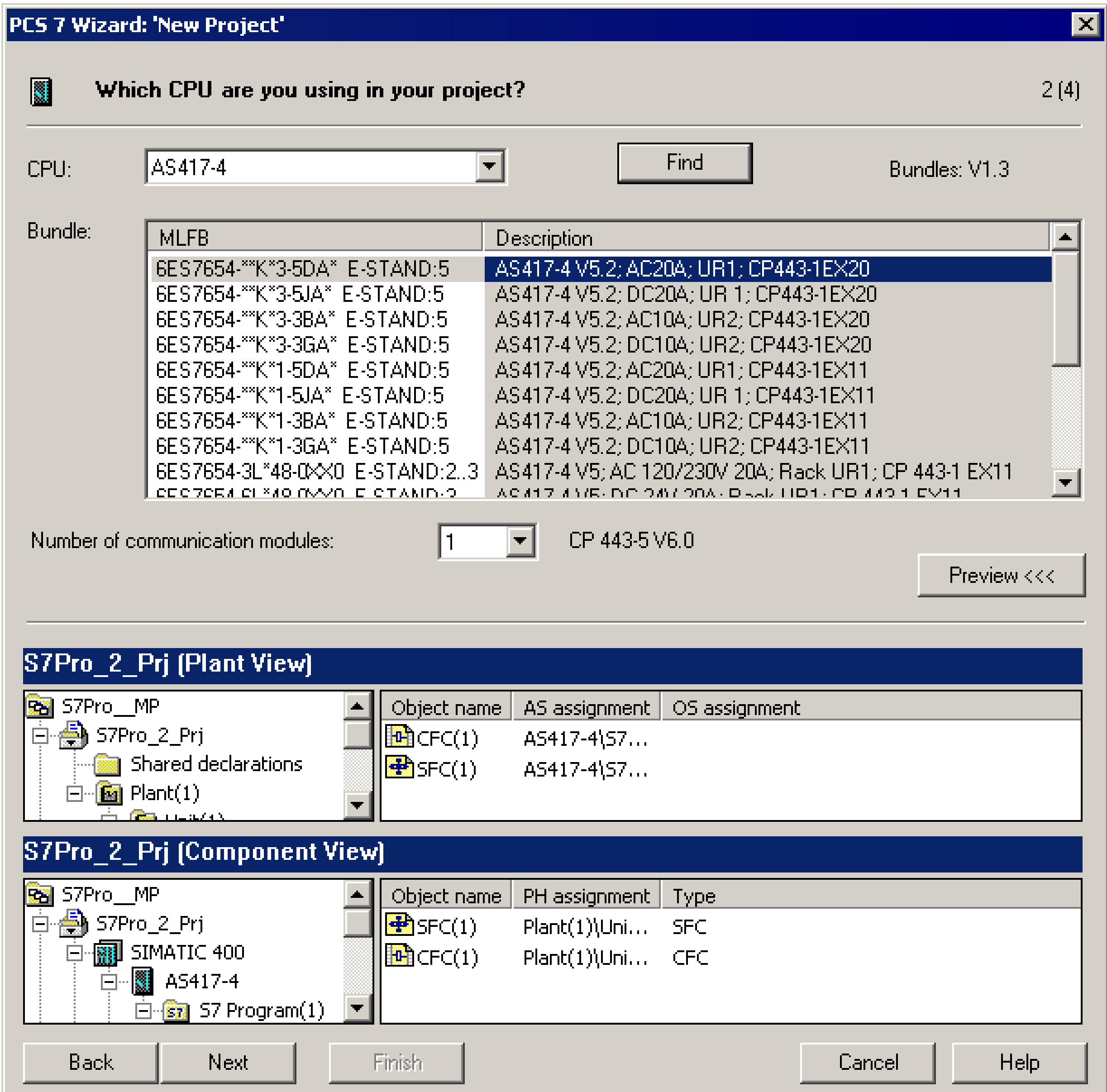
- One project
- The master data library

You are guided through the individual configuration steps of the PCS 7 wizard. While working through the wizard, you specify the CPU, select the number of levels in the plant hierarchy and the AS objects to be created (CFC/SFCs) and OS objects (PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control). Technological names such as plant, unit and function are specified and you can adapt these later to the requirements of your plant.

Procedure

1. Select the menu command **File > "New Project" Wizard** in the SIMATIC Manager.
2. You can check the structure of the multiproject using the "Preview" button.

3. Click "Continue".



4. Select the desired CPU (bundle) and the number of communication modules (CP 443-5) as required.
5. Click "Continue".
6. Define the project structure you require in the next dialog:
   - AS objects: CFC/SFC
   - OS objects: PCS 7 OS, SIMATIC BATCH, SIMATIC Route Control, OpenPCS 7
   - Configuration: single-station system, multiple station system or redundant multiple station system .
7. Click "Continue".

8. Specify the directory names (project name) and the storage location (path) of the multiproject.

   Note

   Project name in PCS 7

   The following characters are permitted in names of multiprojects or projects in PCS 7:

   - Alphabet in capital and small letters (A to Z; a to z)
   - Numbers (0 to 9)
   - Underscore (_)
   - Hyphen (-)

   ---

9. Click "Finish" to start creating the multiproject.
10. Select the "Assign unique message numbers CPU-wide" option in the "Message number assignment selection" dialog box.
11. Click "OK".

Result

The multiproject is created and contains one project as shown in the preview. The relevant objects are created in the component view and in the plant view. There is also a master data created with the following content:

- in the component view:
  an S7 program with the folders for source files, blocks and charts
  a folder for shared declarations
- in the plant view:
  separate folders for process tag types, models and shared declarations

Opening the multiproject

When you create a multiproject with the PCS 7 wizard, it opens automatically in the SIMATIC Manager.

When you open the multiproject at a later point in time, be sure to always open it with the menu command **File > Open >** "Multiprojects" tab **>** "<Name of the multiproject>" **>** "OK" button.

9.4.4 How to expand the multiproject by adding new (empty) projects

Procedure

1. Select the multiproject in the SIMATIC Manager.
2. Select the menu command **File > Multiproject > Create in Multiproject...**.
3. Enter a name for the new project and specify the storage location.
4. Click "OK".

Result

A new project is created in the multiproject, which you can configure further (e.g. with HW Config, plant hierarchy) or expand by adding pre-configured stations with the PCS 7 "Expand Project" wizard.

Additional information

- For multiproject engineering, read the information in the section "Configuring in a Multiproject (Page 172)" about the rules for distribution of automation systems, operator stations and SIMATIC PC stations to the individual projects of the multiproject.
- Section "How to expand a project with pre-configured stations using the PCS 7 wizard (Page 237)"

9.4.5 How to insert an existing project into a multiproject

Introduction

If you want to continue using an existing project (single project unchanged or modified), you can integrate it in your multiproject.

If the project already belongs to another multiproject, a message is displayed. If you want to include such a project in the multiproject, it is removed from the other multiproject.

Procedure

1. Open the multiproject.
2. Select the menu command **File > Multiproject > Insert in Multiproject...** in the SIMATIC Manager.
3. Select the project you want to insert.
4. Click "OK".

Note

If this project originates from an earlier PCS 7 version, keep to the procedure described in the manuals *Process Control System PCS 7; SW Update ...*.

Rules for the external archive server in multiproject

Note

Only one external archive server (Process Historian) can be configured in a multiproject.

When using a redundant Archive Server, there may only be one PC station for the Archive Server itself in the multiproject and one more for the redundant PC station of the Archive Server.

If an external Archive Server is already available in the multiproject, then please check **before inserting** a project that already exists that this is not configured in any other Archive Server.

9.4.6 How to remove a project from the multiproject

Introduction

You can remove projects that are no longer required from the multiproject.

Procedure

1. Open the multiproject.
2. Select the project that you want to remove from the multiproject.
3. Select the menu command **File > Multiproject > Remove from Multiproject...** in the SIMATIC Manager.

Result

The project is no longer part of the multiproject. However, it was not deleted; only the assignment to the multiproject has been removed. You can delete the project with the menu command **File > Delete > User projects**.

9.4.7 How to expand a project with pre-configured stations using the PCS 7 wizard

PCS 7 "Expand Project" Wizard

With the PCS 7 "Expand Project" wizard, you can expand a project with pre-configured stations, such as an AS or a PC station (without integrating any hardware) for OS, BATCH or Route Control, or OpenPCS 7.

Note

To insert a maintenance station using the wizard, proceed as you do for an OS station. The specification of the OS as a maintenance station is then carried in the plant hierarchy.

For the AS, this involves assembled configurations (bundles), which you can find in the PCS 7 catalog, and are already aware of from the PCS 7 "New project" wizard. If you use such bundles in your plant, all required objects are created when you insert pre-configured stations. Therefore, you do not have to integrate the components of the bundle individually.

Inserting an AS

1. Select the project to be expanded in the SIMATIC Manager.
2. Select the menu command **Insert > Pre-configured station…**.
3. Select the desired CPU from the "CPU:" drop-down list.
4. Select the desired bundle from the "Bundle" list.
   You can find the components of this bundle in the "Description" column.
5. Select the number of communication modules (distributed I/O) you want to set up from the "Number of communication modules (CP 443-5)" drop-down list.
6. Click "Continue".
7. If you also want to insert a PC station, select the desired station type (OS objects).
8. Click "Continue".
9. You are shown the project name and storage location in the next dialog.
10. Click "Finish".

Result

The appropriate automation system is created, including the hardware configuration for all components of the selected bundle.

Inserting a PC station

1. Select the project to be expanded in the SIMATIC Manager.
2. Select the menu command **Insert > Pre-configured station…**.
3. Select the "(without integrating hardware)" item in the "CPU:" drop-down list.
4. Click "Continue".
5. Select from the following under "OS objects":
   - PCS 7 OS
     Select the OS station as a maintenance station here as well.
   - SIMATIC BATCH
   - SIMATIC Route Control
   - OpenPCS 7

6. Then select from the following:
   – Single station system
   – Multiple-station system
   – Multiple station system redundant
7. Click "Continue".
   You are shown the project name and storage location in the next dialog.
8. Click "Finish".

Result

The appropriate SIMATIC PC stations including the hardware configuration are created.

9.4.8 How to expand a project by adding objects

Introduction

The basic configuration is created with the PCS 7 wizards; you can expand this basic configuration by adding objects that fit your plant.

Procedure

The procedure described here applies regardless of the selected view. The selection of objects that can be inserted depends on the selected object and the selected view.

1. Select the folder/object in the SIMATIC Manager.
2. Select the **Insert** menu.
   The **Insert** menu offers all objects that can be inserted below the folder.
   The selection depends on whether you have selected the object in the process object view, in the plant view or in the component view.
3. Select the required object with the menu command and specify the object name.

Additional information

- Online help for the SIMATIC Manager

9.4.9 How to provide projects/libraries with access protection

Introduction

As of PCS 7 V7.0, you have the option of assigning a project password to provide access protection for projects and libraries.

Once you have configured the access protection, you can record online actions in a change log.

Requirements

- SIMATIC Logon is installed.
- The "Project administrator" and "Project editor" roles in SIMATIC Logon are automatically created during the PCS 7 installation.
- You are assigned the "Project administrator" role in SIMATIC Logon.
- You are logged on as the project administrator or project editor.

Rules

- The user currently logged on (project administrator, project editor) is displayed in the status bar of the SIMATIC Manager.
- The project format is changed the first time access protection is activated. You receive notice that the modified project can no longer be edited with older PCS 7 versions.
- By using the function **Remove access protection and change log** you lose the information about the users who have access to the project or library and all the change logs.

Activating access protection and assigning a password

1. Select the project/library in the SIMATIC Manager.
2. Select the menu command **Options > Access Protection > Activate**.
3. Enter the password and confirm it in the "Activate access protection" dialog box.
4. Click "OK".
   The corresponding project/library is now password-protected and can only be opened by authorized users for editing.

Deactivating access protection

1. Select the project/library in the SIMATIC Manager.
2. Select the menu command **Options > Access Protection > Deactivate**.
3. Enter the password and confirm it in the "Deactivate access protection" dialog box.
4. Click "OK".
   The corresponding project/library is no longer password-protected and can be opened by any user for editing.

Activating/deactivating the change log

1. Select the project/library in the SIMATIC Manager.
2. Select the menu command **Options > Change log > Activate** or**Deactivate**.
   Specific online changes are also logged.

Displaying the change log

1. Select the desired section (project, SIMATIC station, operator station) in the tree view of the SIMATIC Manager.
2. Select the menu command **Options > Change Log > Display**.
   The change log opens, and comments can be added to it.

Other aspects of access protection

Menu command	Purpose
Options > Access Protection > Manage	Editing the user management (in the "SIMATIC Logon Role Management" dialog box) As the project administrator, you have the right to: • Activate or deactivate access protection • Manage and synchronize users • Change the project password • Activate, deactivate and display the change logs • Removing access protection and change log As the project editor, you have the right to: • Open and edit projects/libraries with access protection • Display change logs
Options > Access Protection > Synchronize in multiproject	When a multiproject is open, this specifies the project administrators and project editors globally for all the projects and libraries in a multiproject. The properties specified for the object selected (e.g. a project or a library) are assigned to all other objects in the multiproject.
Options > Access Protection > Remove Access Protection and Change Log	Removes the access protection and deletes the change log of a password-protected project/library (because the access protection is longer required)

Additional information

- Section "Protecting projects/libraries with access protection (Page 166)"
- Section "How to document changes in the ES log (Page 621)"
- Online help for the SIMATIC Manager
- Manual *SIMATIC Logon; SIMATIC Electronic Signature*

9.4.10 How to open an access-protected project/library

Introduction

The following describes how you can open protected projects/libraries. This generally depends on whether or not the SIMATIC Logon Service is installed.

Note

If you open a multiproject that contains protected projects/libraries without first logging on to the SIMATIC Logon Service, the protected projects/libraries are grayed out and cannot be edited.
To view the projects/libraries involved (including path), position the mouse cursor over the grayed out project or library (tooltip), or access the detail view.

If you attempt to open a protected project/library and are not registered as the project administrator or project editor, or do not know the project password, the project/library will not open.

Procedure

If...	Then
• SIMATIC Logon Service is **installed** • You are registered as a project administrator or project editor • You have logged on with the SIMATIC Logon Service • The project/library is not open	1. Select the menu command **File > Open...** in the SIMATIC Manager. 2. Select the desired project/multiproject/ library. 3. Click "OK".
• SIMATIC Logon Service is **installed** • You are registered as a project administrator or project editor • The project/library is not open	1. Select the menu command **File > Open...** in the SIMATIC Manager. 2. Select the desired project/multiproject/ library. 3. Click "OK". 4. Enter your user name and password in the "SIMATIC Logon Service" dialog box. 5. Click "OK".
• SIMATIC Logon Service is **not installed**, • The project/library is not open	1. Select the menu command **File > Open...** in the SIMATIC Manager. 2. Select the desired project/multiproject/ library. 3. Click "OK". 4. Enter the project password in the "Enter project password" dialog box. 5. Click "OK".

Result

The protected project/library opens and can be edited.

9.4.11 How to manage multilingual texts

Introduction

To visualize the process on the operator station you use faceplates, which show the plant operator the measured values, operating limits, units, and operator texts of the blocks, for example.

PCS 7 allows you to export texts that are stored in one language in a project, have them translated, re-import them, and have them displayed in the translated language.

Note

If operator texts or display texts have been changed compared to the PCS 7 version in blocks for the system which is being updated and you wish to use the new PCS 7 V7.1 faceplates, you should back up the "old" operator texts.

Requirement

The desired language is already installed in the project.
(Select the menu command **Options > Language for Display Devices** in the SIMATIC Manager in order to have the list of available languages displayed).

Rules

- The new texts must not be longer than the default texts. If longer texts can not be avoided, check whether the text is still displayed correctly.
- Export:
  The export is carried out for all the blocks and symbol tables that lie under the selected object. One export file is created for every text type. This contains one column each for the source and the target language.
  The texts in the source language may not be changed.
- Import:
  The import is carried out for all the blocks and symbol tables that lie under the selected object. During importing the contents of the columns for the target language (right column) is imported into the selected object. Only those texts are imported for which an agreement with an existing text is found in the column for the source language.

Exporting

1. Open the project to be updated in the SIMATIC Manager.
2. Select the folder of the master data library (or if it does not exist, the project folder) in the component view.

3. Select the menu command **Options > Manage Multilingual Texts > Export**.
   The "Export User Texts" dialog box opens.
4. Make the following settings:
   – Select the storage location and format of the export file (*.xls or *.csv) in the "Text tables" group.
   – In the "Language" group select the target language and source language in accordance with your display language.
   – Select the text types to be exported in the "Text types" group.
   – If appropriate, activate the "Enter points of use of texts in the export file" check box.
5. Click "OK".
   An export file is created for each text type in the target directory.

If you manage several project-specific languages, repeat Steps 3 and 4. Note that you then have to set different export file names or target directories.

Importing

1. Open the project to be updated in the SIMATIC Manager.
2. Select the folder of the master data library (or if it does not exist, the project folder) in the component view.
3. Select the menu command **Options > Manage Multilingual Texts > Import**.
   The "Import User Texts" dialog box opens.
4. Select the storage location and format of the export file (*.xls or *.csv) in the "Source" group.
5. Click "OK".
   The texts are imported and a log file of the import is output.

Display languages in multilingual projects

- For multilingual projects, you must add all display languages that will later be required in the SIMATIC Manager before the first OS compilation (for additional information on this topic, see section "How to set the language for display devices (Page 294)").
- You must perform the compile and download operations in the same language that was used when making changes to the configuration.
  If, for example, you are importing Spanish texts (language for display devices: Spanish), you must also perform the compile and download operations in this language. Otherwise the changed texts will not be added to the WinCC text library.
- For the purpose of using texts from the *PCS 7 library* in WinCC, you can only select the following S7 languages in the SIMATIC Manager under "Language for display devices":
  – German (Germany)
  – English (USA)
  – French (France)
  – Italian (Italy)
  – Spanish (international sorting)

- The texts for Spanish (international) are converted to texts for Spanish (traditional) when the OS is compiled. The same applies if you want to translate your own texts into one of the 5 main languages and import them into your project using the menu command **Options > Manage multilingual texts** . For other languages, refer to the languages available in WinCC.
- It is not possible to use different variants or sortings of a language in parallel for WinCC, i.e. you cannot use English (USA) alongside English (UK) or Spanish (international sorting) alongside Spanish (traditional sorting) or Dutch (Netherlands) alongside Dutch (Belgium).

Additional information

- Online help for the SIMATIC Manager
- Manual *SIMATIC; Programming with STEP 7*
- Manual *Process Control System PCS 7; Operator Station*

9.5 Configuring the SIMATIC and PC stations

Overview

You create the following objects in the projects of the multiproject in the SIMATIC Manager:

- a "SIMATIC 400 station" for each automation system
- a "SIMATIC PC station" for the engineering station
- A "SIMATIC PC station" for each operator station (single-station or multiple-station system)
- A "SIMATIC PC station" for the Maintenance Station (single-station or multiple-station system)
- A "SIMATIC PC station" for each BATCH station (single-station or multiple-station system)
- A "SIMATIC PC station" for each route control station (single-station or multiple-station system)
- a "SIMATIC PC station" for each OpenPCS 7 station
- A "SIMATIC PC station" for an external archive server (Process Historian)

Configure the hardware for the automation systems and PC stations, e.g. ES, OS, using the HW Config application.

Note

If you require distributed editing of the projects of the multiproject, read the information in the section "Configuring in a Multiproject (Page 172)" on the distribution of automation systems, operator stations and SIMATIC PC stations to the individual projects of the multiproject.

9.5.1 How to add the SIMATIC 400 stations to the projects of the multiproject

Introduction

If you created the multiproject using the PCS 7 wizard, an automation system is inserted by default. You can insert additional automation systems as follows:

- With PCS 7 "Expand Project" wizard
  You can find information about this in the section "How to expand a project with pre-configured stations using the PCS 7 wizard (Page 237)".
- Manually (described below)

Procedure

1. In the component view of the SIMATIC Manager, select the project in which you want to insert a SIMATIC station.
2. Select the menu command **Insert > station > SIMATIC 400 station**.
   A new station ("SIMATIC 400-Station(1)"; you can adapt the name to match your requirements) is inserted.
3. Repeat the procedure to add further SIMATIC stations.

Additional information

- Section "How to create a SIMATIC 400 station (Page 321)".
- Online help for the SIMATIC Manager

9.5.2 How to start the configuration of the SIMATIC 400 stations

Introduction

This section describes how to start the basic configuration of the automation systems. We recommend the following work flow for multiprojects:

- On the central engineering station, the automation systems in the individual projects are created and the communications processors are configured for connection to data network. This is described below.
- The complete hardware with connected I/Os is only configured on the distributed engineering stations after moving the projects for distributed editing. The complete hardware configuration is described in the section "Configuring the hardware".

Note

If you have created the SIMATIC 400 station with PCS 7 "Expand Project" wizard, all hardware components of the respective bundle are already available.

Procedure

To start the basic configuration of the automation systems, follow these steps:

1. Select the required SIMATIC 400 station from the component view and open the HW Config by double-clicking the "Hardware" object in the detail view.
   The hardware configuration of the automation system is opened.
2. If the hardware catalog is not visible, select the menu command **View > Catalog**.
3. In the SIMATIC 400 > Rack-400 hardware catalog, select the required rack and insert it by dragging with the mouse.
   Make sure that the arrangement selected here matches the arrangement of the physical hardware.
4. In the "SIMATIC 400 > PS-400" hardware catalog, select the required power supply and add it by dragging with the mouse.

5. In the "SIMATIC 400 > CPU-400" hardware catalog, select the required CPU and insert it by dragging with the mouse.
6. Depend of the selcted CPU you can confirm the properties of one the following fieldbus systems:
   – PROFINET
   – PROFIBUS

   Click "OK" to confirm the "Properties - ..." dialog box that opens.
7. Repeat the procedure to add additional components.
8. Select the menu command **Station > Save and Compile** in HW Config.

Additional information

- Section "Configuring the hardware"

9.5.3 How to insert CPs in the SIMATIC stations and assign them to the networks

Introduction

The communications processors (CP) inserted in the SIMATIC 400 stations must be configured for network attachment in HW Config and assigned to the communications network. In multiproject engineering, it is advisable to carry out this configuration work on the central engineering station for all projects. This ensures, for example, that node addresses are unique on the bus.

Note

If you have created the SIMATIC 400 station with the PCS 7 "Expand Project" wizard, all hardware components of the respective bundle are already available including the CPs. In other words, you require the procedure described here to add additional CPs later on.

Procedure

1. Select the required SIMATIC 400 station from the component view and open the HW Config by double-clicking the "Hardware" object in the detail view.
   The hardware configuration of the automation system is opened.
2. If the hardware catalog is not visible, select the menu command **View > Catalog**.
3. In the "SIMATIC 400 > CP-400" hardware catalog, select the CP (CP 443-1) you require for the network being used and insert it with drag-and-drop.
   Once you have inserted the CP, the "Properties - Interface" dialog box is opened.
4. Set the required CP address on the bus in the "Properties - Interface" dialog box.

5. Select the subnet from the "Subnet" group:
   – If you have not yet set up a subnet, click "New" and define a new network.
   – If you have already set up a subnet, select the required network in the "Subnet" group.
6. Click "OK".
   The "Properties" dialog box closes.
7. Select **Station > Save and Compile** from the menu.

Additional information

- Section "Configuring the hardware"

9.5.4 How to insert an engineering station

Introduction

The engineering station is configured in the SIMATIC Manager. The following steps are carried out during this process:

- Insertion of a SIMATIC PC station
- Configuration of the hardware in HW Config
- Configuration of the communication connection in NetPro

The communication connections set up for the PC station can then be checked with the diagnostics functions of the station Configuration Editor.

Procedure

1. Select the project into which you want to insert the engineering station in the component view of the SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties...**, and enter the required name.
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.
6. Under "SIMATIC PC station > HMI ..." in the hardware catalog, select the required "WinCC application" and drag it into the configuration table:
7. In the hardware catalog under "SIMATIC PC Station > CP Industrial Ethernet", select the communications processor installed in the SIMATIC PC station and drag it to the PC station.
   If you use a standard network card, select the "IE General" processor.
   The "Properties - Ethernet Interface" dialog box opens.

8. Set the required address on the bus for the CP:
   - If the network adapter is connected to the terminal bus, activate the "IP protocol is being used" check box.
   - If the network adapter is connected to the plant bus, activate the "Set MAC address / Use ISO protocol" check box.
   - For a network card connected to the plant bus via BCE, enter the name in the "General" tab and set the "Interval" to "30" in the "Send keep alive for connections" group of the "Options" tab.
9. Select the subnet from the "Subnet" group:
   - If you have not yet set up a subnet, click "New" and define a new network.
   - If you have already set up a subnet, select the required network in the "Subnet" group.
10. Click "OK".
    The "Properties" dialog box closes.
11. Select **Station > Save and Compile** from the menu.

Additional information

- Section "Setting up PC stations (Page 231)"
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.5.5 How to insert an operator station or maintenance station

Introduction

SIMATIC Manager handles each server, redundant server, client or single-station system of a PCS 7 OS as SIMATIC PC station. The SIMATIC PC station always contains the following objects:

- A WinCC application
- A communications processor that is not inserted by the wizard
- An OS

If you created the multiproject with the PCS 7 wizards, you can already have inserted a PCS 7 OS if you selected the appropriate option. You can insert additional operator stations as follows:

- With the PCS 7 "Expand project" wizard
  You can find additional information on this in the section "How to expand a project with preconfigured stations using the PCS 7 wizard (Page 237)".
- Manually (described below)

Note

An operator station can also be configured and used as a Maintenance Station (MS). Therefore, the following description also applies to the insertion of a Maintenance station.

Procedure

1. Select the project in which you want to insert the operator station in the component view of SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the required name.
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.
6. Under "SIMATIC PC station > HMI" in the hardware catalog, select the required WinCC application and drag it into the configuration table:
   - SPOSA application (for OpenPCS 7 station)
   - WinCC application (for OS server or OS single station system)
   - WinCC application (stby) (for redundant OS server)
   - WinCC application client (for OS client)
   - WinCC appl. Client ref (for reference OS client)
   - WinCC application ref (for reference OS single station system)
7. In the hardware catalog under "SIMATIC PC Station > CP Industrial Ethernet", select the communications processor installed in the SIMATIC PC station and drag it into the PC station.
   If you are using a standard network adapter, select the "IE General" processor.
   The "Properties - Ethernet Interface" dialog box opens.
8. Set the required address on the bus for the CP:
   - If the network adapter is connected to the terminal bus, activate the "IP protocol is being used" check box.
   - If the network adapter is connected to the plant bus, activate the "Set MAC address / Use ISO protocol" check box.
   - For a network adapter connected to the plant bus via BCE, enter the name in the "General" tab and set the "Interval" to "30" in the "Send keep alive for connections" group of the "Options" tab.
9. Select the subnet from the "Subnet" group:
   - If you have not yet set up a subnet, click "New" and define a new network.
   - If you have already set up a subnet, select the required network in the "Subnet" group.
10. Click "OK".
11. Select **Station > Save and Compile** from the menu.
12. Follow the same procedure if you want to install additional operator stations.

Specifying the target OS and standby OS

Once all the required operator stations have been created in the SIMATIC Manager, and the network connections have been configured for all operator stations, the computer path of the target OS or standby OS must be assigned to each operator station.

- If you only have a single OS, you only need to specify the target OS.
- If you have a redundant OS, you must specify both the target OS (master) and the standby OS.

You enter this setting in the object properties of the OS in the component view. Select the "OS" object below the SIMATIC PC station and then the menu command **Edit > Object Properties** (path to target OS and standby OS).

Specifying the basic OS and the swap file scope for reference OS single station systems

For reference OS single station systems, perform the following steps in the SIMATIC Manager:

1. Select the object "OS" below the SIMATIC PC station of the reference OS single station system.
2. Select the menu command **Edit > Object Properties**.
3. Select the tab "OS Ref: options for OS Reference objects".
   – Enter the path for the target OS computer.
   – Select the basic OS.
4. Click "OK".
5. If you select a redundant OS single station system as the basic OS, you can specify the scope of the archive data swap file:
   – Select the menu command **Edit > Object Properties**.
   The "Swap file scope" tab appears in the "Properties" dialog box.
   – Select the "Swap file scope" tab.
   Specify which archive data is to be swapped out.
   – If the current setting should apply to all OS single station systems already created with a "WinCC Application Ref", click the "Propagate" button. A prompt to accept the setting opens. Select the desired button "Yes/No".
   – Click "OK".

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- Manual *Process Control System PCS 7; Maintenance Station*

See also

Diagnostics with maintenance station (Asset Management) (Page 641)

9.5.6 How to insert a BATCH station

Introduction

Each server, client or single-station system of a BATCH station is managed as a SIMATIC PC station in the SIMATIC Manager. This always contains the following object:

- A BATCH application (standard, standby, client)

If you created the multiproject with the PCS 7 wizard, you can already have inserted a BATCH station if you selected the appropriate option. You can insert additional SIMATIC BATCH stations as follows:

- With the PCS 7 "Expand project" wizard
  You can find additional information on this in the section "How to expand a project with preconfigured stations using the PCS 7 wizard (Page 237)".
- Manually (described below)

WARNING
Configuring applications (WinCC, SIMATIC BATCH, etc.) on separate "SIMATIC PC station" objects and subsequently merging them to create one PC station by assigning the same computer name to the "SIMATIC PC station" objects is not permitted!

Requirement

The relevant SIMATIC BATCH add-on package is installed and licensed on the engineering station.

Procedure

1. Select the project into which you want to insert the BATCH station in the component view of the SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Set the computer name of the SIMATIC PC station:
   – To do this, select the PC station.
   – Select the menu command **Edit > Object Properties**.
   – Enter the computer name in the "Computer name" group or activate the "Computer name identical to PC station name" check box.
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.

6. Under "SIMATIC PC station > BATCH" in the hardware catalog, select the required BATCH application and drag it into the configuration table:
   – BATCH application (for BATCH server)
   – BATCH application (stby) (for redundant BATCH server)
   – BATCH application client (for BATCH client)
7. In the hardware catalog under "SIMATIC PC Station > CP Industrial Ethernet", select the communications processor installed in the SIMATIC PC station and drag it to the PC station.
   If you use a standard network card, select the "IE General" processor.
   The "Properties - Ethernet Interface" dialog box opens.
8. Set the required address on the bus for the CP:
   – If the network adapter is connected to the terminal bus, activate the "IP protocol is being used" check box.
9. Select the subnet from the "Subnet" group:
   – If you have not yet set up a subnet, click "New" and define a new network.
   – If you have already set up a subnet, select the required network in the "Subnet" group.
10. Click "OK".
    The "Properties" dialog box closes.
11. Select **Station > Save and Compile** from the menu.
12. Follow the same procedure if you want to install additional BATCH stations.

Additional information

- Manual *Process Control System PCS 7; SIMATIC BATCH*
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.5.7 How to insert a route control station

Introduction

The server, client or single-station system of a route control station is managed as SIMATIC PC station in the SIMATIC Manager. This always contains the following object:

- A Route Control application (standard, standby, client)

If you created the multiproject with the PCS 7 wizard, you can already have inserted a Route Control station if you selected the appropriate option. You can insert additional SIMATIC Route Control stations as follows:

- With the PCS 7 "Expand project" wizard
  You can find additional information on this in the section "How to expand a project with preconfigured stations using the PCS 7 wizard (Page 237)".
- Manually (described below)

Requirement

The SIMATIC Route Control add-on package is installed and licensed on the engineering station.

Procedure

1. Select the project into which you want to insert the Route Control station in the component view of the SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Set the computer name of the SIMATIC PC station:
   – To do this, select the PC station.
   – Select the menu command **Edit > Object Properties**.
   – Enter the computer name in the "Computer name" group or activate the "Computer name identical to PC station name" check box.
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.
6. Under "SIMATIC PC station > Route Control" in the hardware catalog, select the required Route Control application and drag it into the configuration table:
   – RC application (for Route Control server)
   – RC application (stby) (for redundant Route Control server)
   – RC application client (for Route Control client)
7. In the "SIMATIC PC Station > CP Industrial Ethernet" hardware catalog, select the communications processor installed in the SIMATIC PC station and drag it to the PC station.
   If you use a standard network card, select the "IE General" processor.
   The "Properties - Ethernet Interface" dialog box opens.
8. Set the required address on the bus for the CP:
   – If the network adapter is connected to the terminal bus, activate the "IP protocol is being used" check box.
   – If the network adapter is connected to the plant bus, activate the "Set MAC address / Use ISO protocol" check box.
   – For a network adapter connected to the plant bus via BCE, enter the name in the "General" tab and set the "Interval" to "30" in the "Send keep alive for connections" group of the "Options" tab.
9. Select the subnet from the "Subnet" group:
   – If you have not yet set up a subnet, click "New" and define a new network.
   – If you have already set up a subnet, select the required network in the "Subnet" group.
10. Click "OK".
    The "Properties" dialog box closes.

11. Select **Station > Save and Compile** from the menu.
12. Follow the same procedure if you want to install additional Route Control stations.

Additional information

- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- Manual *Process Control System PCS 7; SIMATIC Route Control*

9.5.8 How to insert an OpenPCS 7 station

Introduction

The OpenPCS 7 station is configured as a SIMATIC PC station in the SIMATIC Manager. It always contains the "SPOSA Application" object.

The following steps are carried out during this process:

- Insertion of a SIMATIC PC station
- Configuration of the hardware in HW Config

The communication connections set up for the PC station can then be checked with the diagnostics functions of the station Configuration Editor.

If you created the multiproject with the PCS 7 wizard, you can already have inserted an OpenPCS 7 station provided that you selected the appropriate option. You can also insert an OpenPCS 7 station as follows:

- With the PCS 7 "Expand project" wizard
  You can find additional information on this in the section "How to expand a project with preconfigured stations using the PCS 7 wizard (Page 237)".
- Manually (described below)

Procedure

1. Select the project into which you want to insert the OpenPCS 7 station in the component view of the SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties** and enter the required name.
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.

6. Under "SIMATIC PC station > HMI ..." in the hardware catalog, select the required SPOSA application and drag it into the configuration table:
7. Select **Station > Save and Compile** from the menu.

Additional information

- Section "How to configure the OpenPCS 7 station to access PCS 7 data (Page 567)"
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.5.9 How to set up an external archive server

Introduction

Long-term archiving, for example, of messages and process values, is possible in PCS 7. You can use the Process Historian as an external archive server in a PCS 7 plant. The steps for integrating the Process Historian in the PCS 7 project are described below.

Note

One Process Historian in the multiproject

Only one Process Historian may be configured in a multiproject.

In a redundant configuration, there is another PC station as partner server of the Process Historian for the Process Historian.

Procedure

1. Select the project in which you want to insert an external archive server from the component view in SIMATIC Manager.
2. Select the menu command **Insert > station > SIMATIC PC station**.
   A new SIMATIC PC station is inserted in the selected project.
3. Select the SIMATIC PC station, select the menu command **Edit > Object Properties**, and enter the desired name of the Process Historian. If this name of the PC station differs from the computer name in the operating system, you must additionally enter the computer name under "Computer name".
4. Select the SIMATIC PC station from the component view and open the HW Config by double-clicking the "Configuration" object in the detail view.
   The hardware configuration of the SIMATIC PC station opens.
5. If the hardware catalog is not visible, select the menu command **View > Catalog**.
6. In the hardware catalog, navigate to the folder "SIMATIC PC Station > Archive".

7. Select the desired application and drag-and-drop it to the configuration table:

External archive server needed	Application in the hardware catalog
Process Historian	• "Process Historian Appl." for the PC station of the archive server • "Process Historian Appl. (stby)" for the redundant PC station of the Process Historian

8. Click "OK".
   The "Properties" dialog box closes.
9. Select **Station > Save and Compile** from the menu.
10. Proceed in the same way to insert an additional PC station, e.g. for a redundant archive server.

Additional information

- You can find information on the external archive server in the manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- For detailed information on Process Historian, refer to the documentation for SIMATIC Process Historian
- You can find information on installing the Process Historian in the documentation *SIMATIC; Process Historian Installation Notes; Process Historian 2013 - Installation Notes, section 'Installing Process Historian Ready component'*

9.5.10 How to configure and download the PC stations

Introduction

The project-specific network settings for the communication modules (Ethernet) are downloaded directly to the PC station by the engineering station.

Requirements

- The following is installed on each PC station:
  – Operating system
  – Specific software for the PC station (e.g. PCS 7 Engineering, OS Server)
- All PC stations to be downloaded are linked to the engineering station by means of at least one network.
- The operating system network is configured.
- The network addresses of the PC stations are configured.
- The protocol for the communication on the terminal bus is set to TCP/IP.

- The following settings are made on each PC station:
  - The communication card for communication between the PC station and the terminal bus is selected.
  - The network addresses for the plant bus are set.
  - The access point of the PC station is set to "S7ONLINE: = PC internal (local)".
- The PCS 7 project is created.

Procedure

Note

Note the following:

- Perform the following tasks first for the engineering station before configuring and downloading additional PC stations.
- When configuring the **local** PC station, the "Use configured target computer" check box must be deactivated (see Step 6).

1. In SIMATIC Manager, open the PCS 7 project.
2. In the component view, select the target computer.
3. Select the menu command **Target System > Configure...**.
   The "Configure" dialog box opens. The PC station selected in the project is entered in the "Target Computer" group.
4. From the "Local Network Connection" drop-down list, select the network connection to be used to access the target computer.
5. Click "Update".
   The list of accessible computers is updated.
6. Select the desired target computer (PC station) from the list of available computers.

   Note

   If the selected PC station does not appear in the list, this suggests network problems or a faulty configuration in the project.

   Please ensure that the "Use configured target computer" check box is selected (as opposed to the local PC station).
7. Click "Configure".
   The "Configure: <selected station>" dialog box opens.
8. In the "Configure: Target Computer" dialog box, click "OK".
   The "Information" dialog box opens.
9. Click "OK".
   The configuration data is transferred to the PC station.
   The completion of the "Configuration" step is indicated in the dialog box message line.
   To activate the network connections, you must then download the network settings to this PC station.
10. Click "Close".

11. For the computer selected in step 2, select the menu command **Target system > Download**.
    The "Download to target system in current project" dialog box opens.

    Note

    The configured network address of the Ethernet interface in the PC station must match the preset address in the target system.

12. If the dialog box warns you that the configuration data will be overwritten, make the decision as follows:
    - During initial commissioning, click "Yes".
    - If the PC station is in process mode, you can only click "Yes" when a communication interruption is permissible.

    The "Stop target module" dialog box opens.
13. In the "Stop target module" dialog box, click "OK" to confirm.
    The "Download" dialog box opens.
14. Click "OK" to confirm.
    The download is performed.
    Once the configuration has been applied, the PC station is ready to operate.
15. Repeat steps 2 through 14 for all of the PC stations.

Switching the logs on the bus (Industrial Ethernet)

Note

You must not deactivate the TCP/IP protocol or the ISO protocol during operation. These protocols are mandatory for the configured operating mode.

If a bus within a system must be switched to a different protocol (for example, from TCP protocol to ISO protocol), you must temporarily set a mixed protocol (TCP and ISO) on the engineering station. Now load the configuration data onto the AS and the operator control and monitoring systems.

Additional information

- *SIMATIC NET; Commissioning PC Stations - Manual and Getting Started* manual

9.6 Creating the plant hierarchy (PH)

Introduction

In the plant view, you structure the project according to technological aspects. In the process you hierarchically organize automation, operator control and monitoring functions into the hierarchy levels plant, unit or function. Name the relevant hierarchy folder according to its technological significance.

Arrange the following in the hierarchy folder:

- CFC and SFCs for the AS
- Pictures and reports for the OS
- Additional documents such as descriptions of units, process tag sheets, planning documents etc. (from Word, Excel, etc.)

The resulting project structure is the plant hierarchy.

Note to reader

The following description is based on the following points:

- The plant hierarchy is created on the central engineering station and, if necessary, filled with additional documents. This is described below.
- The CFC/SFCs or OS pictures/OS reports created on the distributed engineering stations are then assigned to the hierarchy folders.

Overview of configuration tasks

This overview shows you the steps for creating the plant hierarchy:

What?	Where?
Creating the plant hierarchy (Page 265)	SIMATIC Manager
Inserting Additional Hierarchy Folders into the Plant Hierarchy (Page 267)	Plant hierarchy
Specifying the AS/Os assignment (Page 270)	Hierarchy folder in the plant hierar-chy
Assignment of objects of the plant hierarchy (Page 272)	Component view
Checking the Consistency in the Plant Hierarchy (Page 273)	SIMATIC Manager

9.6.1 Configuration of the PH

PH created with the PCS 7 "New Project" wizard

With the "New Project" PCS 7 wizard, you create a PCS 7 multiproject with project and master data library including the corresponding plant hierarchy (PH).

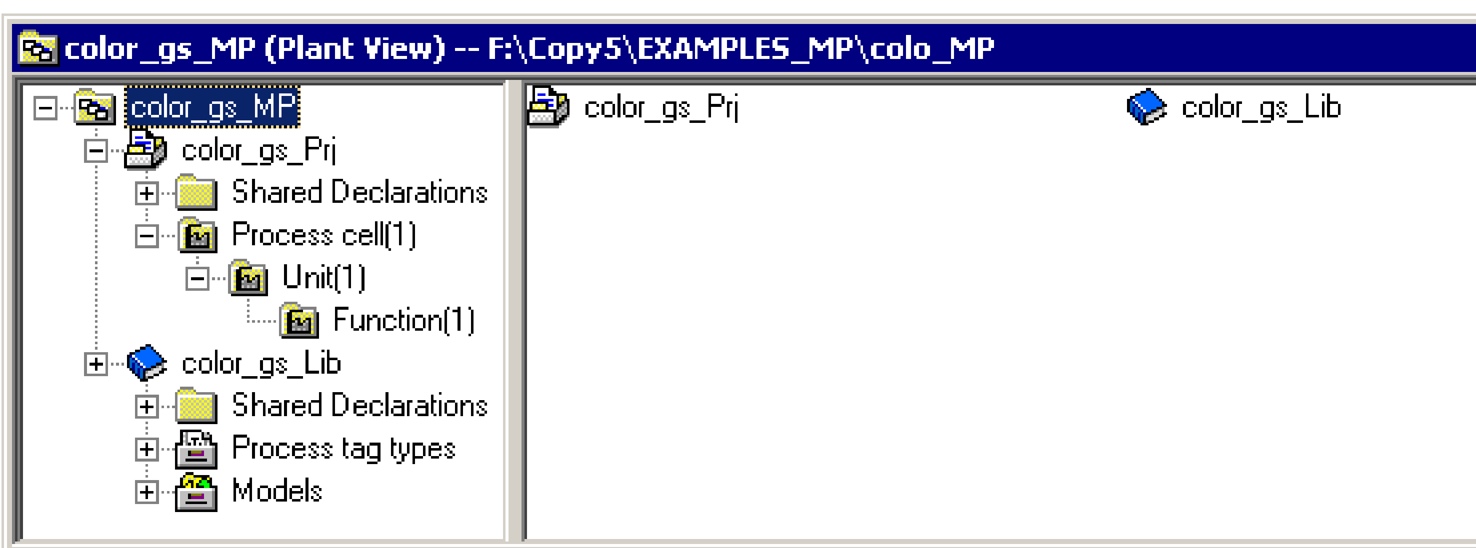
The following hierarchy objects are created in the plant view or in the process object view:

- Multiproject (in the s7_Pro4_MP)
- Project (in the example s7_Pro4_Prj)
- Shared declarations
- Plant (in the example: plant(1))
- A unit (in the example: Unit(1))
- A technological function (in the example: function(1))
- Master data library (in the example: s7_Pro4_Lib)
  In the component view:
  An S7 program with the folders for
  - Source files
  - Blocks
  - Charts
  - One folder for shared declarations

  In the plant view:
  The folders for
  - Process tag types
  - Models
  - Shared declarations

Select plant view

If the plant view is not visible, select the menu command **View > Plant View**.



9.6.2 PH Settings and Properties

Introduction

When you create a multiproject with the PCS 7 wizard, defaults or specified parameter settings made in the individual steps of the PCS 7 wizard were used (for example, the number of hierarchy levels, assignment to AS). You can change these settings later or adapt them for hierarchy folders to be added later.

Definition of the Higher Level (Plant) Designation (HID)

The higher-level or plant designation (HID) is used to identify parts of the plant according to their unique functional aspects. The HID is structured hierarchically according to the plant configuration.

When making the settings for the plant hierarchy, you can specify which **hierarchy levels** are included automatically in the HID and how many characters each part of the name will have. As a result, the HID consists of the names of the various hierarchy folders.
Example:
[NameHierarchyfolderLevel1]\[NameHierarchyfolderLevel2]"

For each **hierarchy folder** at each hierarchy level, you can also specify whether its name is included in the HID or whether it should be removed from the HID. Hierarchy folders that are included in the HID, are said to be "hierarchy folders included in the designation".

Note

To ensure consistent naming throughout the entire project, make sure that you select a suitable naming scheme for the hierarchy folders in the plant view during configuration.

The number of characters in the names of the hierarchy folders must not exceed the number of characters specified for the HID.

Overview of the settings for the plant hierarchy

Setting	Description
Number of hierarchy levels	Specifies the maximum number of possible hierarchy levels, maximum eight levels. At each level, you can insert as many hierarchy folders as required.
Basing the picture hierarchy on the plant hierarchy	With this option, the OS picture hierarchy is derived completely from the configured data of the plant hierarchy. This picture hierarchy is transferred to the Picture Tree Manager when you later compile the OS.
Derive diagnostics screens from the plant hierarchy	With this option, the diagnostics screens are generated in the plant hierarchy for the maintenance station. You can also specify if the names of the diagnostic screens to be generated should derived from the name of the hierarchy folders or from the comments of the hardware components. You can only select this option when the option "Derive picture hierarchy from the plant hierarchy" is also set.

Setting	Description
Migrating diagnostics settings	After you have selected an OS for the diagnostics area, properties will be automatically modified at this OS (and at all other OS of the multiproject), including the expansion of the startup list. These settings must be migrated in the course of an upgrade to higher PCS 7 versions.
Level settings	
Max. number of characters	Specifies the maximum number of characters permitted for the name of a hierarchy folder at this level (1 to 24).
Included in HID	You can select the levels from which hierarchy folder names (if selected for inclusion) will be included in the HID. Hierarchy folders that do not contribute to the naming scheme can be used to create additional "drawers" (e.g, for reference documents such as plant descriptions or process tag sheets). Naming scheme means that the names contributing to the HID are entered in the origin of the message (OS) and in the tag names on the OS (process tag). **Note**: Remember that when assigning names and compiling the OS, the tag name must not be longer than 128 characters. The name consists of the following elements: • Name of the folder in the hierarchy path (including server prefix) • Chart name • Block name • Separator • I/O name
With separator	With this option, a separator can be included in the HID after the name of hierarchy folders of this level. Separators are used in the textual representation of the hierarchy path to differentiate between the names of the hierarchy folders. The "\" character is used as the separator.
OS area	With this, you can decide which hierarchy level should count as the OS area. The default is the 1st level. The definition of an OS area is necessary for area-specific messages in process mode.

9.6.3 How to perform the settings for the PH

Procedure

1. Open the plant hierarchy in the SIMATIC Manager with the menu command **View > Plant View**.
2. Select a hierarchy folder and select the menu command **Options > Plant Hierarchy > Customize...**.
   If you have selected several projects in a multiproject, you can first see a dialog box with a list of the selected projects. You can make the setting shown in the following dialog box only after selecting a project.

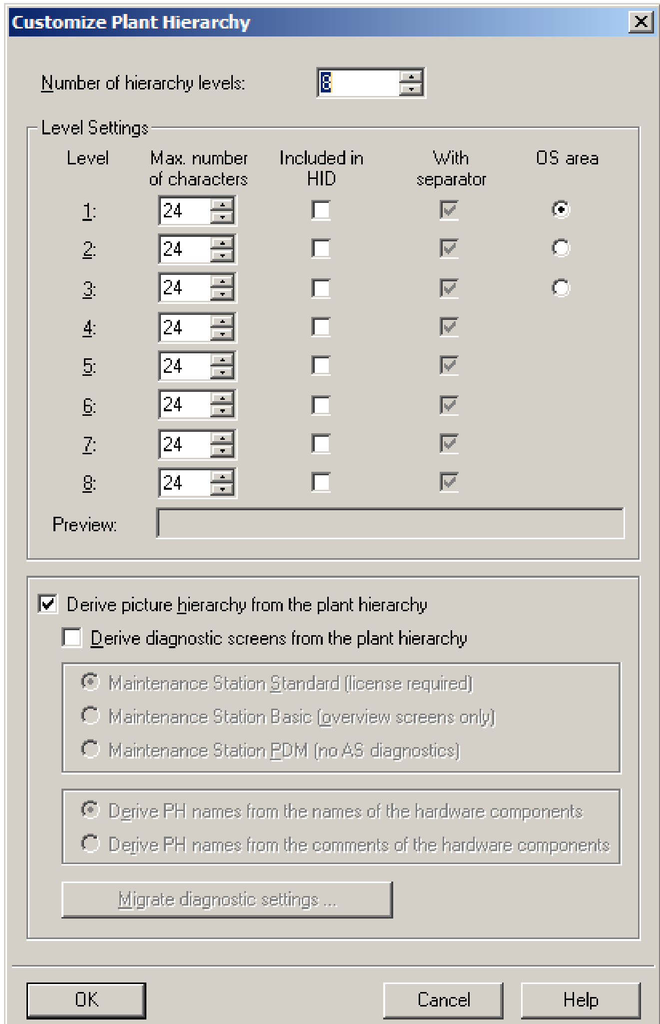
   Note

   The settings function as a template and are passed on to all other projects that were included in the selection. Projects that were not selected retain their settings.

   If you select the multiproject explicitly, all the projects it contains will adopt the settings you made in the template project.

   ---

3. Click "OK".
   The "Plant Hierarchy - Settings" dialog box opens.



4. Make the settings of the plant hierarchy for the project.
   (You can find more information on this topic in the section "PH Settings and Properties (Page 263)").
5. Click "OK".

Additional information

- Manual *Process Control System PCS 7; Operator Station*
- Online help for the "Plant Hierarchy - Settings" dialog

9.6.4 Naming conventions for the PH

Expanding the basic structure

You can create up to 8 hierarchy levels with the PCS 7 wizard without additional nesting of hierarchy folders. You can further expand this basic structure during configuration by adding further hierarchy folders and/or technological objects.

When doing this, remember the following rules for naming folders/objects in the plant hierarchy.

Naming conventions for folders/objects

- The following special characters may not be used in the name of a hierarchy folder: [.] [%] [/] [\ ] ["]

Note

The characters ['] [.] [%] [\ ] [*] [?] [:] [blank] within a name are converted into the substitute character $ when compiling the OS.

The ES separator [\ ] is converted to the [/] character.

If, for example, you assign the name "TICA:1" for a CFC (this becomes "TICA$1" on the OS) and the name "TICA*1" for another CFC (also becomes "TICA$1"), you will receive an error message when you transfer the second chart because the chart name already exists.

- The maximum length of a tag name is 128 characters. Remember, however, that many of the editing windows on the OS can not display 128 characters in their entirety. You should therefore restrict the length of the HID.
- Remember that special characters associated with certain national languages take up two characters, thus reducing the maximum name length accordingly.
- Remember that the length of the texts transferred depends on the maximum text length of a target block in the OS (Tag Logging, for example, event 50 characters; origin 32 characters). When compiling the OS, texts up to a maximum length of 255 characters are transferred.
  Remedy:
  Increase the maximum character length of the user text field or select a shorter HID.
- The message texts of the transferred messages are made up of the hierarchy path, chart name, and the block name (if you decided to include the names in the HID).

9.6.5 How to insert additional hierarchy folders

Introduction

You can create up to 8 hierarchy levels with the PCS 7 wizard without additional nesting of hierarchy folders. You can expand this structure that was created by the PCS 7 wizard with additional hierarchy folders and/or technological objects.

Hierarchy folder

The hierarchy folder is used to structure the plant in a hierarchy. It can contain additional hierarchy folders and objects:

- CFCs
- SFCs
- OS pictures
- OS reports
- Equipment properties
- Additional documents (for example: Excel, Word)

The higher-level designation (HID) of an object results from the names of the hierarchy folders (path) and the object name (if you decided to include the names in the HID).

Procedure

1. Open the plant hierarchy in the SIMATIC Manager with the menu command **View > Plant View**.
2. Select a hierarchy folder below which you want to insert the additional hierarchy folder.
3. Select the menu command **Insert > Technological Objects > Hierarchy Folder**.
4. Enter the technological name of the hierarchy folder.

Assigning technological names

After insertion, the hierarchy folder is displayed in the right window area. It is prepared for you to change its name: The name field with the name assigned by the system is selected, and the cursor is located after the last character of the folder name. You can now enter the required technological name directly with the keyboard (delete and edit).

9.6.6 How to insert objects in the hierarchy folder

Introduction

The technological objects CFCs, SFCs, OS pictures, OS reports, and equipment properties can be inserted in the plant hierarchy in both the plant view and process object view. The method for inserting objects is practically identical. Below you will find a description of how to insert technological objects into the plant view.

Inserting an object

You can insert the following objects: CFC/SFC, OS picture/OS report, equipment properties.

1. Open the plant view in the SIMATIC Manager with the menu command **View > Plant View**.
2. Select the hierarchy folder below which you want to insert the object.
3. Select the menu command **Insert > Technology Objects > "<Required Object>"**.

Inserting additional documents

In addition to the objects required for automation and for operator control and monitoring of the plant, you can also insert additional documents in a hierarchy folder (for example, unit descriptions, process tag sheets, engineering documents).

1. Select the hierarchy folder below which you want to insert the object.
2. Select the menu command **Insert > Technology Objects > Additional Document**.
   The "Insert additional documents" dialog box opens. All available applications are displayed.

   Note

   You can also create a new additional document by selecting the type in the "Registered Applications" box, entering the name and confirming with "OK".
   The additional document is created in the PH. Double-click the document to open and edit it.

   ---
3. Click "Import".
4. Select the required additional document.
5. Click "OK".
   The selection is entered.

9.6.7 Rules for copying and moving within the PH

Rules for copying/moving/deleting hierarchy folders

- If you copy or delete hierarchy folders, all the objects they contain are copied or deleted as well. When copying, it is possible to copy an entire unit in one step, for example. Afterwards, you only need to carry out the modifications to the copied unit (for example, link to process signals).
- If the target hierarchy folder to which you want to copy or move has **no assignment** to an AS (chart folder) and/or to the OS, this is created automatically by the system (you can find information about this in the section "How to specify the AS/OS assignment (Page 270)") This means that within a project the same assignment is entered on the copied hierarchy folder as in the source files folder. In the case of multilevel hierarchy branches with different assignments, the different assignments are retained.

- When more than one project is involved, every AS and OS in the target environment is identified. If a unique assignment cannot be made, (no AS or OS, or only one), a list of the possible alternatives is displayed for selection. Once again, if hierarchy branches have different assignments, they are also different in the target as specified in the source hierarchy branch.
- If the target hierarchy folder to which you want to copy/move already has an assignment to an AS and/or to an OS, this assignment is passed on to all copied objects.
- You can also copy and move the hierarchy folders containing objects with different assignments. A warning is displayed asking you whether you really want to copy or move the folder. If you answer "Yes", all the objects are copied to the AS (or OS) that is assigned to the target hierarchy folder. If you answer "No", nothing happens.
- If the hierarchy folders you want to copy/move are models or replicas of models, remember the special rules that apply to them (you can find information about this in the section "How to work with models in the SIMATIC Manager (Page 524)").

Additional information

- Section "Relationships between the views (Page 221)"
- Section "Cross-view functions and how to use them (Page 222)"

9.6.8 How to specify the AS-OS assignment

Introduction

You must assign an OS and at least one AS for the hierarchy folder in the plant hierarchy. The AS/OS assignment produces the following results in the component view:

- All CFC and SFCs inserted in the plant hierarchy are stored in the chart folder of the assigned AS.
- All OS images and OS reports inserted in the plant hierarchy are stored in the folder of the assigned OS.

Block icons for AS blocks from different library versions

Beginning with PCS 7 V8.1, the same block icons for AS blocks from different library versions can be shown in the process pictures of an OS. If an OS is assigned to several AS, only AS blocks of the following versions of the Advanced Process Library can be configured for each AS:

- AS blocks from PCS 7 V7.1 SP3
- AS blocks as of PCS 7 V8.1

The block icons are inserted into the process pictures when the OS is compiled. The standard picture "@PCS7TypicalsAPLV8.pld" serves as template for creating/updating the block icons of all AS in the process pictures.

Procedure

1. Select the hierarchy folder for which you want to make the AS-OS assignment in the plant view.
2. Select the menu command **Edit > Object Properties** and change to the "AS-OS Assignment" tab.
3. From the "Assigned AS (Chart Folder)" drop-down list, select the S7 program that you want to assign to the selected hierarchy folder.
4. If the lower-level objects have a different assignment and you want to have the same assignment for all lower-level objects, check the "Pass on selected assignment to Pass on all the lower-level objects" check box.

   Note

   The "Pass on selected assignment to all lower-level objects" check box is only active if the lower-level objects have another assignment or no assignment.

5. From the "Assigned OS" list, select the operator station you want to assign to the selected hierarchy folder.
6. If the lower-level objects have a different assignment and you want to have the same assignment for all lower-level objects, check the "Pass on selected assignment to Pass on all the lower-level objects" check box.

   Note

   If the "area-oriented" compilation mode is activated, the OS assignment can only be changed for PH folders of the OS area level.

7. Click "OK".

Result

The AS/OS assignment is selected, and the lower-level objects are passed on or not passed on according to your setting.

Note

If you have distributed the projects so that there is only one OS or one AS in a project, you do not need to make an AS/OS assignment.

Additional information

- Online help for *PH*, *IEA* and *PO*
- Online help for the "AS-OS Assignment" tab

9.6.9 How to assign objects to the PH

Introduction

You can also assign objects from the component view, for example, a CFC or SFC, to the plant hierarchy at a later time. This is always the case whenever charts are inserted directly in the component view and you subsequently create a plant hierarchy, for example. If you always create charts and pictures in the plant view or in the process object view, they are automatically assigned to the plant hierarchy.

Requirement

The hierarchy folder has the same AS or OS assignment as the assigned object. If the target hierarchy folder has a different AS-OS assignment, the assigned object is also moved to this AS/OS in the component view.

Note

If you have selected the setting "Derive picture hierarchy from the plant hierarchy" in the settings of the plant hierarchy, only one picture of the same OS is permitted for each hierarchy folder.

Procedure

1. Select the required object in the component view.
2. Hold down the <Shift> key (move) and drag the object to the required hierarchy folder of the PH.

If you have created OS pictures/OS reports directly in the OS and want to assign these object to the plant hierarchy later, follow these steps:

1. Select the OS in the component view of your project.
2. Select the menu command **Options > OS > Import WinCC Objects**.
3. Select the required object in the component view.
4. While holding down the <Shift> key (move), drag the object from the component view to the required hierarchy folder of the PH.

Assignment after copying/moving

- When you copy/move a hierarchy folder to a hierarchy folder that is assigned to a different AS or OS, the copied/moved hierarchy folder also receives the assignment of the target folder.
- When you copy/move objects (such as CFCs, OS pictures/OS reports) to a hierarchy folder assigned to a different AS/OS, these objects are also copied/moved to the other AS or OS.
- When you copy/move hierarchy folders with CFCs and OS pictures, the references of the dynamic objects from these OS pictures to CFC blocks are automatically updated in the target hierarchy folder.

Note

The process variables referenced in the C scripts in WinCC must be defined in the "#define section".

Interconnections after copying/moving

When you copy / move CFCs, the interconnections to shared operands are either automatically copied or deleted.

The settings can be made in CFC with the **Options > Settings > Copy/Move...** menu command or in the SIMATIC Manager with the **Options > Charts > Settings for Copying/Moving....** menu command. The option "Copy interconnections with operands" is the default setting.

Canceling the PH assignment

If you want to use the charts, OS pictures, and OS reports in a project without PH, or delete the PH from the current project without losing the charts, pictures, or reports, you can cancel the assignment to the PH with the menu command **Options >Plant Hierarchy > Cancel Assignment...**.

The function is available in the component view and in the plant view.

Interconnections between charts and OS pictures

When you copy/move hierarchy folders containing interconnected pictures and charts, the picture interconnections are always updated. Explicit updating is not necessary.

When you compile the OS, all changes that affect ES variables are updated.

9.6.10 How to check the consistency of the PH

Introduction

You can use PCS 7 to determine whether the configured data are consistent with the settings made in the project or multiproject.

Consistency checks

The following properties are evaluated in the consistency check:

- Non-unique names of S7 programs, CFCs and SFCs
- Brackets in the names of hierarchy folders
- Length of the hierarchy folder names
- Number of hierarchy folder levels
- Area assignment to an OS for uniqueness and completeness

The following is checked when the check box "Derive picture hierarchy from the plant hierarchy" is selected:

- Number of OS pictures per hierarchy folder
- Unique picture names for OS

The results are displayed in the individual tabs.

Additional information concerning the test results displayed in the tabs is available by clicking "Help".

Additional tests for a selected multiproject

Note

If a **multiproject** is selected, the following checks are also made:

- Check for unique names of S7 programs. Check whether the names of CFCs and SFCs are unique in the entire multiproject.
- Check if only one object for each type (S7 program, OS) is available in the master data library.
- Check for uniformity in the OS assignment when area folders have the same name in the multiproject
- Check for uniformity in the OS compiling mode ("AS oriented" or "Area oriented") throughout all projects in the multiproject
- Check for consistent PH settings in the multiproject (levels of the OS area, derivation of the picture hierarchy and diagnostics, HID relevance)

If a **project** or hierarchy folder is selected, then the tests are related exclusively to that project / hierarchy folder.

Procedure

1. Select the multiproject or a project in the plant hierarchy.
2. Select the menu command **Options > Plant Hierarchy > Check Consistency**.
   The "Consistency Check - Log" dialog box opens, with the errors.
3. Clear the errors and run the consistency check again.

Display check log

A message is displayed when the check is complete, or, if errors occurred, the check log is output.

You can also display the log later without running the check again with the menu command **Options > Plant Hierarchy > Display Check Log**. A check log is not displayed when the last consistency check has shown that the configured data are consistent with the settings that have been made.

Note

Violations of the naming scheme can occur, for example, when you change settings at a later date or copy/move folders to different levels. The system tolerates these violations to avoid unnecessary error messages while you are working.

Additional information

For additional information about the check log, refer to the online help.

9.6.11 Additional PH functions in a multiproject

PH functions specific to multiprojects

The functions of the plant hierarchy are adapted to the needs of multiproject engineering. Support begins with the creation of the multiproject by the PCS 7 wizard.

The following functions are important for multiprojects:

Function	Description
Creating a Multiproject	In the SIMATIC Manager, the PCS 7 wizard automatically creates a multiproject. • The project is created with the content selected in the PCS 7 wizard (PH, AS, OS). • Three hierarchy folders are created in the master data library in the PH that serve as storage for process tag types, models and shared declarations.
Cross-project consistency checks	• The consistency check allows multiple assignment of names to single control units to be recognized early. This prevents these errors from canceling the data transfer procedure to the OS (during the compile OS function). • You can check the uniqueness of the S7 programs in all of the multiproject projects. The uniqueness of the S7 programs is a requirement for the proper functioning of the Import/ Export Wizard and the diagnostic function. • Within the master data library, a check is made to ensure that there is only one S7 program and only one OS.

Function	Description
Passing on PH Settings to other Projects of a Multiproject	The PH settings for the projects in a multiproject can be changed by using the menu command **Options > Plant Hierarchy > Customize...**: • Settings for an individual project If you select an individual project in a multiproject, you can define PH settings which are exclusive to this project. • Identical settings for several/all projects If you select several projects in a multiproject or the multiproject itself to display the settings dialog box, an additional dialog box is displayed in advance. Use this dialog box to select a project template and then enter the TM settings in the next dialog box. The settings of this template are passed on to all projects included in the selection.
Create/update block icons in all projects of a multiproject	The menu command **Options > Plant Hierarchy > Create/update block icons...** is used to take into account all the pictures whose block icons are based on the PH, starting with the selected object (multiproject, project, hierarchy folder). In a multiproject, the path in the PH is the key for searching in other projects. PH structures with the same name are searched for in all projects of the multiproject. The CFCs found there are included in the editing process.
Set/update the size of the block icons	As of PCS 7 V8.1, you can define the size of the block icons of the Advanced Process Library (as of V8.1) for the process pictures of an OS. To set the size, select the menu command **Options > Plant Hierarchy > Create/update block icons...**. Enter the required percentage in the "Zoom block icons" area.
Synchronizing Hierarchy Folders in the Multiproject	When working in a multiproject, in some situations it is necessary to create redundant folders in parts of the plant hierarchy in all or individual projects of a multiproject. There are two applications: • In SIMATIC BATCH, the folder identified as "Process cell" is required in the first hierarchy level in all projects. • By using the same names in the plant hierarchy in the individual projects of the multiproject, AS and OS parts that belong together are detected when the functions "Create/Update Block Icons" and "Create/Update Diagnostic Screens" are executed. The plant hierarchy synchronization function in the multiproject allows you to save multiple configurations. This also protects the project from (accidental) changes that would result in differing names. You can start the synchronization function in either the process object view or the plant view by selecting the menu command **Options > Plant Hierarchy > Synchronize in the Multiproject...**.
Renaming or modifying attributes of the hierarchy folder	When attributes of a hierarchy folder are renamed or modified, a check is carried out to determine if the hierarchy folders derived from it exist in the other projects of the multiproject. If this is the case, they are renames and the attributes are set accordingly.
Create/update diagnostics screens	Use menu command **Options > Plant Hierarchy > Create/update block icons** to create or update diagnostics screens for a project or for the projects of a multiproject. Requirement: A diagnostics structure must have already been set up in the project.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.6.12 Defining types in hierarchy folders on the basis of ISA-88

Introduction

You can assign attributes to the hierarchy folder in the PH in accordance with the ISA-88.01 standard. This "ISA-88 type definition" is required, for example, for BATCH plants and applications at works management level (MES).

You can use the object properties to change the hierarchy folder object type from "Neutral" to "Process cell," "Unit" or "Equipment module".

Procedure

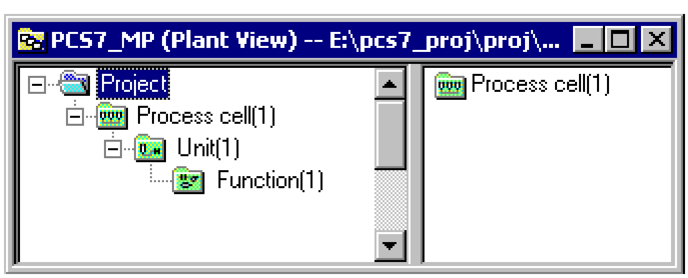
1. Select the object whose settings you want to change in the PH.
2. Select the menu command **Edit > Object Properties**
3. Open the "ISA-88 Type Definition" tab.
4. Change the object type for example from "<Neutral>" to "Process cell."
5. Click "OK".

Result

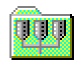
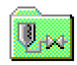
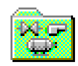
When you create further folders, the folders in the two levels directly below are assigned the attributes for "Unit" and "Equipment module" according to their hierarchical level.

Plant hierarchy structure

The following figure shows the 3 hierarchy folders with the ISA-88 type definition.



Technological significance of the PH

Hierarchy folder	Symbol	Meaning
Plant		Within a project, only one process cell can currently be created.
Unit		Several units can be defined in one process cell.
Equipment module (Phase)		Several equipment modules such as a dosing or bottling machine can be defined in a unit.

Neutral folders

The 3-level hierarchy can be extended by adding neutral folders to improve the structuring of the project, for example, to divide units into groups. The neutral folders can be created at any level. The total number of possible levels (ISA-88 hierarchy levels, levels with neutral folders) is limited to eight.

Neutral folders can, for example, be inserted above the "Unit" level. This level can then be used, for example, as the area level. A further level could, for example, be inserted below the "Equipment Module" level. This level can then serve as a control module level.

Successor for the "Unit" object type

A successor is the unit that executes the operations in a production process that were initiated by another unit (the predecessor).

With the "Unit" object type, a different unit from the same or another project can be selected as the "successor" to the unit. If this successor is in a different project, it is inserted in the current project as a hierarchy folder with a link. This is set on the "ISA-88 Type Definition" tab with the "Successor/Predecessor" button.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.6.13 How to configure the automatic display and hide of messages from system charts

Introduction

This function is used to enable the automatic display/hiding of messages from message-capable blocks of the system charts in process mode in the operator station/maintenance station.

Numeric system charts

For this, all numeric system charts must be moved from the component view to the plant hierarchy.

With numeric system charts, the file names begin with the character "@" and a subsequent number e.g. "@1....".

Information about the automatic display/hiding of messages in particular process states, e.g.startup, shutdown, can be found in section "Show and hide messages automatically in process mode (Page 207)".

Requirement

The AS was compiled with the function "Generate module driver".

Procedure

1. Place a hierarchy folder in the plant hierarchy of the project/multiproject outside the "Diagnostic" range.
2. Select the hierarchy folder.
3. Select the command **Object Properties...** from the shortcut menu.
4. Select the "AS-OS Assignment" tab.
5. In the area "Assigned AS (chart folder):", select the corresponding AS from the drop-down list.
6. Select the desired OS/MS in the "Assigned OS:" area from the drop-down list.
   - In the case of a single-station system, the PC station of the OS/MS
   - In the case of a multi-station system, the PC station of the OS/MS server
   - In the case of a SIMATIC MS PDM, the PC station of the SIMATIC MS PDM
7. In the component view, select all numeric system charts for which a number follows the "@" character, e.g. "@1.....".
8. Select the command **Cut** from the shortcut menu.
9. In the plant view, select the hierarchy folder that you created in step 1.
10. Select the menu command **Paste** in the shortcut menu.

Result

For the automatic display/hiding of messages from message-capable blocks of the system charts, these system charts were moved from the component view to the plant hierarchy.

9.7 Creating the master data library

Advantages of a library

During configuration it is advantageous if all objects (blocks, charts, source files, process tag types, models, SFC types) used in the project are grouped in their own library. This means, for example, that you can be sure that only one version of a particular block type is used throughout the entire project.

Note

Operating different library versions with one OS

Since PCS 7 V8.1, the block icons for AS blocks from different versions can be operated and monitored from one OS. If you use a master data library, note that you can only configure and download AS blocks of one version into an AS.

Master data library

When you use the PCS 7 Wizard to create a multiproject, a master data library is created automatically. The master data library is used for storage of the master data of the project for all projects of a multiproject. When you move projects from the multiproject to distributed engineering stations for editing, you must also transfer the master data library so that all configuration engineers have an identical database available.

The master data library helps you to ensure that a defined version of types is reused. The master data library is automatically archived together with the multiproject.

Both those objects used in projects and those objects specially adapted for the projects are stored in the master data library. This includes, for example, the following elements:

- Block types
- SFC types
- Process tag types
- Models
- Shared declarations
- OS pictures
- OS reports

In addition, the following objects can be included in the master data library.

- Object from the *PCS 7 Advanced Process Library*
- Objects from libraries of suppliers
- User-created objects

Maintaining the master data library

Plan your master data library maintenance strategy carefully. We recommend that you thoroughly test block types you create yourself or adapt to the needs of the project before you include them in the master data library. Subsequent changes (after generating block instances) are supported by the system, but involve more effort, due to central modification of the block type or recompilation of the OS.

Note

If you have used blocks or SFC types from the PCS 7 library in your master data library and the version of the PCS 7 library has changed, you need to perform an update.

The function "Update block types" is available for synchronizing the block types and SFC types. You can find information about this in the section "How to update block types and SFC types (Page 289)".

Note

The supplied libraries are always copied during PCS 7 installation. If you have edited supplied libraries, the libraries you have changed will be overwritten by the originals if you install again.

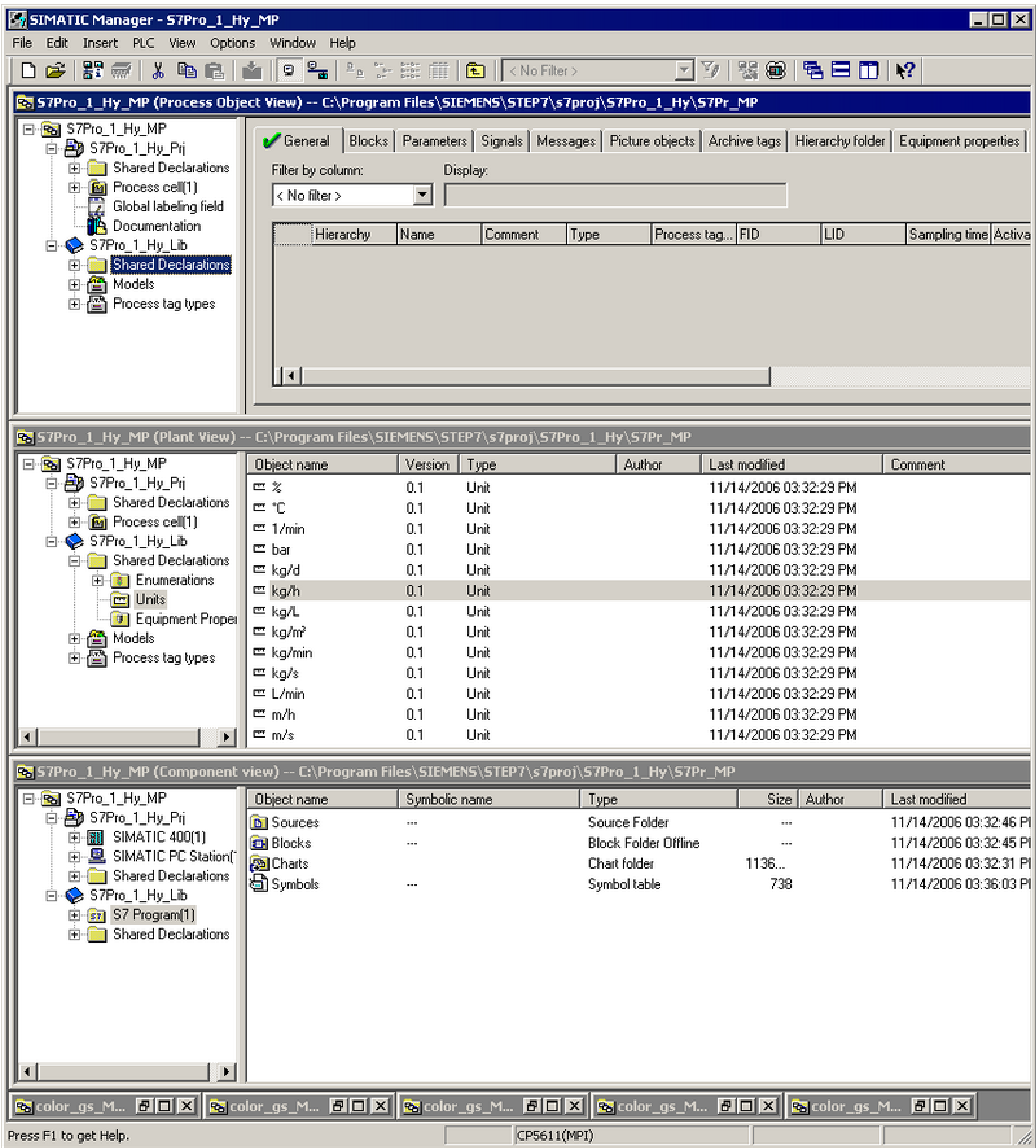
Overview of configuration tasks

What?	Where?
Creating the master data library (Page 285)	SIMATIC Manager
Copying objects to the master data library (Page 287)	SIMATIC Manager
How to adapt blocks to specific projects (Page 290)	SIMATIC Manager (component view)
Creating process tag types (Page 475)	SIMATIC Manager (plant view)
Creating models (Page 518)	SIMATIC Manager (plant view)
Testing the library objects (Page 304)	CFC or SFC Editors
Documenting the library objects (Page 305)	In the relevant editors
Hiding libraries (Page 286)	SIMATIC Manager

9.7.1 Objects of the master data library

Master data library configuration

The master data library contains different folders depending on the view in use:



In the component view

The master data library contains the following in the component view:

- One S7 program with separate folders for blocks, sources and charts
- A folder for shared declarations
- The object symbol (symbol table) in the detail window

Copy all block types (technological blocks, driver blocks, communication blocks) you need for the multiproject to the block folder of the master data library.

This may be a collection from PCS 7 libraries, libraries of suppliers, or blocks you have written yourself.

The blocks from the PCS 7 libraries are suitable and usable for most situations encountered during configuration. If blocks need to be adapted for special requirements, you should make these adaptations early; in other words, before the blocks are used in the projects.

SFC types are stored in the chart folder of the master data library.

Note

SFC types can also be part of process tag types or models.

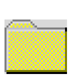
The OS pictures and OS reports that are intended for use as templates, are copied to a hierarchy folder of the master data library after they have been tested in the project. At this time an OS is created in the master data library. It can be seen in the component view.

Note

This OS is not part of the automation solution.

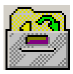
In the Plant View and Process Object View

In the plant hierarchy (plant view or process object view), the master data library contains one folder each for process tag types and models. These two hierarchy folders each have an AS assignment to the S7 program and identifiers that identify them as hierarchy folders of a master data library.



- **Shared declarations**
  You can define the following elements as shared declarations, which you can use in a variety of applications:
  - Enumerations
  - Units
  - Equipment properties

- **Process tag types**
  A process tag type is a CFC configured for a specific process control function for the basic automation of a process engineering plant, such as fill-level control. Copies can be made from this process tag type and then adapted and utilized in accordance with the specific automation task. The copy of a process tag type is a process tag.



- **Models**
  A model consists of hierarchy folders that contain the following elements:
  - CFC/SFCs
  - OS pictures
  - OS reports
  - Additional documents

  Any number of replicas can be created from these elements by using the Import Export Assistant.
- **Templates**
  The PCS 7 library "Advanced Process Library" contain templates for technological functions.

Function of the hierarchy folders

The hierarchy folders of the Master data library can be distinguished from the hierarchy folders of the project in the following ways:

- When the copy destination is not a master data library or the same folder hierarchy is already contained in it, during copying/moving the folder hierarchy loses its identifier, which identifies it as a folder hierarchy of the master data library.
  If a hierarchy folder loses its identifier, the icon of a normal hierarchy folder replaces its icon.
- You cannot insert any new hierarchy folders with this identifier explicitly in the master data library. If the corresponding folder is no longer available when creating models and process tag types, it is automatically created in the master data library.
- Hierarchy folders that lose their identifier can no longer be identified after they are returned to the master data library.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.7.2 How to create a master data library

Introduction

If you have created your multiproject with the PCS 7 wizard, it already contains a master data library. SIMATIC Manager can be used in the following manner to define a master data library if you still do not have one in your multiproject:

- Create a new library and define it as the master data library.
- Define an existing library as the master data library.

Note

Each multiproject can only contain one master data library. The master data library can only contain one S7 program.

Procedure

Requirement: No library is defined as a master data library in the multiproject. If, however, a master data library is defined, the definition of an existing master data library must be reversed. This can be achieved by carrying out the step 4 under "Procedure".

To create a new library as the master data library in your multiproject, proceed as follows:

1. Select the menu command **File > New** in the SIMATIC Manager
2. Open the "Libraries" tab and enter a name for the library (preferably the multiproject name).
3. Enter the storage location (path), if necessary.
   The library is created and opened.
4. Select the library in the multiproject in the component view and then the menu command **File > Multiproject > Define as master data library**.
   The library is defined as a master data library.
5. Select the library and then the menu command **Insert > Program > S7 Program**.
   An S7 program is created, including block and source folders.
6. Add a chart folder below the S7 program with the menu command **Insert > S7 Software > Chart Folder**.

Result

Your multiproject has a new master data library. The models or process tag types folders do not need to be set up explicitly in the plant hierarchy. These are automatically set up when models or process tag types are created.

Naming

> **Note**
>
> The SIMATIC Manager supports names longer than 8 characters. The name of the library directory is, however, limited to 8 characters. Library names must therefore differ from each other in the first 8 characters. The names are not case-sensitive.
>
> Please make sure that the name of the file always coincides with the name of the library originally set up. Name changes do not take effect at the file level in SIMATIC Manager.

9.7.3 How to work with libraries

Introduction

This section explains the most important functions when handling libraries. Become familiar with these functions prior to adding objects to the master data library from other libraries.

Library functions

In the SIMATIC Manager, you can use the following functions with libraries:

- Open a library with the menu command **File > Open >** in the "Libraries" tab.
- You can copy a library with the menu command **File > Save As** and assign a different name for the library.
- You can delete a library with the menu command **File > Delete** in the "Libraries" tab.
- You can delete parts of libraries such as charts, blocks, and source files with the menu command **Edit > Delete.**
- Libraries not in use can be hidden and then made visible again in the following manner:
  - Select the menu command **File > Manage** in the "Libraries" tab.
  - Select the desired library and click "Hide".

  The library can be made visible again with the "Display" button.

  > **Note**
  >
  > We recommend that you hide all of the libraries except for the master data library since the master data library contains all the objects used in the project.

Creating a new library

1. Select the menu command **File > New** in the SIMATIC Manager.
2. Change to the "Libraries" tab and enter the name and the location for the library if necessary.
3. Click "OK".

Result

A new library is set up in the multiproject.

Naming

Note

The SIMATIC Manager supports names longer than 8 characters. The name of the library directory is, however, limited to 8 characters. Library names must therefore differ from each other in the first 8 characters. The names are not case-sensitive.

Please make sure that the name of the file always coincides with the name of the library originally set up. Name changes do not take effect at the file level in SIMATIC Manager.

9.7.4 How to copy objects from other libraries to the master data library

Introduction

The following section describes how to enter objects from the supplied PCS 7 library (PCS 7 Advanced Process Library) or from libraries from other suppliers in the master data library.

Note

Block types in the AS 41x (download block types in RUN to AS 410H)

Only the block types of one PCS 7 library version can be loaded to an AS at any one time.

As of PCS 7 V8.1 or higher, the "type update with a CPU 410-5H" can be used to load block types with modified interface into an AS in RUN.
Requirement:
CPU 410-5H as of firmware version 8.1 or higher used in the AS.
You can find additional information on this in the online help for CFC.

Procedure

If you want to copy part of a library, for example, software, blocks, pictures etc., proceed as follows:

1. Select the menu command **File > Open** in the SIMATIC Manager.
2. Open the "Libraries" tab.
3. Select the desired library and click "OK".
   The library opens.
4. Select the object to be copied (for example, process tag type, blocks) in the open library (source) and then select the menu command **Edit > Copy**.

5. Select the folder in the master data library (destination) where you want to store the copied object.
6. Select **Edit > Paste** from the menu.

Result

The copied object is stored in the master data library.

Rules for copying

- If you want to copy the supplied process tag types from the PCS 7 Advanced Process Library to your master data library, select only the desired process tag types within the "Templates" folder, copy them and then paste them into the "Charts" folder of your master data library.
- If you copy templates to your master data library, please note that they may overwrite any existing blocks which have been customized for the specific project.
- If you copy blocks from different libraries, it is possible that blocks could have different names (and functions) but the same block numbers. In this case, a dialog box opens where you can rename the block or synchronize the attributes.

  Note

  Simultaneous use of the libraries "Standard Library" (STEP 7), "CFC Library" (ES/CFC), "PCS 7 Advanced Process Library":

  The libraries of STEP 7, ES/CFC, and PCS 7 contain blocks with the same name (but with different functions) as well as blocks with the same number (but with different functions).

  - **Same block name** - CONT_C/CONT_S/PULSGEN/CTU/CTD/CTUD
    For these blocks, please use the blocks from the CFC Library, since these are better adapted to the PCS 7 environment.
  - **Same block number**
    Solution: The blocks must be assigned free FB/FC numbers in the block folder.
    - For: FC 61 ...125 in the libraries "Standard Library - S5-S7 Converting Blocks" and "Standard Library - TI-S7 Converting Blocks" and "CFC Library ELEMENTA"
    - For: FC 1 ... FC 40 in the libraries "Standard Library - Communication Blocks", "Standard Library - IEC Function Blocks" and the reserved FC inventory in CFC.

- The symbolic name is also copied when blocks from a library are copied.
- When copying into the block folder, the "Insert Function Block" dialog box opens if the system detects that the system attributes of a block you want to insert into the chart from a library differ from those of the exiting block. You can perform an attribute update here (see also the online help for *STEP 7*).

Rules for multiple instance blocks

- If blocks contain code used for accessing other blocks (multiple instance blocks), the applicable version of these lower-level blocks must also be copied. Lower-level FBs that are missing can be determined later by engineering. Missing FCs, however, cannot be detected during compiling or downloading.
- Remember that the block numbers used to access the blocks are stored in the code of the multiple instance block. These numbers (and in turn, the code) can be changed by using the menu command **Options > Rewire....**, which provides access to the rewiring function in the SIMATIC Manager. Exception: with protected blocks.

9.7.5 How to update block types and SFC types

Introduction

After including a new version of a block type or SFC type in the master data library or after adapting a block type in the master data library, you can use the "Update block types" function to list all components in which an older version of the modified block type or SFC type is used. You can also select the components in which the modified block type or SFC type should be updated throughout the entire multiproject.

The blocks of the templates (process tag types, models) are also updated.

If differences are found at SFC types, you can call up the Version Cross Manager (VXM) by using the "Display differences" command button before carrying out updating, if the VXM optional package is installed. The VXM displays the detailed differences of the compared SFC types.

Note

Block types in the AS 41x (download block types in RUN to AS 410H)

Only the block types of one PCS 7 library version can be loaded to an AS at any one time.

As of PCS 7 V8.1, the "type update with a CPU 410-5H" can be used to load block types with modified interface into an AS in RUN.
Requirement:
CPU 410-5H as of firmware version 8.1 used in the AS.
You can find additional information on this in the online help for CFC.

Procedure

1. Select one or more blocks in the block folder of the master data library or one or more SFC types in the chart folder or the chart folder.
2. Select the menu command **Options > Charts > Update Block Types....**
   The "Update Block Types" dialog box opens.
3. Select the S7 programs to be checked for differences compared with the block types/SFC types selected in the master data library.

4. Click "Continue".
   All the selected S7 programs are checked and a further dialog box for selecting the block/SFC types is opened. Here, you also obtain information about the possible effects of updating the block/SFC types.
5. Specify the block/SFC types to be updated for the individual S7 programs: All the block/SFC types to be updated are selected. If necessary, you can deselect any types that should not be updated.
   If there are no block/SFC types to be updated, no block/SFC types are displayed. In this case, close the dialog box.
6. Click "Finish".

Result

The block/SFC types are updated in all the selected S7 programs and a log is displayed.

Note

An update is required after changing blocks. Make the changes to the blocks only in the master data library.

Additional information

- Online help on the dialog boxes

9.7.6 Adapting blocks

9.7.6.1 Adapting blocks to the project requirements

Introduction

The blocks from the PCS 7 libraries are suitable and usable for most situations encountered during configuration. If blocks must be adapted for a specific project and for special requirements, adapt the blocks before using them in the projects and then store them in the master data library.

Overview of configuration tasks

The following block properties and attributes can be adapted:

What?	Where?
Changing the attributes of the block I/Os (Page 291)	LAD/CSF/STL Editor
Locking message attributes against changes at block instances (Page 292)	PCS 7 message configuration

What?	Where?
Translating Message Texts (Page 293)	SIMATIC Manager
Setting the language for display devices (Page 294)	SIMATIC Manager
Exporting/importing operator and display texts (Page 296)	SIMATIC Manager

Note

You may only adapt the blocks to the project requirements in the library. We also assume that you are adapting the blocks in the master data library.

9.7.6.2 How to change the block I/O attributes

Introduction

The block I/Os of the block types have attributes that you can adapt to the project requirements.

Procedure

1. Select the block to be modified in the block folder of the master data library.
2. Select the menu command **Edit > Open Object**.
   The LAD/STL/FBD editor is launched (if the block is protected, you will receive a message). When you select an object in the tree view of the interface, its content is displayed.
3. In the right window, select the desired I/O followed by the menu command **Edit > Object Properties**.
   The "Properties" dialog box opens.
4. Select the "Attributes" tab
   The attributes are displayed in the form of a table.
5. Modify the attributes and their values in this table, or enter them again.
   If you click the "Attribute" column, a selection of the possible attributes for this I/O appear in a drop-down list.

Modifying attributes is not difficult since there is a syntax check when the attributes are entered and you will be informed of errors or missing information.

Note

Information regarding the use of attributes and their description can be found in the online help for the LAD/STL/FBD editors.

Please take note of the following special situations

- Configure the texts for the attributes "S7_string_0", "S7_string_1", "S7_unit" and "S7_shortcut" in the language that will be used by the operator on the OS. If you would like to have these texts available on the OS in additional languages, they must be translated in the WinCC dictionary.
- The "S7_enum" attribute can be used to assign an enumeration to a block parameter. In addition, an "enumeration" data type with the name selected by the user is set up in the ES. In addition, a parameter of the data type "BOOL," "BYTE," "INT," "DINT," "WORD," or "DWORD" is created for the block parameters that use the enumeration. This parameter is given the "S7_enum" system attribute. The ES defined "enumeration" name is used as the value. The "enumeration" names can be configured in several different languages.
- When you modify attributes that are synchronized with the faceplates or the block structure on the OS (for example, S7_m_c), errors may occur when you interconnect the faceplates or when you compile the OS.
- The attributes can be distinguished in the following manner:
  - Attributes with a "type character"
    The property refers to the block type. Changes made to these attributes (for example, S7_link) will also apply to all existing block instances.
  - Attributes with an "instance character"
    The property refers to the individual instance. Changes made to these attributes (for example, S7_visible) do **not** retroactively affect existing block instances. They simply function as the default option.
    Exception: in the attributes "S7_string_0", "S7_string_1", "S7_unit" and "S7_shortcut", modifications are adopted by the CFC if the user has not changed the value in the block instance.
- Read back the parameters from the CPU
  In the read back dialog box, you can set the parameters to be read back:
  - all (S7_read_back = true; default)
  - can be controlled and monitored (S7_m_c := 'true')
  - marked parameters (S7_read_back := 'true')
  - none
    The block is excluded completely from read back
    (S7_read_back = false).

You can find additional information on this in the section "How to download to all target systems (Page 612)".

9.7.6.3 Lock message attributes against changes to block instances

Message texts and message attributes

When using the "User-configurable message classes" function, refer to the information in the section "User-configurable message classes".

Messages are important for the operator when controlling the process. With the aid of messages, you can monitor and evaluate the process. Message texts and message classes are preset in the block types in the PCS 7 libraries. Messages, for example, are "Actual value too high", "External error", "Overdosing". These messages are sent by the automation system when the corresponding event occurs.

You have the opportunity to adapt these message texts and their attributes to your particular needs: The message texts and their attributes can be adapted in the block type or also in the block instance. If you want to avoid message attributes being modified in the block instances, you can lock the instances.

Procedure

1. Select the block to be modified in the block folder of the master data library.
2. Select the command **Special Object Properties > Message...** in the shortcut menu.
   The "Message Configuration" dialog box opens. This displays all the messages configured for this block.
3. Place a check mark in the column behind the text that you wish to lock.
4. Click "OK" to apply the changes.

Result

The text is locked.

Note

If block instances already exist, the locking of the message attribute can be passed on to the instances by repeating the block import.

Additional information

- For more detailed information on adapting operator and message texts, refer to the Configuration Manual *Process Control System PCS 7; Operator Station*.

9.7.6.4 How to translate message texts

Multilingual message texts

You can enter message texts in more than one language. The PCS 7 library blocks already have prepared message texts in German, English and French, Italian and Spanish.

If you require a language that is not currently available for the message texts of blocks, you can set the language and translate the texts.

Procedure used for the block type example

1. In the SIMATIC Manager, select the menu command **Options > Language for Display Devices...**.
2. From the list of "Available Languages", select the language to be displayed on the OS. Click " -> " to transfer the selected language to the list of "Languages Installed in the Project".
3. Select the language from the "Languages installed in the project" group that you want to set as the standard language and then click "As standard".
4. Click "OK".

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*

9.7.6.5 How to set the language for display devices

Language for display devices

The language for display devices is relevant for transferring messages from the ES to the OS (Compile OS). If you have not selected the required language, the message texts are transferred to the wrong column in the text library and do not appear in process mode.

Procedure

1. In the SIMATIC Manager, select the menu command **Options > Language for Display Devices...**.
2. Set the language for the PCS 7 blocks, for example, "German (Germany)".
3. Select the language from the "Languages installed in the project" list that you want to define as the standard and then click "Standard".
4. Click "OK".

For your project, you can select several languages from the list of available languages and define one of them as standard.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*
- Online help for the dialog box

9.7.6.6 How to create your own blocks for the master data library

Creating your own blocks

You can create your own PCS 7-compliant AS blocks or faceplates and store them in the master data library.

You can find information on creating your own blocks in the manual *Process Control System PCS 7; Programming Instructions Blocks*.

There you can also find a description how to store your own blocks in a library and install it on the target computer with setup for transfer to the master data library.

9.7.6.7 Using faceplates and block icons for OS pictures

Faceplates and block icons

Controlling and monitoring a block instance in process mode on the OS requires the corresponding faceplate. The faceplate contains the graphic representation of all elements of the technological block intended for operator control and monitoring. The faceplate is depicted in a separate window in the OS and is opened via a block icon (typically placed in the OS overview display).

For each technological block type of the PCS 7 Library there is already a corresponding faceplate. Block icons are generated automatically following a menu command. You can also create or adapt faceplates and block icons yourself.

Several block icons can be created in a process picture for each block type in order to depict specific variants of a type.

Note

In CFC, you can assign the block icons to specific instances in the object properties of the blocks.

Faceplates for block types of the PCS 7 "Advanced Process Library"

The display and operator input options of the faceplates for the block types of the PCS 7 library are described in the *PCS 7 Process Control System; Advanced Process Library* manual.

Creating your own faceplates

You can find step-by-step instructions on creating your own faceplates in the *PCS 7 Process Control System;* APL Style guide Programming Manual.

Creating your own block icons

You can find information on generating and adapting block icons in the configuration manual *Process Control System PCS 7; Operator Station*.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*

9.7.6.8 How to import/export blocks, I/Os and messages

Introduction

The entire content of a table can be exported from the process object view for the external assignment of modified parameter values and interconnections to a copied unit. You can then import the modified data again. This method can be used as an alternative to the Import/Export Assistant.

Import/export of parameters, signals, and messages

To visualize the process in process mode, use the faceplates that show the plant operator measured values, operating limits, unit of measure, and block operator texts.

Proceed as follows in the process object view when making centralized changes to the parameters, signals, and messages of the faceplates:

- Export the contents of the table to a file.
- Edit the texts using standard applications (MS Excel, MS Access),
- Import the modified texts.

All the editable fields for parameters, signals, and messages in the process object view are imported/exported. The CFCs in the selected and all lower-level hierarchy folders are taken into account (according to the selection in the process object view).

After export, you receive a message indicating the CSV file and the path where the data were stored. Here, the cells contents are displayed in double quotes separated by a semicolons so that they can be edited with MS Excel or MS Access.

Note

The instances are edited during import/export procedure described above. The ability to make centralized changes is lost.

Exporting the current view

From the process object view, you can also export any assembled view that contains the filter and display settings. This can then be processed further in other tools for documentation purposes, for example.

The export file contains all of the columns and visible fields from the current view, including the corresponding column titles.

Languages

PCS 7 can be used to store all operating and display texts in any language. The only requirement is that the language is already installed in your project.

The available languages can be displayed in the SIMATIC Manager with the menu command **Options > Language for Display Devices**. The number of languages offered is specified when Windows is installed (system characteristics).

Structure of the export and import file for blocks

The export file and the import file for blocks consists of the following 10 columns:

Columns	Column titles	Meaning
1 - 3	Hierarchy; Chart; Block;	Identification of the block
4 - 9	Block comment; Create block symbol; Block symbol;Operating and monitoring property;Reading back allowed; Block group	Attributes that are exported/imported
10	Block type	Information about the block

Structure of the export and import file for I/Os

The export file and the import file for I/Os consists of the following 18 columns:

Columns	Column titles	Meaning
1 - 4	Hierarchy; Chart; Block; I/O;	Identification of the I/O
5 - 14	I/O comment; Value; Unit; Interconnection; Signal; Identifier; Text 0; Text 1; For test; Enumeration	Attributes that are exported/imported
15 - 18	Data type; I/O; Block type; I/O type.	Information on the I/O

Rules for the export and import file for I/Os

- The CSV file for importing I/Os must include at least the first 4 columns for identification of the I/O. The remaining columns are optional and can be used in any order.
- The columns with information on the I/O are ignored when importing.
- Empty text fields (cells) are ignored when importing. Therefore you can only create or modify texts during importing but not delete them.
- If several I/Os are listed for a block resulting in several rows for the block, then the block comment will appear a corresponding number of times. If you modify the comment, only the last line of the block comment will be considered during import.

Structure of the export and import file for messages

The export file and the import file for messages consists of the following 20 columns:

Columns	Column titles	Meaning
1 - 5	Hierarchy; Chart; Chart comment; Block; I/O; Subnumber;	Identification of the I/O
6 - 19	Block comment; Class; Priority; Origin; OS area; Event; Batch ID; Operator input; Free text 1; Free text 2; Free text 3; Free text 4; Free text 5; Info text 6; Reaction time 7; Description 8; Cause 9; Operator action 11; Consequence12	Attributes that are exported/imported
20	Block type	Information on the I/O

Rules for the export and import file for messages

- The CSV file for importing message texts must include at least the first 5 columns for identification of the I/O. The remaining columns are optional and can be used in any order.
- Empty text fields (cells) are ignored when importing. Therefore you can only create or modify texts during importing but not delete them.

Exporting the current view

1. Set the required view (select the tab, followed by Filter and Display).
2. Select the menu command **Options > Process Objects > Export Current View...**.

An export file (CSV file) is generated; this contains all the selected information about the object (project, hierarchy folder, or CFC) that has been selected in the tree.

Exporting blocks

1. Select the menu command **Options > Process Objects > Export Blocks**

An export file (CSV file) is created that contains all the attributes and information about the blocks of the object (project, hierarchy folder or CFC) selected in the tree window.

Exporting I/Os

1. Select the menu command **Options > Process Objects > Export I/Os...**.

An export file (CSV file) is generated containing all the attributes of the selected I/Os and information about the I/Os of the object (project, hierarchy folder, or CFC) selected in the tree. The information from the process object view ("Parameters" and "Signals" without filters) including the titles is written.

Exporting all the I/Os

1. Select the menu command **Options > Process Objects > Export All I/Os...**.

An export file (CSV file) is generated containing all the attributes and information about all the I/Os of the object (project, hierarchy folder, or CFC) selected in the tree.
All I/Os means that it also takes account of I/Os which have not been selected for the process object view.
The information from the process object view ("Parameters" and "Signals" without filters) including the titles is written.

Exporting messages

1. Select the menu command **Options > Process Objects > Export Messages...**.

An export file (CSV file) is generated containing all the message texts (and block information) concerning the object (project, hierarchy folder, or CFC) selected in the tree.

Additional Editing

Note

Never overwrite management information (language identification or path specifications) while editing the exported texts.

Only edit lines beginning with "T-ID=".

Note

Always open the file inside of the program, for example, when using MS Excel with the menu command **File > Open** and not by double clicking the file.

Never edit the first column or the first row with the spreadsheet editing tool and do not delete any semicolons.

Backup export before starting the import

Before you import, a dialog box is displayed in which you can check the import file (name and content). Here, you can also set the "Execute backup export" option.

Use the option "Execute backup export" to backup the current project data (attributes) before starting the import.

Importing blocks

1. Select the menu command **Options > Process Objects > Import Blocks....**
2. Select the required import file (CSV file).

The attributes and information of the blocks of the selected import file are imported into the desired project. They are assigned to the blocks.

Importing block texts

1. Select the menu command **Options > Process Objects > Import Block Texts....**
2. Select the required import file (CSV file).

The block texts of all the CFCs within the selected import file are imported into the desired project. In doing this, you assign the texts to the blocks of the named process tags (hierarchy, chart, block, I/O).

Importing I/Os

1. Select the menu command **Options > Process Objects > Import I/Os....**
2. Select the required import file (CSV file).

The I/O attributes and information of the selected import file are imported into the desired project. They are assigned to the I/Os of the designated process tags (hierarchy, chart, block, I/O).

Importing I/O texts

1. Select the menu command **Options > Process Objects > Import I/O Texts...**.
2. Select the required import file (CSV file).

The texts of all the I/Os for all the CFCs within the selected import file are imported into the desired project. In doing this, you assign the texts to the I/Os of the named process tags (hierarchy, chart, block, I/O).

Importing messages

1. Select the menu command **Options > Process Objects > Import Messages...**.
2. Select the required import file (CSV file).

The message texts of the selected import file are imported into the desired project. They are assigned to the blocks of the designated process tags (hierarchy, chart, block).

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*
- Online help on the dialog boxes

9.7.7 Working with process tag types

Introduction

Process tag types are saved automatically to the "Process tag types" folder in the master data library as soon as a new process tag type is generated from a CFC. The process tag types are managed in this master data library. The following functions are available:

Overview of the functions

Below you will find an overview of the functions that are important when working with process tags/process tag types.

These functions can be accessed by selecting the **Options > Process tags** menu command in the SIMATIC Manager after you have selected a chart or process tag type.

Function	Purpose
Creating/changing a process tag type	• Creating a process tag type from CFCs: – You select the I/Os of blocks and charts that are to be assigned parameter descriptions and signals. – You select blocks with messages for the assignment of message texts. • Changing an existing process tag type • Checking for inconsistencies between existing process tags and the process tag type, as well as synchronization of any possible deviations.
Synchronize	The process tags in the project are automatically synchronized when you modify the process tag type. You can explicitly run a synchronization if inconsistencies have developed between the process tag type and process tags (e.g. because it was not possible to access all process tags of the project during automatic synchronization).
Assigning/creating an import file	An import file must be assigned to the process tag type concerned in order to create process tags. Using the "Assign an import file to a process tag type" wizard, carry out the following tasks: • Assign an existing import file • Open and check an import file that has already been assigned • Create and assign a new import file
Importing	Importing the data of the process tag types The process tag type is copied as a process tag from the master data library to the specified target projects. Thereafter the data is imported. The number of process tags generated depends on the number of entries in the import file. As a result of the import, a process tag of this process tag type is generated in the target project for each line of the import file according to the specification in the hierarchy path.
Exporting	Exporting the process tag data for a process tag type The following options are available: • Selecting a process tag for individual export. • Select a higher-level hierarchy folder or the project node in order to select all lower-level process tags for export. As a result, one row is created in the relevant export file for each process tag of a process tag type found.

Additional information

- Section "How to create a process tag type from a CFC (Page 475)"
- Section "How to change a process tag type (Page 476)"
- Section "How to synchronize process tags with the process tag type (Page 483)"
- Section "What happens during import? (Page 585)"
- Section "What happens during export? (Page 589)"

- Online help for *PH*, *IEA* and *PO*

9.7.8 Working with models

Introduction

Models are created from the hierarchy folders in the master data library that contain the required CFCs. The new models are stored and managed in the master data library. The following functions are available:

Overview of the functions

Below you will find an overview of the functions that are important when working with models/ replicas.

These functions are available in the SIMATIC Manager with the menu command **Options > Models**.

Function	Purpose
Creating/modifying models	You can create models with the Import/Export Assistant (IEA) as follows: • You select the I/Os of blocks and charts that are to be assigned descriptions for parameters and signals and imported. • You select blocks with messages for the assignment of message texts. • You assign the data of an import file to the model data. You obtain a model in which the selected I/Os and messages are each assigned to a column of an import file. If you modify an existing model and change the column structure or the column titles, the assignment to the structure of the current IEA file is no longer correct. In this case you must select a suitable IEA file or adapt the file. If replicas of the modified model exist, then modifications can also be carried out on the replicas.
Importing	Importing the model data The model is copied from the master data library to the specified target projects as a replica. Thereafter the data is imported. The same number of replicas are generated as there are entries in the import file. As a result of the import, a replica of this model is created in the target project for each row of the import file, according to the information in the hierarchy path.
Exporting	Exporting the replica data for a model The following options are available: • Select one model to export it individually. • Select a higher-level hierarchy folder or the project node to select all lower-level replicas for export. As the result, one row is created in the relevant export file for each replica of a model.

Additional information

- Section "How to create a model (Page 518)"
- Section "What Happens during Import? (Page 585)"

- Section "What Happens during Export? (Page 589)"
- Online help for *PH*, *IEA* and *PO*

9.7.9 How to save shared declarations

Introduction

If you have created your multiproject with the PCS 7 wizards, the master data library already contains a "Shared Declarations" folder. You can then use this to store shared declarations that can be used by various applications. You can explicitly create the "Shared Declarations" folder if it does not yet exist.

The "Shared Declarations" folder contains the following subfolders:

- Enumerations
- Units
- Equipment properties

Shared declarations

You can define the following elements as shared declarations:

- **Enumerations**
  You can use enumerations to define textual representatives for the parameter values of the block or chart I/Os with data types "BOOL," "BYTE," "INT," "DINT," "WORD," and "DWORD". A suitable text is assigned to each value of an enumeration and this is displayed at the I/O. Several values can be assigned to each enumeration.
- **Units**
  The unit of measure (for example, mbar, l/h, kg) is text with a maximum of 16 characters. It can be entered during the parameter and interconnection descriptions of block or chart I/Os. It is used for example, in process pictures when visualizing the values of the block I/Os. All the units of measure included in the CFC basic set are available as defaults.
- **Equipment properties**
  Equipment properties are parameters of a unit, such as shell material, volumes etc. The type of equipment property is defined as a "shared declaration". Instances of this type are used in SIMATIC BATCH and its attributes are individually adapted.

Procedure

1. Select the master data library of the multiproject.
2. Select the menu command **Insert > Shared Declarations > Shared Declarations**.
   The "Shared Declarations" folder is created with the subfolders "Enumerations", "Units" and "Equipment Properties".
3. When declaring an enumeration, select the "Enumerations" folder and then the menu command **Insert > Shared declarations > Enumeration** followed by the menu command **Insert > Shared declarations > Value**.

4. When declaring a unit, select the "Units" folder and then the menu command **Insert > Shared Declarations > Unit**.
5. If you want to declare an equipment property, mark the "Equipment Properties" folder and select the menu command **Insert > Shared Declarations > Equipment Property**.

Additional functions in a multiproject

The shared declarations function is tailored to the needs of the multiproject. The following update functions are important for multiprojects:

Menu Command	Purpose
Options > Shared Declarations > Update in Multiproject	You can select the following update methods here: • Merge the shared declarations of all projects in the multiproject • Export the shared declarations of one project in other projects
Options > Shared Declarations > Display Full log	This opens the full log listing all errors that occurred in the most recent synchronization of the shared declarations in the multiproject. No log is generated if no errors occurred in the most recent update of all projects.
Options > Shared Declarations > Check Plausibility	This checks the values of the enumerations for uniqueness.
Options > Shared Declarations > Display Full log Plausibility Check	This opens the full log for the plausibility check of the shared declarations. Here, you can see a list of the projects in the multiproject where errors or warnings were detected. A log has been created for each listed project. You can open the log file by selecting the project and then the menu command **Shared Declarations > logs...**.

Additional information

- Online help for the SIMATIC Manager

9.7.10 How to test library objects

Testing library objects

We recommend that you thoroughly test objects before storing them in the master data library. Use the functions for compiling, downloading testing of the tool in which you created the respective object for testing.

- Store the objects in the master data library after successfully testing them.
- After the test declare the process tag and model as a process tag type or as a model. These objects are then automatically stored in the master data library.

Requirement

The AS must be accessible from the engineering station since the test is always executed in the AS. Test the corresponding OS pictures in the OS if the models contain OS pictures.

Additional information

- Online help of the relevant tools (for example, CFC Editor)

9.7.11 How to document the library objects

Documenting library objects

To document library objects, use the documenting and printing functions of the tool used to create the library objects, for example, the CFC Editor functions or the functions in the LAD/ STL/FBD editor.

Additional information

- Online help of the relevant tools (for example, CFC Editor)

9.8 Distributing the multiproject for distributed editing (multiproject engineering)

Note to reader

Pay attention to the following sections if you now want to edit the multiproject (including the master data library) **on distributed stations** and **with several editors at the same time**.

If you do not want to distribute the multiproject for editing, you can skip the following sections and continue with the section "Configuring the Hardware".

Introduction

It is possible to edit the projects of the multiproject on distributed stations allowing several editors to work on smaller handier projects at the same time.

The distributed editing of projects and the merging on a central engineering station server for cross-project functions is the most efficient method compared with other procedures.

Despite distributing the projects on several engineering stations, it is possible to read other projects at any time. This can, for example, be used to copy functions and to access libraries.

Note

You should always work with a multiproject even if it only contains one project. In this case, you do not need to distribute it for editing.

Requirements

If you want to distribute projects on different computers within a network, the following conditions must always be met:

- The projects are located in folders that are shared for read and write access.
  - The folders in which the multiproject or the projects are to be located must be set for sharing before the multiproject is set up.
  - The share names must be unique within the network.
  - The shares and share names of the resources (folders) involved in the multiproject must not be changed.
    Reason: when a project is inserted into the multiproject, PCS 7 generates a reference to the location of this project. The reference depends on the share and share names of the resources involved.
  - A project can only be found using the share name under which it was included in the multiproject.
  - For security reasons complete drives should not be shared.
  - Folders must only be shared in one hierarchy level.
- PCS 7 must be installed on the computers where the folders containing the projects are located. PCS 7 provides the necessary database server functions for accessing the projects.
- If you include projects for which you have configured messages in a multiproject, make sure that the message number ranges of the CPUs do not overlap if you are using project-oriented assignment of message numbers. If you use CPU-oriented message number assignment, such overlapping does not occur.

If you execute cross-project functions, we recommend consolidating all projects on one programming device/personal computer.

If you want to execute cross-project functions while the projects are distributed on different computers then comply with the following:

- All the computers on which the projects and the multiproject are located can be reached over the network during the entire editing time.
- While class-project functions are executing, no editing must take place.

Recommendations

The following recommendations apply to working with multiprojects:

- One engineer manages the multiproject centrally. This engineer creates the structures for the projects. This person also distributes the projects for distributed editing and returns them again to the multiproject (including synchronization of the cross-project data and execution of cross-project functions).
  The following activities should only be performed on the central engineering station:
  – Moving, copying, and deleting the projects of the multiproject
  – Moving projects out of the multiproject for distributed editing
  – Merging of the projects into the multiproject following distributed editing
- It is not possible to make a general recommendation about how many stations a project should have. We recommend that projects on a distributed engineering station have only one 1 AS or 1 OS.
- Only move the PCS 7 objects to a distributed engineering station that are actually necessary for editing. This means that all other objects of the multiproject are available for editing on other distributed engineering stations.
- Keep in mind the number of available project editors when distributing the projects.

Note

If there is only one OS in the project, this must always be recompiled on the central engineering station. This ensures the correct structure of the cross-project connections to the automation systems.

Rules for Multiproject Engineering with SIMATIC BATCH

NOTICE
For multiproject engineering with SIMATIC BATCH, distributed engineering on distributed engineering stations including testing is only possible when certain conditions are met and the additional steps are taken. You can find additional information on this topic on the Internet (https://support.industry.siemens.com/cs/ww/en/view/23785345).

Additional information

- Section "Constraints for working within the network and in the multiproject (Page 309)".

9.8.1 Constraints for working within the network and in the multiproject

Constraints

Observe the following conditions when working in the multiproject:

- An operating system approved for PCS 7 must be installed on the central engineering station for working in the network. Information is available in the PCS 7 Readme (Internet version; see "AUTOHOTSPOT").
  The same is true for the distributed engineering station.
- The storage location of projects within the network must be specified in UNC notation: \\Computer name\Share name\Storage path
  not with drive letter (which means **not** "d:\Projects\Storage path...").
- The folder with the project must already be shared with other project editors on the relevant PC. The share name must be unique.
- The storage paths must not be modified later (after storing projects)!
- All the projects and the S7 programs must have unique names within the multiproject.
- After distributed editing of projects containing an OS, each OS must be recompiled on the central engineering station. To speed up compilation, unmodified objects can be deactivated in the "Compile and Download Objects" dialog box (menu command in the SIMATIC Manager **PLC > Compile and Download Objects**).
- A mixture of the previous project-oriented and the new CPU-oriented message number concept is not possible.

NOTICE
Security information on configuration in the network
When performing configuration in the network, make sure that the central server or a shared drive is accessible only to authorized persons. This should be ensured not only by measures on the level of the operating system and PC network. You can find information on access protection PCS 7 in the section "Protecting projects/libraries with access protection (Page 166)".

Rules for multiproject engineering with SIMATIC BATCH

Note

For multiproject engineering with SIMATIC BATCH, distributed engineering on distributed engineering stations including testing is only possible when certain conditions are met and the additional steps are taken.

You can find additional information on this topic on the Internet (https://support.industry.siemens.com/cs/ww/en/view/23785345).

Additional information

- Section "Merging projects after distributed editing (multiproject engineering) (Page 569)"
- Section "Compiling and downloading (Page 609)"
- Online help on STEP 7

9.8.2 Overview of the handling steps

Prior to distribution

There are no binding specifications as to when the projects are to be moved to the distributed engineering stations. The table below indicates in the columns "Mandatory/Optional" which step must or can take place prior to distribution.

The description for executing the configuration below is structured according to this sequence of steps.

Activity	Information in section:	Mandatory	Optional
Creating multiproject with (all) projects (structure)	Creating the PCS 7 project	X	
	Configuring the SIMATIC and PC stations		X
	Creating the plant hierarchy	X	
	Creating the master data library	X	
Creating basic configuration for all projects of the multiproject	Configuring the hardware		X
	Creating network connections		X
	Creating the SIMATIC connections		X

Distribution -> distributed processing -> merging

The following listing of the handling steps also reflects the recommended sequence of processing.

Activity	Information in section:	Where?
Moving projects for distributed processing to distributed engineering station	How to move projects to distributed engineering stations (Page 312)	Centralized engineering station: SIMATIC Manager
Distributed editing of projects	How to continue editing projects on distributed stations (Page 313)	Distributed engineering station
Merging projects again on the central engineering station	How to move projects edited on distributed stations to the central engineering station (Page 570)	Centralized engineering station: SIMATIC Manager

Prior to distribution or after merging

The "Mandatory/Optional" rating offers help in determining whether this activity must or can take place after distribution.

Activity	Information in section:	Mandatory	Optional
Executing cross-project functions	How to merge subnets from different projects into a multiproject (Page 571) Cross-project connections in a multiproject (Page 423)	X X	
Compile/download of configuration data	Compiling and downloading (Page 609)	X	

9.8.3 How to store the projects of the multiproject

Requirements

- The multiproject is located on a central engineering station to which all other engineering stations have access.
- The multiproject contains the libraries (in particular the master data library with the models and process tag types).

Storing the projects

Projects which are to be inserted into the multiproject can be created in the following manner:

- Creating projects on the central engineering station and then moving them to the distributed engineering stations for editing.
  You can find information about this in the section "How to move projects to distributed engineering stations (Page 312)".
- Creating projects on the distributed engineering stations (incl. HW configuration) and inserting them into the multiproject at a later date.
  You can find information about this in the section "How to move projects edited on distributed stations to the central engineering station (Page 570)".

Procedure

1. Specify the storage location for your projects. Create the required folder structure with the Windows Explorer.
   Observe the information in the following sections:
   - Distributing the multiproject for distributed editing (multiproject engineering) (Page 306)
   - Constraints for working within the network and in the multiproject (Page 309)
2. In the SIMATIC Manager, select the menu command **Options > Customize** and set the storage location of the projects, multiprojects, and libraries. Comply with the DOS name conventions.

Additional information

- Online help for the SIMATIC Manager

9.8.4 How to move projects to distributed engineering stations

Requirements

- The project is physically located on the central engineering station and is included in the multiproject.
- The distributed engineering station can be reached over the network.
- When SIMATIC PDM is installed on the engineering station:
  The PdmAssetService is stopped.

Procedure

1. In the component view of the SIMATIC Manager, select the project in the multiproject that you want to move to the distributed engineering station.
2. Select the menu command **File > Save as ...**.
3. Make the following settings:
   – Select the "Add to multiproject" check box.
   – Select the "Current multiproject" entry from the corresponding drop-down list.
   – Enable the "Replace current project" option.
   – Enter the required storage location (path) on the distributed engineering station (in UNC notation).
4. Click "OK".

Result

- An identical copy of the project of the central engineering station is created on the distributed engineering station. The copy is inserted automatically in the multiproject and replaces the original project.
- The existing original project is removed from the multiproject, but remains on the central engineering station. You can either keep the original project as a backup or delete it.

Note

Before the copied project can be copied back to its old location (same folder name), this backup must be deleted.

Note

In the same way, you can also save the project on a data medium and pass this on for distributed editing or archive the project with the "Archive" function and pass on the archive on a data medium.

SIMATIC PDM applied in the project

When SIMATIC PDM is installed on the engineering station:
You can start the PdmAssetService again.
Recommendation: Start the SIMATIC PDM asset service with the option "Allow automatic start/stop".

Removing a project from the multiproject (alternative)

Note

You can also move a project to a distributed engineering station as follows:

1. In the component view of the SIMATIC Manager, select the project within the multiproject that you want to remove from the multiproject.
2. Select the menu command **File > Multiproject > Remove for Editing...**
   The "Select Directory" dialog box opens.
3. Select a directory and click "OK".

Result

The project is marked as "project removed for editing" and displayed in gray.

When a project has been removed, in contrast to the procedure described above, you can not use the "Archive", "Save As", or "Compile OS" functions.

Additional information

- Section "Merging projects after distributed editing (multiproject engineering) (Page 569)"
- Section "How to move projects edited on distributed stations to the central engineering station (Page 570)"

9.8.5 How to continue editing projects on distributed stations

Requirement

All the PCS 7 software components required for editing are installed on the distributed engineering station.

Distributed editing of the project

The following unrestricted functions can be executed when you distribute the project for editing:

- All non cross-project functions
- The following partial functions can be executed as usual:
  - Pure editing work
  - Compiling of an AS
  - Downloading an AS over a preselected module (not with the option "PC internal (local)")

Special additional actions are necessary when you execute the following tasks on a distributed ES:

- Downloading an AS directly via the interface module of the distributed engineering station
- Testing the OS in process mode (OS simulation)

Downloading an AS via the interface module of the distributed ES

Execute the following actions in the project if you want to download an AS for test purposes:

1. Insert a local SIMATIC PC station with a suitable CP module into the project.
2. Configure S7 connections (configured connection) from this OS to the AS.

If you want to test an OS on an engineering station in process mode (**Start OS Simulation** shortcut menu), the two steps above are necessary regardless of the programming device/PC interface setting. In addition, the following step is also necessary:

1. Customize the computer name in WinCC Explorer.

Note

These changes must be reversed before the project is copied or moved back to the central engineering station.

Additional information

- Section "How to move projects edited on distributed stations to the central engineering station (Page 570)"

9.9 Configuring the hardware of automation system (SIMATIC station)

Overview

Configuring the hardware involves the following topics:

- Defining a project-specific catalog profile (Page 316)
- Exporting/importing the hardware configuration (Page 317)
- Overview of configuration steps (Page 319)
- Principle of time synchronization (Page 336)
- Configuring the distributed I/O on PROFIBUS DP (standard) (Page 341)
- Configuring distributed I/O devices on PROFIBUS DP for configuration changes in RUN mode (CiR) (Page 371)
- Configuring the distributed I/O on PROFINET IO (standard) (Page 351)
- Configuring distributed I/O devices on PROFINET IO for configuration changes in RUN mode (CiR) (Page 388)
- Configuring the hardware of high-precision time stamps (Page 338)
- How to activate acknowledgment-triggered reporting (ATR) (Page 339)
- How to download the configuration in CPU-STOP (Page 552)

9.9.1 Overview of hardware configuration

Introduction

The configuration of the hardware involves the configuration of your plant at the automation level (AS, OS, BATCH, Route Control, OpenPCS 7) in the SIMATIC Manager and in HW Config. You may create your SIMATIC 400 stations distributed in various projects and configure the required I/O and communication hardware.

You configure various project types in the PCS 7 OS according to the structure of your plant. For example, you can configure process cells with one or more OS servers or OS clients. Generally, you work with a multiple station project and create several OS servers and OS clients.

In addition you can create and configure redundant components in the hardware configuration (for example redundant OS, use of H-stations).

Overview of configuration tasks

This overview shows you the recommended order in which the individual configuration steps should be carried out, and tells you which tools should be used to do the configuration work:

What?	Where?
Adding all the SIMATIC 400 stations to the project. Inserting the engineering station, operator stations, BATCH stations, Route Control stations, external archive server and OpenPCS 7 station as PC stations into the project.	SIMATIC Manager
Adding hardware components to the SIMATIC 400 stations. You insert hardware components and applications that belong to the particular PC station.	HW Config

Note to reader

For multiproject engineering, the SIMATIC 400 stations and PC stations are often already in your project. The following section describes how you continue by adding the hardware components to the SIMATIC 400 stations.

If the PC stations are not yet configured, first work through the following sections in the chapter "Configuring the SIMATIC and PC stations (Page 246)" before you continue.

Additional information

Information on configuring the hardware for the operator stations can also be found in the configuration manual, *Process Control System PCS 7; Operator Station*.

9.9.2 Defining a project-specific catalog profile

Advantage of the project-specific catalog profile

You can store a specific catalog profile for the hardware in each multiproject. In this way, you can make sure that everyone who works on the individual projects of the multiproject uses the same hardware. You can make this project-specific catalog profile available centrally (access via the network) or you can store it on a distributed station with the other data for distributed editing.

Setting up a project-specific catalog profile

1. Select the menu command **Options > Edit Catalog Profiles** in HW Config.
   Two catalog profiles are opened: The "standard" profile and an "empty" profile that does not contain any components yet.
2. Drag the folders and modules you require from the standard profile window to the "empty" profile window. You can also adapt the structure to your needs with the menu command **Insert > Folder**.
3. Save the new catalog profile with the menu command **Profile > Save As**.

The new catalog profile is created. It then appears in the "Profile" selection list of the "Hardware Catalog" window, where it can be selected.

Exporting a project-specific catalog profile

To make a catalog profile available at another workstation, export the catalog profile as follows:

1. Select the menu command **Options > Edit Catalog Profiles** in HW Config.
2. Select the menu command **Profile > Export**.
3. Select the catalog profile you want to export and set the destination path for the export.

The catalog profile is copied to the configured target in *.dat format. You can also save the file to disk and forward it in this way.

Importing a project-specific catalog profile

1. Select the menu command **Options > Edit Catalog Profiles** in HW Config at the workstation at which you want to use the catalog profile.
2. Select the menu command **Profile > Import**.
3. Set the path to the source and select the catalog profile you want to import.

The catalog profile is imported and appears in the "Profile" selection list of the hardware catalog.

Note

You can remove catalog profiles that you do not require with the menu command **Profile > Delete**.

9.9.3 Exporting/importing the hardware configuration

Introduction

You can not only edit station configurations within the project (e.g. by saving or opening), you can also export it to a text file (ASCII file, CFG file), edit (adapt) it and then import it again independently of the project. The symbolic names of the inputs and outputs can also be exported and imported.

Application

The export/import functions can be used as follows, for example:

- Data import from hardware engineering tools
- Station configuration can be distributed using electronic media (for example, e-mail)
- The export file can be printed out with a word processing system or it can be edited for documentation purposes.

Where is it described?

You can find a detailed description of importing and exporting the hardware configuration in the section "Import/export of the hardware configuration (Page 599)".

9.9.4 Configuring the SIMATIC 400 station (CPU, CPs, centralized I/O)

9.9.4.1 Creating the concept for address assignment

Introduction

Before you can start with the configuration of the hardware, first create a concept for assigning addresses. The networks are independent of each other and have their own range of numbers for addresses.

During assignment, we distinguish between the following addresses:

- Node addresses
- Input/output addresses (I/O addresses)

Node addresses

Node addresses are addresses of programmable modules (addresses on PROFIBUS, PROFINET IO, Industrial Ethernet). They are needed to address the various nodes of a subnet, e.g. to download a user program over the plant bus (Industrial Ethernet) to a CPU. You can find more information about assigning node addresses on a subnet in the section on networking stations.

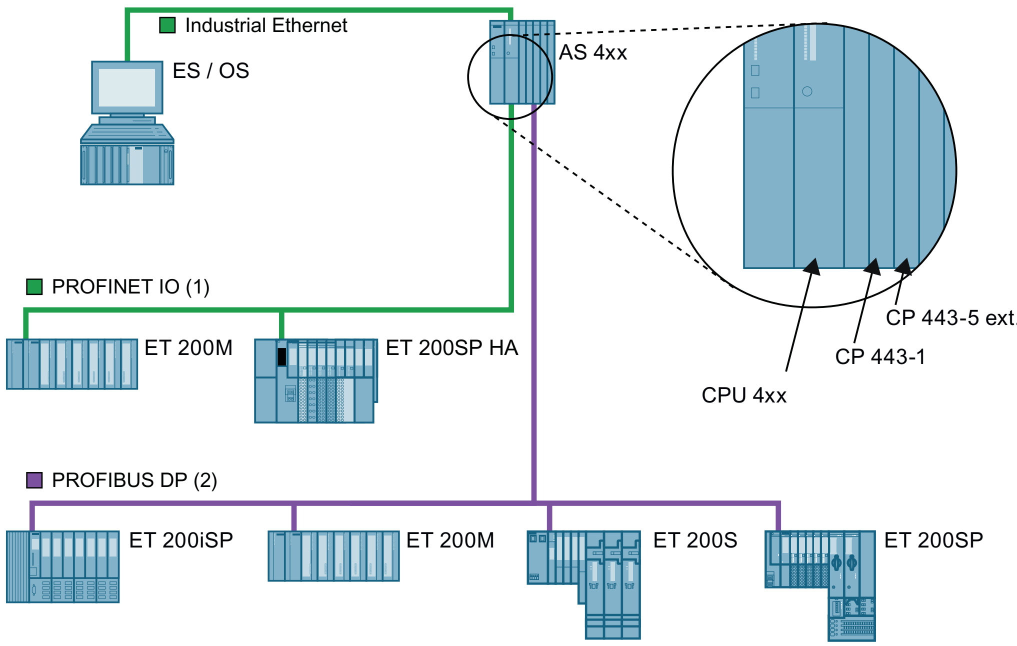
Input/output addresses (I/O addresses)

Input/output addresses (I/O addresses) are needed to read inputs or to set outputs in the user program.

Principle: PCS 7 assigns the input and output addresses when modules are placed in the SIMATIC 400 station in HW Config. This means that each module has its own starting address, which means the address of the first channel. The addresses of the other channels are derived from this starting address. For ease of use, the addresses can be assigned symbolic names (symbol table).

Plant configuration options

The following diagram contains an overview of a few plant configuration with node addresses and I/Os plugged in.



1) PROFINET IO system: max. 100 Mbps; max. 255 nodes

2) DP master system: max. 12 Mbps; max. 126 nodes; profile: PROFIBUS DP

Note

For the high-precision time stamp

- PROFINET IO must be connected to the SIMATIC 410 station up to firmware V8.2.
- PROFIBUS DP must be connected to the SIMATIC 400 station by means of a CP 443-5 Extended or the internal PROFIBUS DP interface.

9.9.4.2 Overview of configuration steps

Overview

The following table provides you with an overview of the various configuration steps and the corresponding tools.

What?	Where?
Creating a SIMATIC 400 station (Page 321)	SIMATIC Manager
Inserting modules in a SIMATIC 400 station (Page 322)	HW Config
Inserting a communications processor (CP) (Page 323)	HW Config
Setting the CPU properties (Page 326)	HW Config

What?	Where?
Setting the process image (Page 329)	HW Config
Configuring fault-tolerant systems (H systems) (Page 335) See the manual *Process Control System PCS 7; Fault-tolerant Process Control Systems* for more information.	HW Config
Configuring fail-safe systems (F systems) (Page 335) See the manual *Automation Systems S7-400F/S7-400FH, Fail-safe Systems* for more information.	HW Config
Setting time synchronization (Page 338)	HW Config
Configuring the distributed I/O for standard (Page 341)	HW Config
Configuring the distributed I/O devices for configuration changes in RUN (CiR) (Page 375)	HW Config
Assigning icons for the input and output addresses (Page 325)	HW Config (Symbol Table)
Configuring PA devices (Page 394)	PDM
Configuring the diagnostic repeater (Page 391)	SIMATIC Manager + HW Config
Configuring intelligent field devices (Page 398)	PDM
Configuring HART devices (Page 396)	PDM
Configuring Y Link and Y coupler (Page 392)	HW Config
Configuring the hardware of high-precision time stamps (Page 338)	HW Config
Activating acknowledgment-triggered reporting (ATR) (Page 339)	HW Config
Downloading the configuration to the CPU (Page 552)	HW Config

Recommended order of the tasks

The tasks involved in configuring and assigning parameters to a process cell should ideally be carried out in the order shown below:

Order of the tasks
Creating a station How to create a SIMATIC station (Page 321)
Calling the application for configuring the HW Arranging the central rack Arranging modules in the rack How to insert the modules in a SIMATIC station (Page 322) Inserting and configuring the distributed I/O Assigning the icons
Specifying the properties of modules/interfaces Setting the CPU properties (Page 326) Setting the process image (Page 329)
Saving a configuration and consistency check Downloading a configuration to a target system How to download the configuration to the CPU (Page 552)
Uploading from the target system to the programming device (reload, e.g. for service purposes).

Additional information

- Online help for HW Config

9.9.4.3 How to create a SIMATIC 400 station

Introduction

In multiproject engineering, automation systems may have already been created in your project. You can insert additional automation systems as follows:

- With PCS 7 "Expand Project" wizard
  You can find information about this in the section "How to expand a project with pre-configured stations (Page 237)".
- Manually if you do not use any supplied bundles (described below)

SIMATIC 400 station

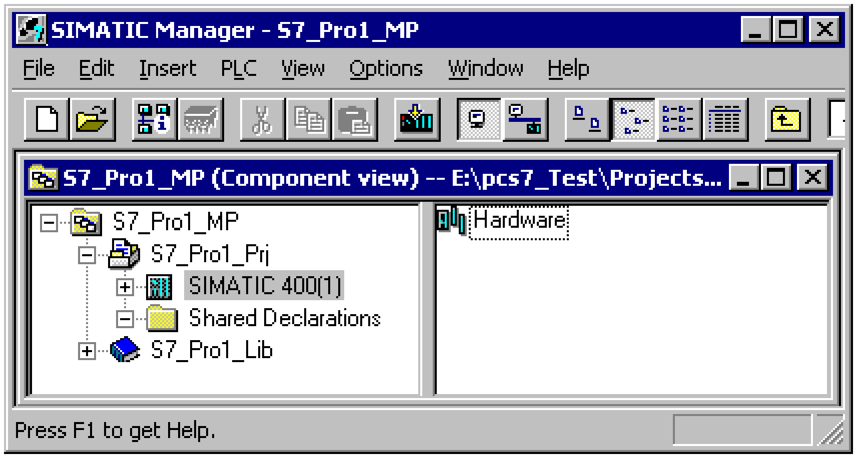
When you create an automation system, you require a SIMATIC 400 station with a power supply, a CPU and an Ethernet communication processor (can be omitted when using a CPU with integrated Ethernet interface). You then configure the centralized and distributed I/O and any further modules you require. The following sections explain how to insert the individual components in the project and set their properties.

Procedure

Before you can start to configure and assign parameters, you need a SIMATIC 400 station in your project that you can insert at the level directly below the project. Then you can set the properties of the SIMATIC 400 station.

1. Select the project to which you want to add another automation system in the SIMATIC Manager component view.
2. Select the menu command **Insert > Station > SIMATIC 400 station**.
   A new SIMATIC 400 station is inserted in the selected project.
3. Repeat the procedure to add more automation systems.

You can change the name as required by selecting the menu command **Object Properties** from the SIMATIC 400 station shortcut menu.



Additional information

- Section "How to insert a module into a SIMATIC 400 station (Page 322)"

9.9.4.4 How to insert a module into a SIMATIC 400 station

Introduction

After you have created the SIMATIC 400 station, add the hardware components to the station from the hardware catalog.

Hardware catalog

The hardware catalog is normally displayed when you open HW Config. If this is not the case, open it in HW Config with the menu command **View > Catalog**.

In the bottom third of the catalog, you can see the article number and a brief description of the currently **selected** component. Compare this article number with the article number of your existing component. You can then be sure that you have selected the right component.

Note

In the hardware catalog, you can select from various profiles (Standard, PCS 7, etc.). All the profiles are based on the "Standard" profile and represent a subset of this profile.

The "PCS 7_Vx.y" profile is displayed by default when you first start the hardware configuration. This profile shows the current versions of all modules and devices released for PCS 7 Vx.y.

If you cannot find the module you require in this profile (for example, an older CPU that is nevertheless released for PCS 7), select the "Standard" profile and then select the required module from it. Please note that module default settings may vary from one module to another.

Information about the modules approved for use is available in the product overview *Process Control System PCS 7; Released Modules*.

You can create an individual profile with the modules and devices which you frequently require: You can find information on this in the section "Defining a project-specific catalog profile (Page 316)".

Procedures

Information regarding connecting a station with IO modules can be found in the following sections:

- Section "How to configure modules in distributed I/O based on PROFIBUS DP as fieldbus (Page 346)"
- Section "How to configure modules in distributed I/O based on PROFINET IO as fieldbus (Page 356)"

9.9.4.5 How to insert a communications processor"

CP 443-1 for connecting to the plant bus

You may use the CP 443-1 communications processor for the connection between automation systems, engineering station or operator stations and Route Control stations over the plant bus (Industrial Ethernet).

Note

If you use a CPU with an integrated Ethernet interface, you can make the connection to the plant bus with it. You then do not need a CP 443-1 communications processor.

Inserting a CP 443-1

1. Select the required SIMATIC 400 station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Select "SIMATIC 400 > CP-400 > Industrial Ethernet ..." in the hardware catalog and drag the CP you require.
   Make sure that the arrangement selected here matches the arrangement of the physical hardware.
   Once you have inserted the CP, the "Properties - Ethernet Interface CP 443-1" dialog box is opened.
3. Select the check box "Set MAC address/Use ISO protocol" and assign the desired MAC address (for example 08.00.06.01.00.12 or the preset address of the CP used) or accept the default address.
   Make sure that the address is unique on the bus.
4. Enter the IP address and subnet mask or deactivate the "IP protocol is being used" check box.
5. Click "New" and replace the name "Ethernet(1)" with a name that will be more meaningful later.
6. Then click "OK" twice.
   The "Properties" dialog box closes.

CP 443-5 Extended for interfacing with the distributed I/O

In addition (or as an alternative) to the PROFIBUS DP interfaces integrated in the CPU, you can use the CP 443-5 Extended to interface with your distributed I/O. With each additional CP 443-5 Extended, you can insert additional DP chains and theoretically address 126 additional DP slaves.

Note

The high-precision time stamps are used in conjunction with the IM 153-2 or routing (parameter assignment for the DP/PA slaves over the ES and the plant bus) through the integrated PROFIBUS DP interface or the CP 443-5 Extended.

Adding a CP 443-5 Extended

1. Select the required SIMATIC 400 station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Select "SIMATIC 400 > CP-400 > PROFIBUS ..." in the hardware catalog and drag and add the required CP to the SIMATIC 400 station.
   Once you have inserted the CP, the "Properties - PROFIBUS Interface CP 443-5 Ext" dialog box is opened.

3. Assign the required PROFIBUS address for the
   DP master ("Parameter" tab; "Address:" list box).

   Note

   The addresses 1 and 126 are default addresses for DP slaves. Do not use the default addresses in your project.

4. Click "New" and replace the name "PROFIBUS(1)" with a name that will be more meaningful later.
5. Select the "Network Settings" tab and set the transmission rate "1.5 Mbps" and the "DP" profile.
6. Then click "OK" twice.
   The "Properties" dialog box for the PROFIBUS interface closes.

Additional information

- Online help for HW Config

9.9.4.6 How to assign symbols to input and output addresses

Introduction

You can assign symbols to the addresses of inputs and outputs when configuring modules without needing to start the symbol table in the SIMATIC Manager (Symbol editor).

You can also find information about this in the section "Free assignment between hardware and software (Page 193)"

Note

The assigned symbols are not downloaded when you download to the station with the menu command **Target system > Download to Module...**.

Effect: When you use menu command **Target system > Upload to PG** to upload to the station configuration, no symbols are displayed.

Procedure

1. Select the digital/analog module to whose addresses you want to assign symbols.
2. Select the menu command **Edit > Symbols...**.
   The symbol table opens.
3. Enter the required symbols for the addresses listed.
4. Click "OK".

Tip:
When you click the "Add Symbol" button in the dialog box, the name of the address is entered as a symbol.

Additional information

- Online help for HW Config

9.9.4.7 Setting the CPU properties

Overview

The CPU properties are entered automatically for PCS 7 in HW Config. They are suitable for most application scenarios. You can also find information about this in the section "Default Parameter Values for the CPUs (Page 335)".

The following table contains the most important settings of the CP properties for PCS 7.

What?	Where?
Setting the CPU startup mode (see below)	HW Config (object properties)
Setting OB 85 (I/O access error) (see below)	HW Config (object properties)
Setting the process image (Page 329)	HW Config (object properties)
Adapting the local data (see below)	HW Config (object properties)

Setting the CPU startup mode

The S7-400 CPU is capable of the following types of startup:

- Warm restart
- Cold restart
- Hot restart

Warm restart

In a warm restart, execution of the program restarts at the beginning of the program with a "basic setting" of the system data and user address areas. Non-retentive timers, counters, and memory bits are reset. All data blocks and their contents are retained.

When you restart (warm restart) an S7-400 (for example by changing the mode selector from STOP to RUN or by turning the power ON) organization block OB100 is processed before cyclic program execution begins (OB 32 - OB 38). As default, all the PCS 7 blocks that have a special startup behavior are installed in OB100.

Warm restart = Default setting for PCS 7 and normal applications

Cold restart

A cold restart is used only in exceptional situations when one of the following functions is required:

- During a cold restart, the process image input table is read and the user program is executed, starting at the first command in OB1.
- Data blocks created by SFCs in the RAM are deleted, while the other data blocks have the default values from the load memory.
- The process image and all timers, counters, and memory bits are reset regardless of whether they were set as retentive.

Note

A cold restart is **not** permitted when using S7-400 CPUs in the PCS 7 process control system and **Blocks from PCS 7 libraries**.

Hot restart

In a hot restart, program execution is resumed at the pointer to which it was interrupted (timers, counters, and memory bits are not reset).

Note

A hot restart is **not** permitted when using S7-400 CPUs in the PCS 7 process control system.

Setting the startup mode

1. Select the CPU in HW Config.
2. Select **Edit > Object Properties**.
   The "Properties - CPU..." dialog box opens.
3. Open the "Startup" tab.
   Recommendation: apply the default settings.
4. Set the required startup type under "Startup after Power On".
5. Click "OK".

Setting OB 85 (I/O Access Error)

The CPU's operating system calls OB 85 if an error occurs while the process image is being updated (module does not exist or defective) and the OB call was not suppressed during configuration.

If you wish to activate the OB 85 call for I/O access errors (I/O AAE), we recommend that you activate the "Only for incoming and outgoing errors" option. In this way, you can not increase the CPU's cycle time by repeatedly calling OB 85, as would be the case with the "For each individual access" option.

The "Only for incoming and outgoing errors" option is the default setting for PCS 7

Apart from the configured reaction "Only for incoming and outgoing errors", the address space of a module also influences how often OB85 starts:

- For a module with an address space up to a double word, OB85 starts once, for example, for a digital module with up to 32 inputs or outputs, or for an analog module with two channels.
- For modules with a larger address space, OB85 starts as often as the number of double word commands required to access it, for example, twice for a 4-channel analog module.

Configuring the response to I/O access errors

1. Select the CPU in HW Config.
2. Select the menu command **Edit > Object Properties**.
   The "Properties - CPU..." dialog box opens.
3. Select the "Cycle/Clock Memory" tab.
4. Select the "Only for incoming and outgoing errors" setting from the "OB 85 call for I/O access areas" drop-down list.
5. Click "OK".

Modifying the local data

The CPU has limited memory for the temporary variables (local data) of blocks currently being executed. The size of this local memory, the local data stack, depends on the particular CPU. The local data stack stores the following elements:

- The temporary variables of the local data of blocks
- The start information on the organization blocks
- Information on the transfer of parameters
- Interim results of the logic in ladder programs

When you create organization blocks, you can declare temporary variables (TEMP) that are available only while the block is running. They are then overwritten. Before the first access, the local data must be initialized. Each organization block also requires 20 bytes of local data for its startup information.

Assigning local data to priority classes

The local data requirements are assigned via the priority classes.

The local data stack is divided equally between the priority classes by default. This means that each priority class has its own local data area. This ensures that high-priority classes and their OBs have space for their local data.

The priority classes do not all need the same amount of memory in the local data stack. With suitable parameter settings for the S7-400 CPUs, it is possible to set local data areas of different sizes for the various priority classes. You can deselect priority classes that are not required. This extends the memory area of the S7-400 CPUs available for other priority classes. Deselected OBs are ignored during program execution and therefore save computing time.

The calculation of the local data is described in an FAQ on the Web.

Modifying local data

1. Select the CPU in HW Config
2. Select the menu command **Edit > Object Properties**.
   The "Properties - CPU..." dialog box opens.
3. Select the "Memory" tab and adapt the local data if necessary.
   You can find further information about this in the online help.
4. Click "OK".

   Note

   Make sure that you also take into account any reserves configured for CiR (configuration change in RUN).

Setting the process image

You can find information about this in the section "Setting the process image (Page 329)".

Additional information

- Section "Default performance parameters for the CPUs (Page 335)"
- Online help for HW Config

9.9.4.8 Setting the process image

Introduction

The driver blocks for the modules in the PCS 7 library do not access the I/O directly to query the current signal states, but rather access a memory area in the system memory of the CPU and the distributed I/O: the process input image (PII) and process output image (PIQ). This process image includes both the digital inputs and outputs as well as the analog inputs and outputs.

The process image starts with I/O address 0 and ends at a high limit as set in HW Config.

Updating the process image

The process image is updated cyclically by the operating system automatically.

<table>
<tr><th colspan="6">Editing the process images for CPUs</th></tr>
<tr><td colspan="3">Start of the current cyclic processing</td><td colspan="3">Start of the next cyclic processing</td></tr>
<tr><td colspan="3">← Current cycle time for OB 1 →</td><td colspan="3"></td></tr>
<tr><td>Output the PIQ</td><td>Update the PII</td><td>Editing the OB 1 or the cyclic interrupts</td><td>Output the PIQ</td><td>Update the PII</td><td>Editing the OB 1 or the cyclic interrupts
etc. →</td></tr>
</table>

Advantages of the process image

In contrast to direct access to the I/O modules, when the process image is accessed directly the CPU has a consistent image of the process signals for the duration of one program cycle. If a signal state at an input module changes while the program is being executed, the signal state in the process image is maintained until the process image is updated in the next cycle.

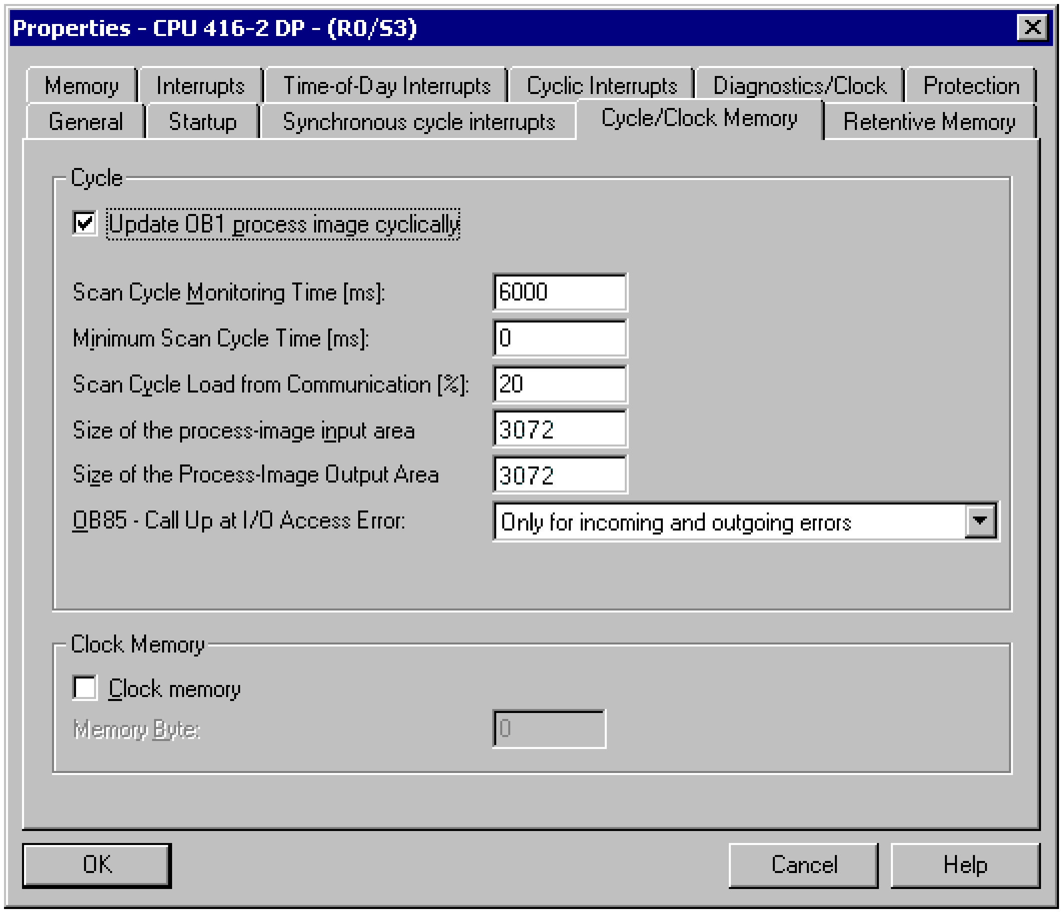
Size of the process image

For PCS 7, the size of the process image must be greater than or equal to the number of inputs and outputs used. By default, the first analog output module has the base address 512 in the process image. Recommendation: Set the size of the process image of the inputs and outputs to a higher value. This will leave space in reserve for further analog modules.

Setting the size of the process image

1. Select the CPU in HW Config.
2. Select the menu command **Edit > Object Properties...**.
   The "Properties - CPU..." dialog box opens.

3. Select the "Cycle/Clock Memory" tab and set the size of the process image.
4. Click "OK".



Note

The default size of the process image depends on the CPU.

You can also find information about this in the section "Default Parameter Values for the CPUs (Page 335)"

Process image partitions

In addition to the process image (PII and PIQ), you can also specify up to 15 process image partitions for an S7-400 CPU (CPU-specific, no. 1 up to max. no. 15).

Note

Please note the following:

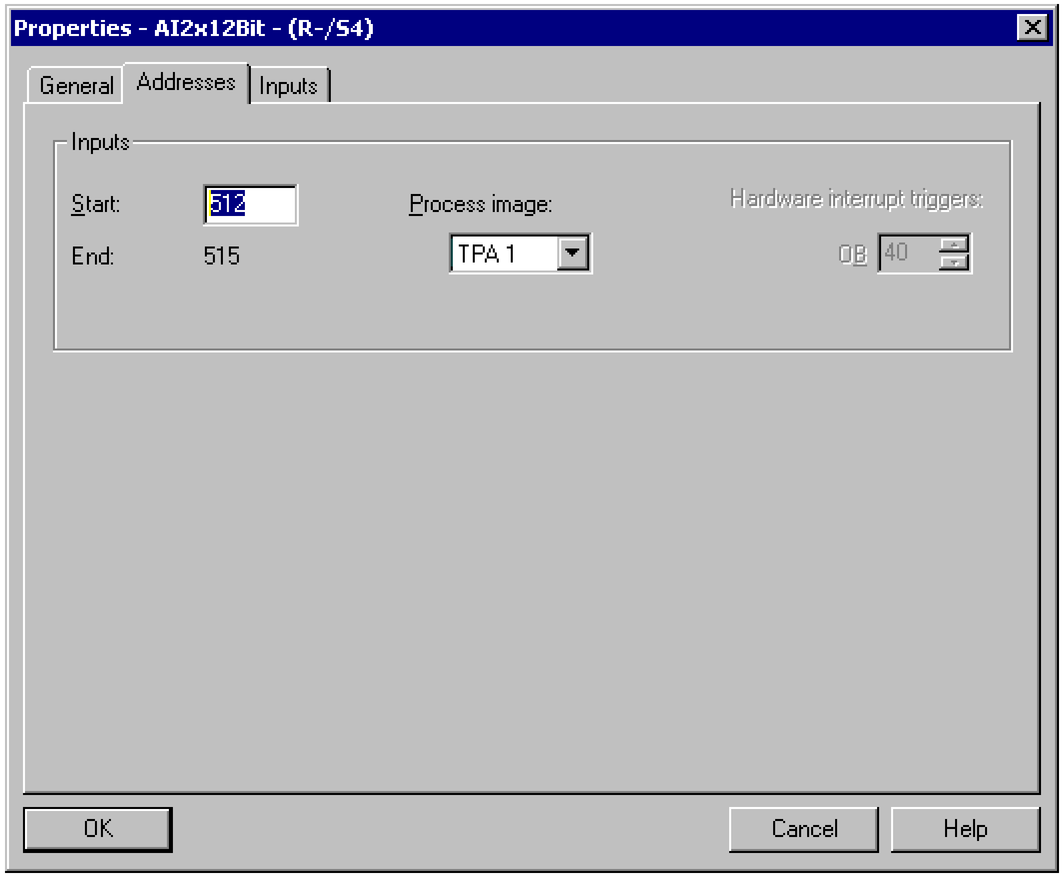
- Each input/output address must be assigned to a process image partition.
- Each input/output address that you assign to a process image partition no longer belongs to the OB1 process input/output image.
- Input/output addresses can only be assigned once throughout the OB 1 process image and all process image partitions.
- Make sure that signals and signal processing (module and corresponding driver) are executed in the same OB.

You make the assignment to the process images during hardware configuration of the I/O modules (see Figure below).

Setting the process image partitions

1. In the HW Config, select the I/O module you want to assign to a process image partition.
2. Select the menu command **Edit > Object Properties...**.
   The "Properties - ..." dialog box opens.

3. Change to the "Addresses" tab and assign to a process image partition as required (PIPx; x=1 through 15).
4. Click "OK".



Updating of the process image partitions by the system

If you link the updating of a process image partition to an OB, the partition is automatically updated by the operating system when this OB is called. This strategy is similar to the updating of the (total) process image which is updated cyclically or after OB1 has been executed.

During operation, the assigned process image partition is then updated automatically as follows:

- before the OB is executed - the process image partition of the inputs (partial PII)
- after the OB is executed - the process image partition of the outputs (partial PIQ)

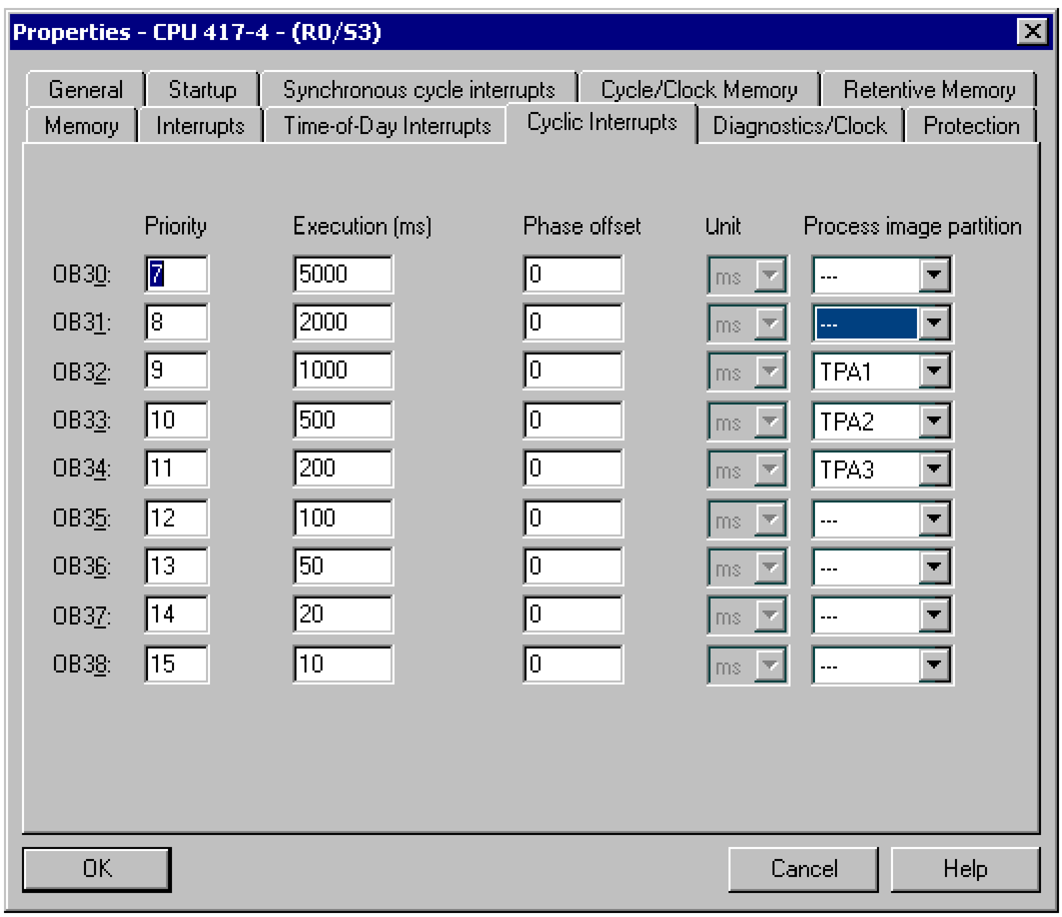
Processing a process image partition when linked to an OB					
Start of the current cyclic interrupt (OB) processing			Start of the next cyclic interrupt (OB) processing		
← Current cycle time of the OB →					
Update the **partial PII**	Execute the cyclic interrupt	Output the **partial PIQ**	Update the **partial PII**	Execute the cyclic interrupt	Output of the **parti-al PIO** etc. →

Assigning the process image partition to OBs

You can specify which process image partition is assigned to which OB when you assign parameters to the CPU and the priority of the OB (see following Figure).

Assigning process image partitions to OBs

1. Select the CPU in HW Config.
2. Select the menu command **Edit > Object Properties**.
3. Select the "Cyclic Interrupts" tab and make the required settings.
4. Click "OK".



Note

Changing the cyclic interrupt time in the RUN of a CPU

Each change to the cyclic interrupt time of a CPU requires compilation of the program. Otherwise, the CPU_RT block continues to work using the old values.

Additional information

- Online help for HW Config

9.9.4.9 Configuring high availability systems (H systems)

SIMATIC H station

For a high availability automation system, add a SIMATIC H station to the project as a separate station type in the SIMATIC Manager. This station type is required if you want to configure two central racks each with an H CPU, thereby configuring your process control system with redundancy.

Description with step-by-step instructions

For complete step-by-step instructions for configuring high availability process control systems, refer to the manual *Process Control System PCS 7; High Availability Process Control Systems*.

9.9.4.10 Configuring fail-safe systems (F systems)

SIMATIC F/FH station

For a fail-safe and high availability automation system (FH system), add a SIMATIC H station to the project as a separate station type in the SIMATIC Manager.

For a fail-safe automation system (F system), add a SIMATIC 400 station to the project as a separate station type in the SIMATIC Manager.

Description with step-by-step instructions

- Manual *S7-400F/S7-400FH Automation systems, Fail-safe Systems*
- For complete step-by-step instructions for configuring high availability process control systems, refer to the manual *Process Control System PCS 7; High Availability Process Control Systems*.

9.9.4.11 Default parameters for the CPUs

Modifying parameters

When you work with new projects, PCS 7 sets default values for the automation systems.

The table in the section "Default Performance Parameters of the CPUs (Page 109)" shows the default parameters for the performance capability of typical CPUs for PCS 7 projects. These values are set as defaults in the configuration of the CPU with PCS 7 software.

The default parameters suffice for typical applications but can be changed within limits as required for configuration.

You can modify these parameters on the tabs of the CPU "Properties" dialog box using the menu command **Edit > Object Properties**.

Note

After adapting the parameters, a download with the CPU in STOP is necessary.

Additional information

- Section "Default performance parameters of the CPUs (Page 109)"

9.9.5 Setting time synchronization

9.9.5.1 Principle of time synchronization

System-wide time synchronization

To be able to analyze the process data, all the components of the process control system must work with exactly the same time. This is the only way that messages can be assigned in the correct chronological order - regardless of the time zone. For example, an OS server must assume the function of time master, such that all other operator stations and automation systems on the plant bus receive the time from this master. In this way, they all have the same time.

Time synchronization for a PCS 7 plant

Station	Synchronization options	Additional information
Operator station and Maintenance station	• Synchronize the time of day through the terminal bus • Synchronize the time of day through the plant bus	Configuration manual *Process Control System PCS 7; Operator Station* 1.)
BATCH station	• Synchronize the time of day through the operating system	1.)
Route Control station	• Synchronize the time of day through the operating system	1.)
SIMATIC PCS 7 BOX	• Synchronize the time of day during integration in a PCS 7 system	Function Manual *Process Control System PCS 7, SIMATIC PCS 7 BOX* 1.)
AS	• Synchronize the time of day with AS as time slave	Section "How to set time synchronization on the AS (Page 338)" 1.)

Station	Synchronization options	Additional information
Domain controller	• Synchronize the time of day Domain controller as the time master on the terminal bus	Manual *Process Control System PCS 7; Operator Station* 1.)
Time master	• The time-of-day master is integrated in a PC or connected to Ethernet as a bus component.	Manual *Process Control System PCS 7; Operator Station* 1.)
	• The time-of-day master can be any device that can send a time signal via Ethernet (a PC, for example).	Manual *SIMATIC NET; SICLOCK TM, SICLOCK TC 400* 1.)

1.) Function Manual *Process Control System PCS 7; Time Synchronization*

Using CPU clocks

You can set and evaluate the time/date of automation systems and operator stations.

Representing time zones

There is only one continuous uninterrupted time of day throughout the plant - the UTC.

Locally on the OS, an additional local time that differs from UTC can be calculated and used for display. The local time is calculated from the UTC by adding or subtracting a time difference.

The local time also takes into account standard and daylight saving time.

Note

In PCS 7 UTC time is always used internally in the system.

Time information displayed to the plant operator in process mode (OS Runtime) can be displayed optionally in UTC or local time. This makes system configuration possible across time zone boundaries.

This makes it possible to configure a system, for example, with the automation system in a different time zone than the operator station. When necessary, the operator can also change over between displayed in UTC or local time during operation.

Time stamp

The time stamp in the diagnostic buffer, messages and OB start information is generated with UTC.

Description for setting the time synchronization

For time synchronization to function throughout a system, certain settings must be made at the nodes involved.

Components Involved	Information on the procedure can be found in
AS: CPU, CP 443-1, CP 443-5 Extended	Section "How to set time synchronization on the AS (Page 338)" Manual *Process Control System PCS 7; High-precision Time Stamps*
OS	Manual *Process Control System PCS 7; Operator Station*
PC station	Whitepaper *Security Concept PCS 7 and WinCC*

Additional information

- Function Manual *Process Control System PCS 7; Time Synchronization*
- Configuration manual *Process Control System PCS 7; Operator Station*
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.9.5.2 How to set time synchronization on the AS

Setting the CPU

1. Open the hardware configuration of the required station.
2. Select the object via which you want to perform time synchronization of the AS:
   - CPU
   - CP
3. Select the menu command **Edit > Object Properties...**.

Additional information

- Function Manual *Process Control System PCS 7; Time Synchronization*
- Manual *Process Control System PCS 7; High-precision Time Stamps*

9.9.6 Configuring the hardware of high-precision time stamps

Highly accurate detection of binary signals

If you require highly accurate analysis of the process signals for a selected area, you can use high-precision time stamps with the following familiys of distributed IO devices:

- ET 200SP HA
- ET 200M
- ET 200iSP

Possible fields of use of high-precision time stamps:

- Accurately-timed detection of problems in process-related equipment. Time stamping enables you to clearly identify signals that indicate the cause of the failure of a process unit.
- Analysis of system-wide interrelationships
- Detection and reporting of the sequence of time-critical signal changes

Note

Time stamps should only be used for selected signals that are of importance to the process. They may never be used for all binary signals to be read:

On the other hand, it is possible for numerous signals to be reported at the same time (for example, when a fault occurs). This increases the risk of messages being lost due to buffer overflow.

Requirement for the time stamp

A requirement for time stamps is that the time is synchronized on all the devices belonging to the system. This requires a connection to a time master.

Description with step-by-step instructions

- You can find detailed step-by-step instructions on configuring high-precision time stamps in the function manual *Process Control System PCS 7; High-precision Time Stamps*.
- You can find a full description and step-by-step instructions for configuring an OS server as the time-of-day master in the configuration manual *Process Control System PCS 7; Operator station*.

9.9.7 Acknowledgment-triggered reporting

9.9.7.1 How to activate acknowledgment-triggered reporting (ATR)

Introduction

If events that trigger messages change their status in very quick succession, this can trigger a message surge. The overview of the plant status can no longer be sufficiently ensured.

By configuring the "acknowledgment-triggered reporting (ATR)" function, you can suppress the repeated signaling of "fluttering" states until an acknowledgment is received.

Procedure

1. Select the required station in the component view.
2. Double-click the "Hardware" object in the detail window.
   The HW Config and hardware catalog open.
3. Select the CPU.
4. Select the menu command **Edit > Object Properties...**.
   The "Properties - ("CPU-xxx")" dialog box opens.
5. In the "Diagnostics/Clock" tab, activate the "Acknowledgment-triggered reporting of SFB 33-35" check box in the "System Diagnostics" group.

Result

SFBs 33 to 35 then only report a change of signal if the previous change of signal (the previous incoming message) has been acknowledged.

9.10 Configuring the connected I/Os (Standard)

9.10.1 Configuring the distributed I/O on PROFIBUS DP (standard)

9.10.1.1 How to configure the distributed I/O on PROFIBUS DP

Introduction

In the following configuration instructions, we start from an example configuration for the distributed I/Os with the following components:

- ET 200M (communication via PROFIBUS DP)
- S7-300 I/O modules plugged into the ET 200M

To configure the distributed I/Os, carry out the following configuration steps one after the other:

1. Add DP slave
2. Add I/O modules
3. Add symbolic names for the channels

Adding a DP Slave - with Reference to the ET 200M

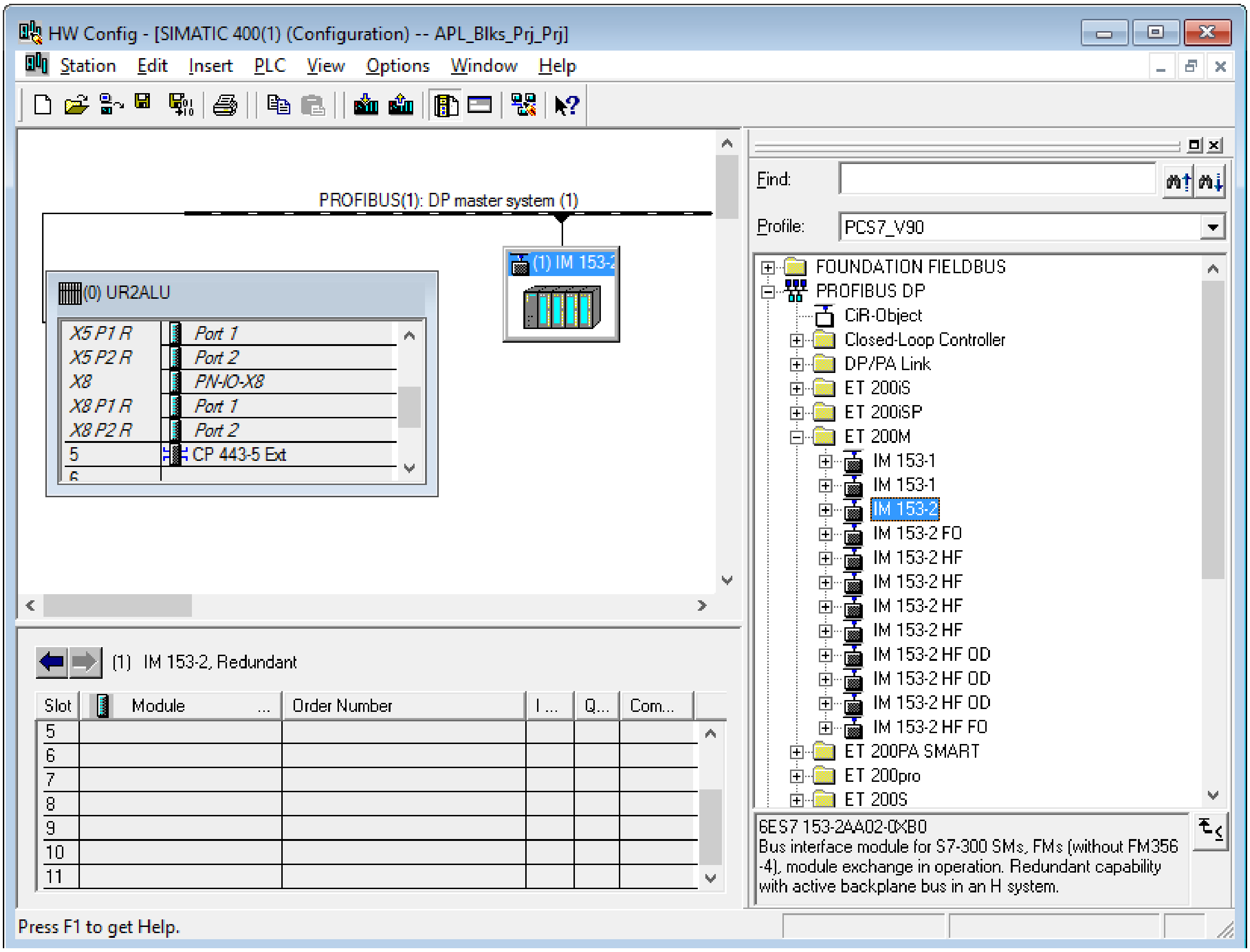
1. Select the required SIMATIC 400 station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Select "PROFIBUS DP > ET 200M > IM 153-..." in the hardware catalog and drag this module to the DP master system(1). The DP master system(1) is the line to the right of the RACK window.
   The "Properties - PROFIBUS Interface IM 153-..." dialog box opens.

   Note

   From the hardware catalog, select the IM 153 that matches the backplane bus you are using (passive or active backplane bus) and the product version marked on the actual IM 153 module you intend to use. In PCS 7, the active backplane bus is used.

3. For the "PROFIBUS Address", select an address for the DP slave that is unique in your DP network (for example, 7). You must set the selected address on the IM 153-... using DIL switches (hardware switches).

4. Click "OK".



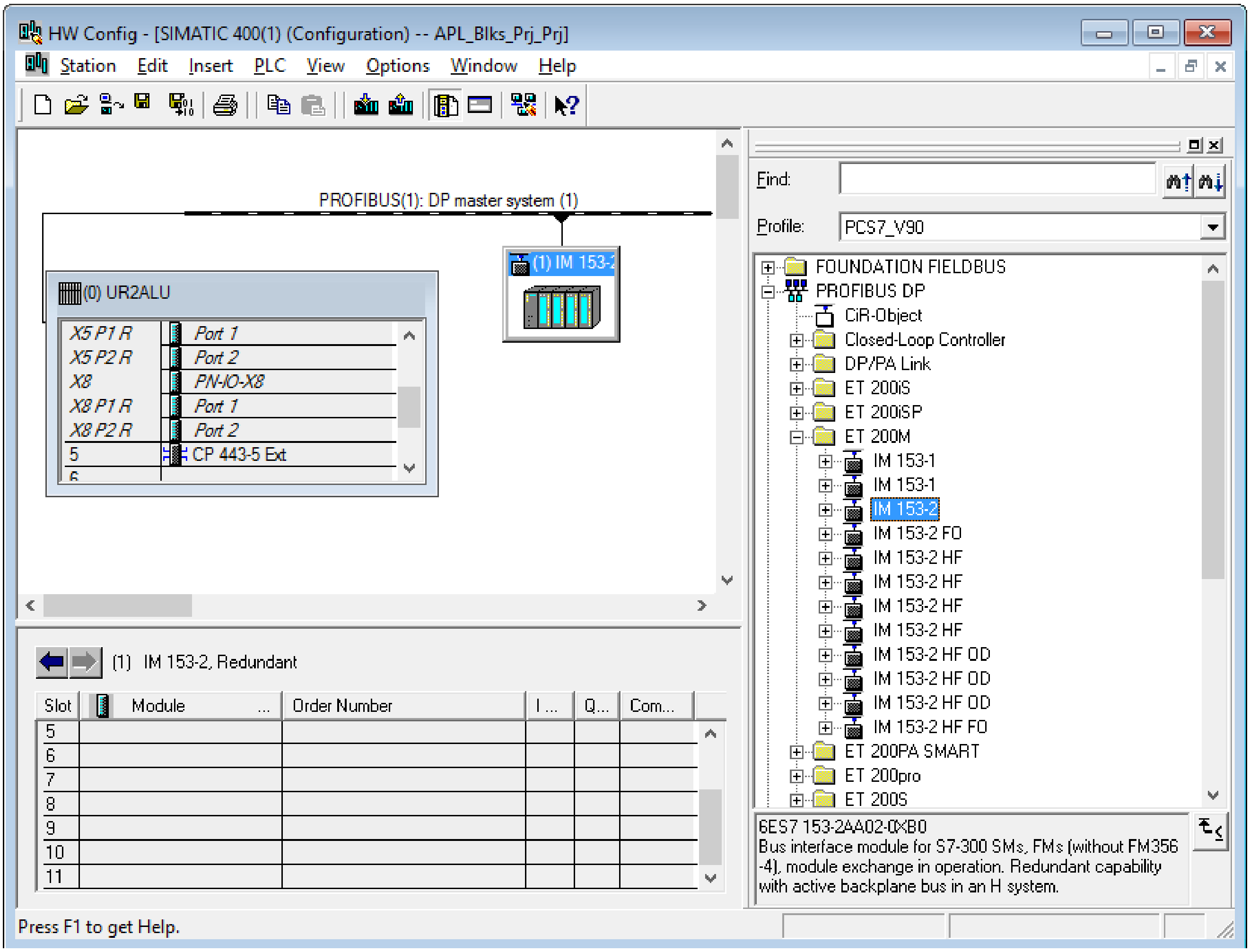
5. Select the ET 200M and select the menu command **Edit > Object Properties...**.
6. Open the "Operating Parameters" tab.
   Select the check box "Replace modules during operation" (default setting).
7. Click "OK".

Note

If you do not check this check box and a module fails, the AS will interpret the module failure as a failure of the ET 200M.

Adding Input and Output Modules

1. Select "PROFIBUS DP > ET 200M > IM 153-... > ..." in the hardware catalog and drag and insert the required modules (bottom hardware configuration window).



2. Select the first module and select the menu command **Edit > Object Properties...**.
3. Set the address and the process image partition in the "Address" tab.

4. Set any other properties of the module according to your configuration requirements, for example, diagnostic alarms or measuring ranges.
5. Repeat the procedure for the other modules.

Note

The channel specific setting "Reaction to CPU-STOP" (OCV, KLV, SV) of a module (for example, analog output module with 4 channels) within the ET 200M distributed I/O station must be set identically for all channels.

Note

Make sure that the measuring range for the analog input module is also be set on the module itself using a coding key. You can find the code letter for setting the coding key in the object properties of the module in the "Inputs" tab to the right of the "Coding Key Setting".

If you use an ET 200M (IM 153-x), you must install at least one input/output module in the ET 200M or a CiR object to avoid consistency errors when saving and compiling the hardware configuration.

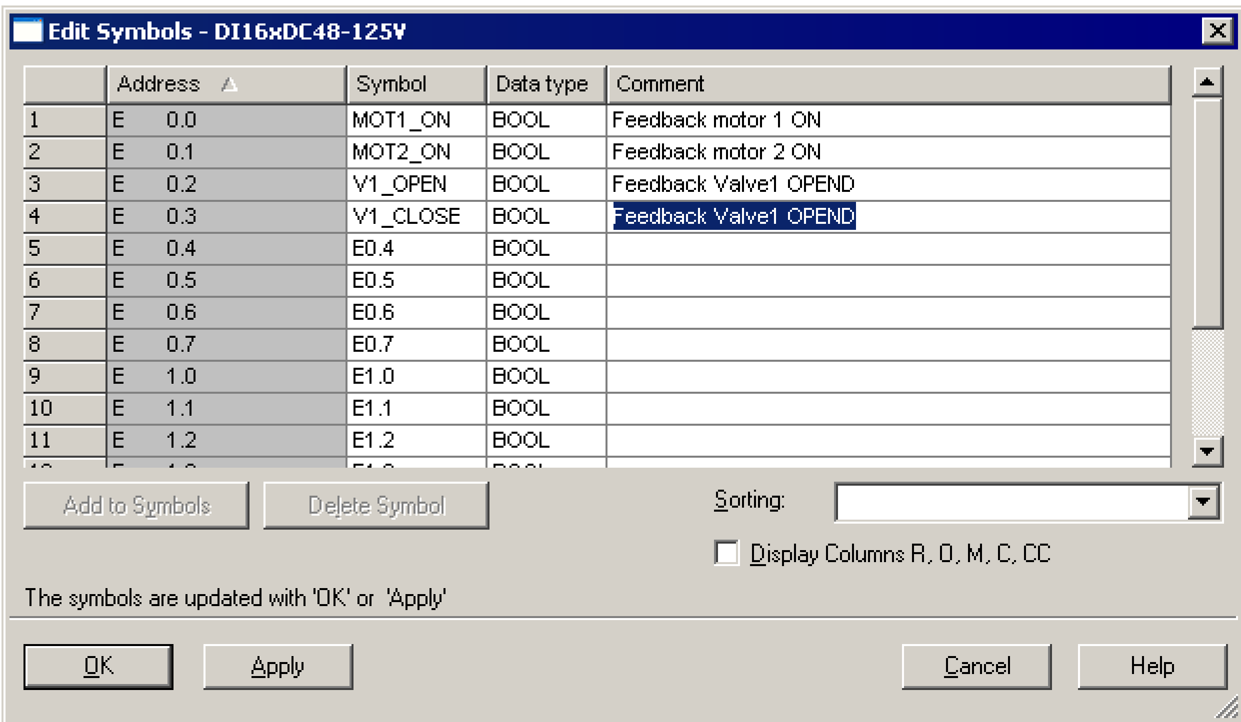
HART field devices

Additional information regarding HART field devices see section "How to configure HART devices on distributed I/O (Page 395)".

Assigning symbolic names to the channels

Driver blocks are assigned to the channels on the modules using symbolic names that are listed in the symbol table. You declare the symbol names in the hardware configuration. Follow the steps outlined below:

1. Select the first module in the ET 200M and select the **Edit > Symbols...** menu command.
2. Enter symbolic names in the "Symbol" column to reflect the technological significance of the value being read in.



3. Follow the same procedure with the other modules and enter the symbolic names for all the other process values you require. Use the process tag list of the plant description as a basis.

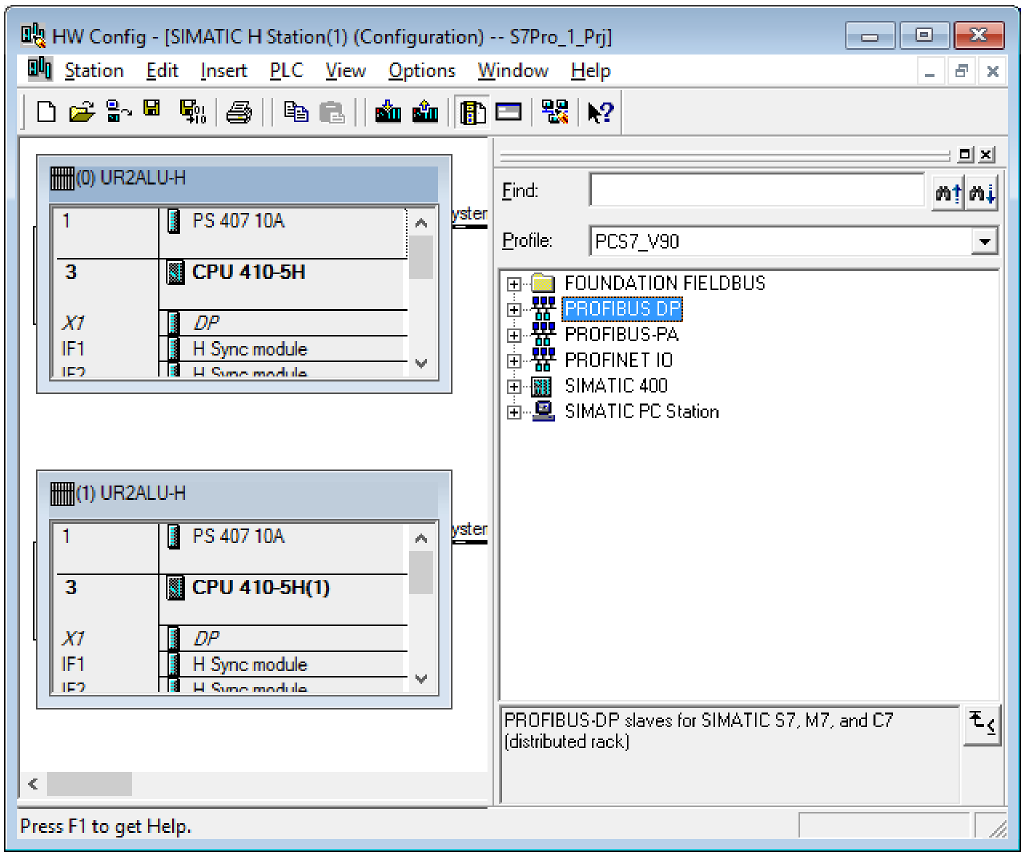
Additional information

- Online help for HW Config
- Manual *SIMATIC; Distributed I/O Device ET 200M*
- Manual *SIMATIC; Distributed I/O System ET 200S*
- Manual *SIMATIC; Distributed I/O Device ET200iSP*
- Manual *SIMATIC; Distributed I/O Device ET 200pro*

9.10.1.2 How to configure modules in distributed I/O based on PROFIBUS DP as fieldbus

Procedure

1. In the component view, select the station and double-click the "Hardware" object in the detail window.
   HW Config and the hardware catalog open.



> **Note**
>
> When you want to add additional modules to a SIMATIC 400 station created with the PCS 7 wizards, continue with Step 6.

2. In the SIMATIC 400 > Rack-400 hardware catalog, select the required rack and insert it by dragging with the mouse.
   Make sure that the arrangement selected here matches the arrangement of the physical hardware.
3. In the "SIMATIC 400 > PS-400" hardware catalog, select the required power supply and add it by dragging with the mouse.
4. In the SIMATIC 400 > CPU-400 hardware catalog, select the required CPU and insert it by dragging with the mouse.
5. Click "OK" to confirm the "Properties - PROFIBUS Interface" dialog box that opens.

6. Proceed in the same way to add any other components you require, for example:
   - "SM 400": Digital and analog signal modules (CPUs)
   - "CP 400": communication modules: You can find information on this in the section "How to insert a communications processor (Page 323)".
7. Select the menu command **Station > Save** in HW Config.

Setting the properties of the integral PROFIBUS DP interfaces

When you add a CPU you have to set the properties of the integral PROFIBUS DP interfaces of that CPU.

Follow the steps below:

1. Select the PROFIBUS DP interface of the CPU.
2. Select the menu command **Edit > Object Properties**.
3. Click the "Properties" button of the interface in the "General" tab.
4. Network the PROFIBUS DP interface with a PROFIBUS network by selecting the PROFIBUS network and assigning the required address.
   If you have not yet created a PROFIBUS network, you can create a new network with the "New" button.
5. Then click "OK" twice.
   The "Properties" dialog box closes.

Note

If you want to connect PROFIBUS DP to a CP 443-5 Extended, you do not need to set the properties.

Note that the integral PROFIBUS DP interface does not perform the same range of functions as the CP 443-5 Extended (e.g. number of PROFIBUS nodes).

Adding and setting additional IF interface modules

1. Select a module slot (IF1/IF2) of the CPU.
2. Select the menu command **Insert > Insert Object**.
3. In the dialog boxes that then open, select:
   - CPU
   - Firmware version
   - Interface module
4. Click the interface "Properties" button in the "Parameters" tab.

5. Network the PROFIBUS DP interface with a PROFIBUS network by selecting the PROFIBUS network and assigning the required address.
   If you have not yet created a PROFIBUS network, you can create a new network with the "New" button.
6. Then click "OK" twice.
   The "Properties" dialog box closes.

Additional information

- Section "How to configure the distributed I/O on PROFIBUS DP (Page 341)"
- Section "How to insert a communications processor (Page 323)"

9.10.1.3 How to configure the "Redundant IO" with ET 200M?

Introduction

You configure the redundant I/O modules using HW Config.

Note

Redundant operation is possible only with certain S7-300 I/O modules of the ET 200M. For additional information, please refer to the following documents:
- Documentation *PCS 7 - Released Modules*
- Manual *Automation System S7-400H; High Availability Systems*

Note

Only input/output modules with the same article number and the same product version in analog or digital version can be used.

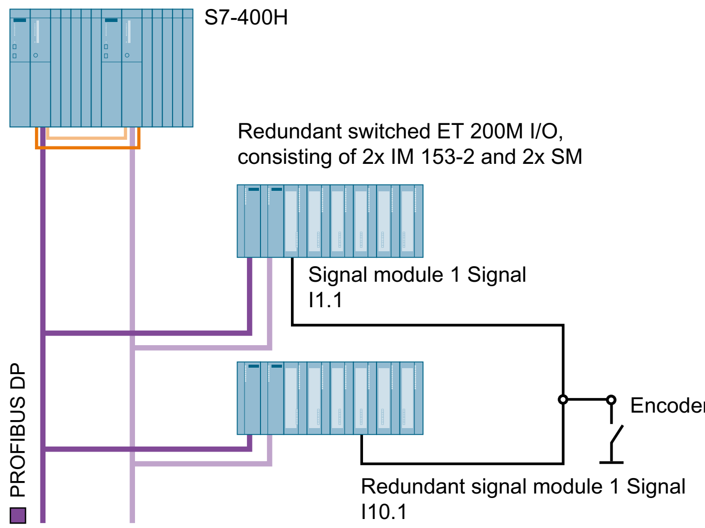
Assigning redundant modules

Redundant modules can be assigned to each other for the ET 200M as follows:

- The modules are located in two different ET 200M stations on the same redundant PROFIBUS DP (see sample configuration).
- The modules are located in two different ET 200M stations on different redundant PROFIBUS DPs.
- The modules are located in the same ET 200M station.

Example configuration with a ET 200M on PROFIBUS DP

The figure below shows the setup for redundant input modules in a switched distributed configuration.



Method of operation in the example configuration

"Signal Module 1" is configured redundantly to "Redundant Signal Module 1". As a result, Signals E1.1 and E10.1 are redundant to one another.

If a fault is detected in "Signal module 1", the user program continues to work with the address I1.1, but the signal comes from the address I10.1. The user program does not detect an error since the signal status is still correct. The event generates a diagnostic message that provides information about the passivated signals.

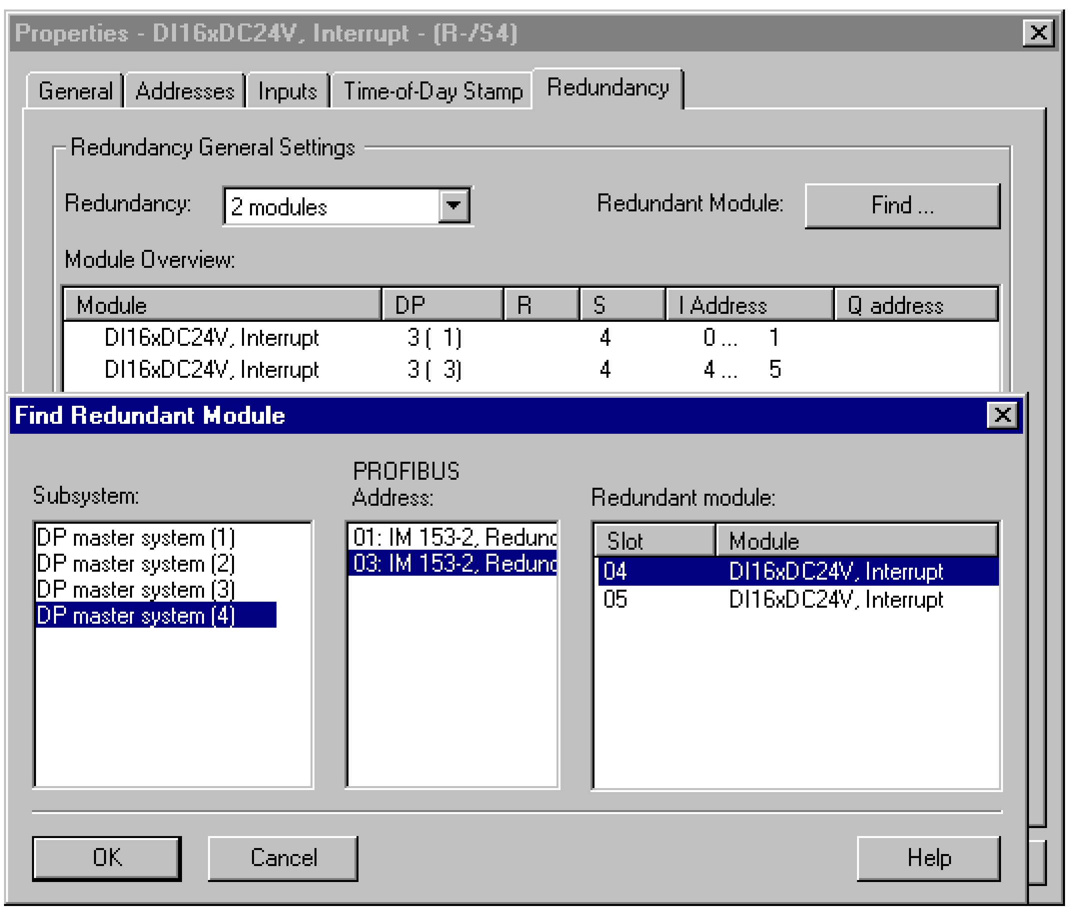
Requirements

- The PCS 7 project involving an H CPU must have been created and opened in SIMATIC Manager.
- A redundant DP master system is configured for the SIMATIC H station in HW Config.
- The interface modules for ET 200M (IM 153-2) on the redundant PROFIBUS DP are configured in HW Config.

Procedure

1. In the component view, select the SIMATIC H station and double-click the "Hardware" object in the detail window.
   HW Config opens.
2. If the hardware catalog is not visible, select the **View > Catalog** menu command.
   The hardware catalog opens.
3. Select the IM 153-2 (ET 200M) in which you want to configure the redundant module.
   The module overview is displayed in the lower window pane.

4. In the hardware catalog, select a signal module that supports redundancy.
   Using drag-and-drop, move the signal module onto a free slot in the IM 153-2 (lower window pane).
5. Repeat steps 3 and 4 for the second signal module.
   The modules for which redundancy is to be configured are inserted.
6. Select the first IM 153-2 again.
7. Double-click the inserted signal module in the module overview.
   The "Properties ..." dialog box for this module opens.
8. Open the "Addresses" tab.
9. Select the process image partition in the "Process image" drop-down list.
10. Select the "Redundancy" tab.
11. Select the entry "2 modules" in the "Redundancy" drop-down list.
12. Click "Find".
    The "Find Redundant Module" dialog box opens.



13. In the "Subsystem" list, select the DP master system in which the redundant signal module is configured.
    All the available PROFIBUS addresses in this DP master system are displayed in the "PROFIBUS address" box.

14. In the "PROFIBUS address" box, select the IM 153-2 in which the redundant signal module is configured.
The redundancy-capable signal modules available in this IM 153-2 for which no redundancy has yet been configured are displayed in the "Redundant module" list.
15. Select the signal module you want to use as a redundant signal module in the "Redundant module" list.
16. Click "OK" to close the dialog box.
17. In the "Additional parameters" area, make any additional settings required for input modules.
18. Click "OK".

Additional information

- Documentation *Process Control System PCS 7; PCS 7 High Availability Process Control Systems*
- Documentation *Process Control System PCS 7; PCS 7 - Released Modules*
- Online help for *STEP 7*
- Manual *Automation System S7-400H; High Availability Systems*

9.10.2 Configuring the distributed I/O on PROFINET IO (standard)

9.10.2.1 Rules to configure a network node for use on PROFINET IO

An IO device must have a device name so that an IO controller can comunicate with it. This procedure was chosen for PROFINET because names are more understandable than complex IP-addresses.

In the PROFINET IO subnet the device name must be obvious.

The assigning of a device name for an actual IO device is equivalent to setting the process in a DP slave.

IO devices' delivery state

In the delivery state an IO device does not have a device name.

Only after the assignment of a device name with the PG/PC is an IO device addressable for an IO controller.

Regulate for the specification of the device name (in accordance with norm IEC 61158-6-10)

- If you configure a device as a PROFINET IO device, you can assign the PROFINET IO device name here. Remember, however, that the device name should ideally be set in the Properties dialog so that it is stored in the project engineering data.
- The device name is also required when the IP address is obtained from a DHCP server using a device name.
- The device name must be specified according to DNS conventions. In other words:
  - Restricted to a total of 240 characters (letters, digits, dashes or periods)
  - Parts of the name within the device name (in other words, a string between two periods) must not exceed a maximum of 63 characters.
  - No special characters such as umlauts (ä, ö etc.), brackets, underscore, slash, blank etc may be used. The dash is the only permitted special character.
  - The device name must not begin or end with the "-" character.
  - The device name must not begin with numbers.
  - The device name must not have the structure n.n.n.n (n = 0...999).
  - The device name must not begin with the character string "port-xyz-" (x , y, z = 0...9).

Example: [Name from the short ID].[Name of the IO system]

The device name must be unique in the Ethernet subnet (PROFINET IO system).

Click the "Assign Name" button to transfer the device name to the device.

Note

CP in the role of PROFINET IO controller

With a CP in the role of PROFINET IO controller, the device name is derived from the short ID during configuration. STEP 7 allows you to add the IO system to the device name automatically (see example above).

Resetting to Factory Settings

With the "Reset" button, you can reset the device to the factory settings. The IP address is then deleted.

NOTICE
Resetting Depending on the type of device, changing the device name or resetting while the addressed device is operating can lead to operational problems. Check the information in the device documentation.

Note

After resetting to the factory settings, the device name on the module is deleted.

Additional information

Section "How to configure a network node for use on PROFINET IO (Page 358)"

9.10.2.2 How to configure the distributed I/O on PROFINET IO

Introduction

In the following configuration instructions, we start from an example configuration for the distributed I/Os with the following components:

- ET 200SP HA; ET 200M or ET 200SP (communication via PROFINET IO)

To configure the distributed I/Os, carry out the following configuration steps one after the other:

1. Add IO device and busadapter
2. Add I/O modules
3. Add symbolic names for the channels

Requirement

The type of networkcables for connecting ET 200SP HA to PROFINET IO is identified. Thereby the of required type of the busadaptor is also identified.

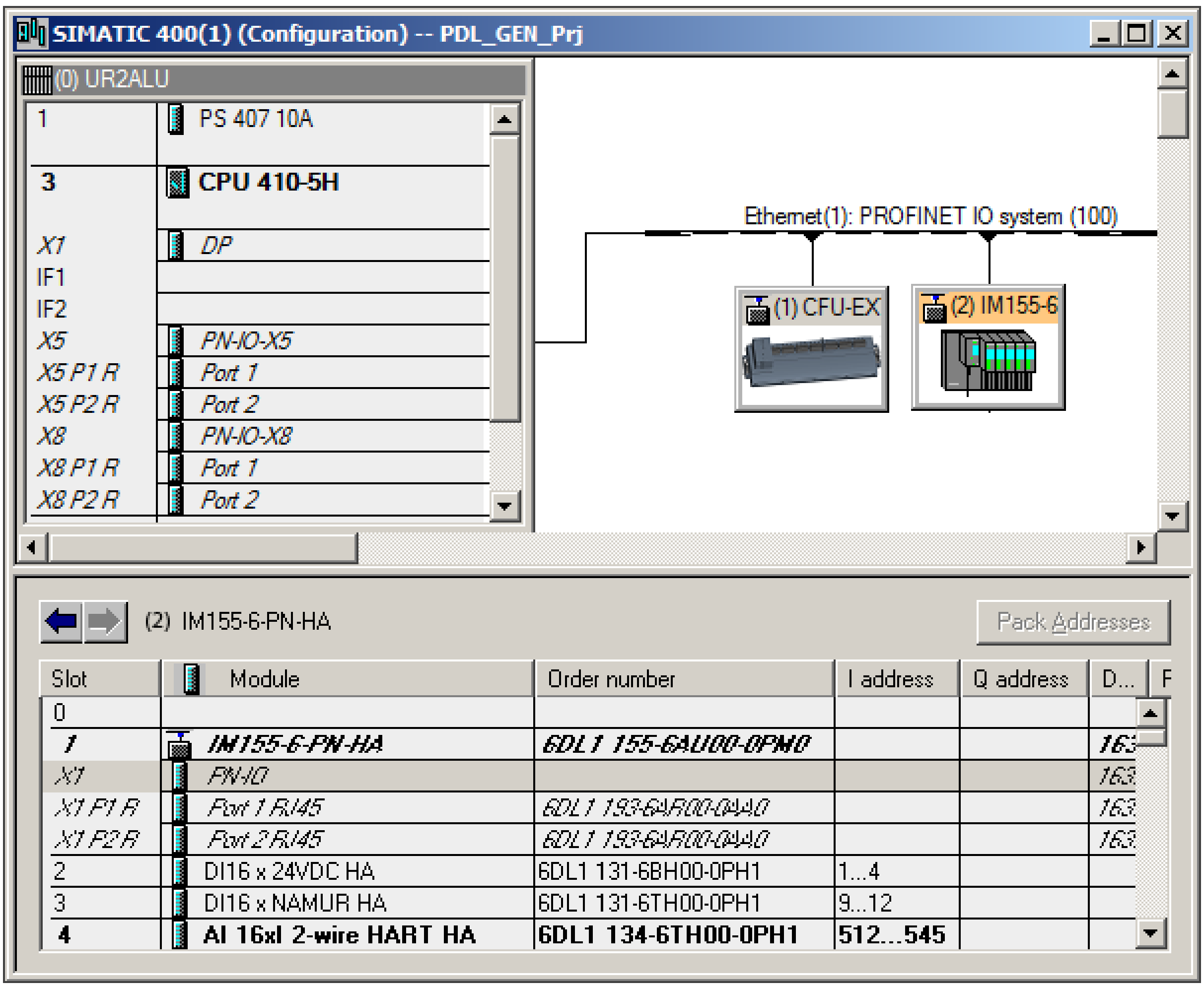
Adding a IO device - with Reference to the ET 200SP HA

1. Select the required SIMATIC 400 station with CPU 410-5H from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system will open.
2. If the hardware catalog in the hardware configuration is not open, select "View > Catalog".
   The hardware catalog will open.
3. Within this catalog, in the current PCS 7 profile, select path **PROFINET IO > IO > ET 200SP HA**".
4. Double-click on the peripherial device you wish to connect: IM 155-... .
   The interface module will be connected directly into the PROFINET IO system.
5. Select path **PROFINET IO > IO > ET 200SP HA > IM 155-... > Submodule > Busadapter**.
6. Double-click on the <required type of busadapter>.
   The busadapter will be connected directly into the interface module.

Adding Input and Output Modules

> **Note**
>
> **Using IO redundancy**
>
> The IO redundant peripheral modules must be configured to HW config on the slots of the carrier module. You must start on an odd slot number. The partner module has to be inserted into the following slot.

1. Select "PROFINET IO > ET 200SP HA > IM 155-..." > ..." in the hardware catalog and drag and insert the required modules (bottom hardware configuration window).



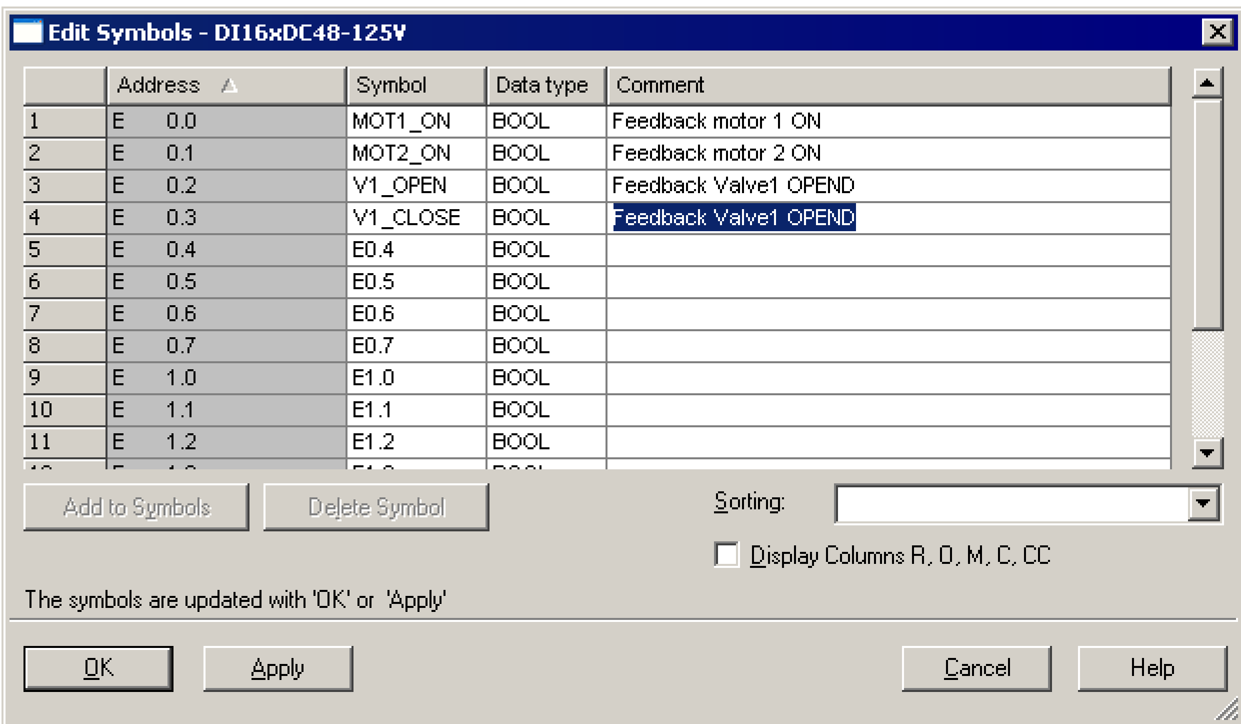
HART field devices

Additional information regarding HART field devices see section "How to configure HART devices on distributed I/O (Page 395)".

Assigning symbolic names to the channels

Driver blocks are assigned to the channels on the modules using symbolic names that are listed in the symbol table. You declare the symbol names in the hardware configuration. Follow the steps outlined below:

1. Select the first module in the ET 200SP HA and select the **Edit > Symbols...** menu command.
2. Enter symbolic names in the "Symbol" column to reflect the technological significance of the value being read in.



3. Follow the same procedure with the other modules and enter the symbolic names for all the other process values you require. Use the process tag list of the plant description as a basis.

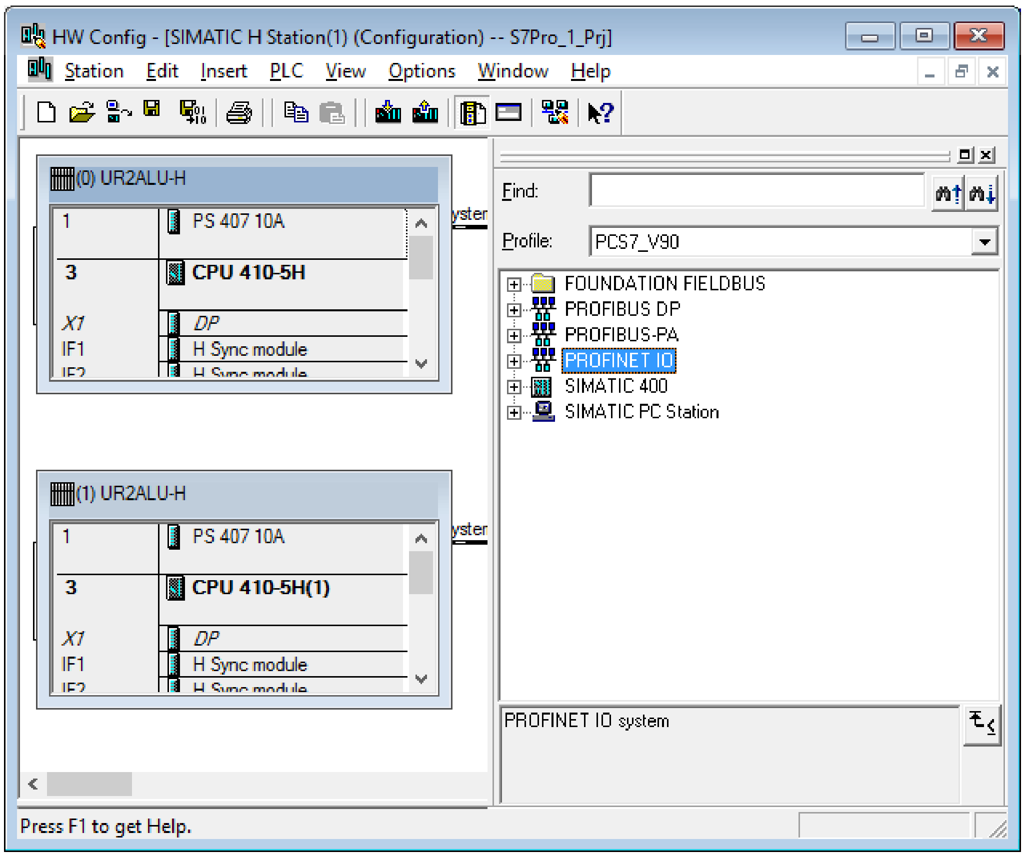
Additional information

- Online help for HW Config
- Manual *SIMATIC; Distributed I/O Device ET 200SP HA*
- Manual *SIMATIC; Distributed I/O System ET 200M*
- Manual *SIMATIC; Distributed I/O System ET 200SP*

9.10.2.3 How to configure modules in distributed I/O based on PROFINET IO as fieldbus

Procedure

1. In the component view, select the station and double-click the "Hardware" object in the detail window.
   HW Config and the hardware catalog open.



Note

When you want to add additional modules to a SIMATIC 400 station created with the PCS 7 wizards, continue with Step 6.

---

2. In the SIMATIC 400 > Rack-400 hardware catalog, select the required rack and insert it by dragging with the mouse.
   Make sure that the arrangement selected here matches the arrangement of the physical hardware.
3. In the "SIMATIC 400 > PS-400" hardware catalog, select the required power supply and add it by dragging with the mouse.
4. In the SIMATIC 400 > CPU-400 hardware catalog, select the required CPU and insert it by dragging with the mouse.
5. Click "OK" to confirm the "Properties - PROFINET Interface" dialog box that opens.

6. Proceed in the same way to add any other components you require, for example:
   - "SM 400": Digital and analog signal modules (CPUs)
   - "CP 400": communication modules: You can find information on this in the section "How to insert a communications processor (Page 323)".
7. Select the menu command **Station > Save** in HW Config.

Additional information

- Section "Setting the properties of the integral PROFINET IO interfaces (Page 357)"
- Section "Adding and setting additional IF interface modules (Page 358)"
- Section "How to configure the distributed I/O on PROFINET IO (Page 353)"
- Section "How to insert a communications processor (Page 323)"

9.10.2.4 Setting the properties of the integral PROFINET IO interfaces

When you add a CPU you have to set the properties of the integral PROFINET IO interfaces of that CPU.

Procedure

1. Select the PROFINET IO interface of the CPU.
2. Select the menu command **Edit > Object Properties**.
3. Click the "Properties" button of the interface in the "General" tab.
4. Network the PROFINET IO interface with a PROFINET network by selecting the PROFINET network and assigning the required address.
   If you have not yet created a PROFINET network, you can create a new network with the "New" button.
5. Then click "OK" twice.
   The "Properties" dialog box closes.

Note

If you want to connect PROFINET to a CP443-1 Extended, you do not need to set the properties.

Note that the integral PROFINET interface does not perform the same range of functions as the CP443-1 Extended (e.g. number of PROFINET nodes).

9.10.2.5 Adding and setting additional IF interface modules

Procedure

1. Select a module slot (IF1/IF2) of the CPU.
2. Select the menu command **Insert > Insert Object**.
3. In the dialog boxes that then open, select:
   – CPU
   – Firmware version
   – Interface module
4. Click the interface "Properties" button in the "Parameters" tab.
5. Network the PROFINET IO interface with a PROFINET network by selecting the PROFINET network and assigning the required address.
   If you have not yet created a PROFINET network, you can create a new network with the "New" button.
6. Then click "OK" twice.
   The "Properties" dialog box closes.

9.10.2.6 How to configure a network node for use on PROFINET IO

Name of an IO device

You find Information regarding rules for the naming of an IO device in section "Rules to configure a network node for use on PROFINET IO (Page 351)".

Creating Device names at an existing project planning in HW Config

The device name must be clear at the PROFINET IO subnet.

Requirements

- The PG interface must be attached directly to the PROFINET IO subnet.
- The device name is deposited into HW Config in the quality dialog of the IO device.
- The MAC address of the IO device is known.

Requirements

1. In HW Config select the IO Device.
2. Select the menu **PLC > Ethernet > Assign Device Name.**
3. In area "Assign Name" click the botton "Assign Name".

4. Make sure for the first award of the device name that the following options boxes are activated:
   In the list "available equipment",
   - Show only devices of the same type
   - Display only devices without names
5. If you want to check whether you have selected the desired IO Device. Click "flash on" button.
   At the highlighted device flash the LED.
6. You click "Assign Name" the button.
   The device name is assigned to the device directly.

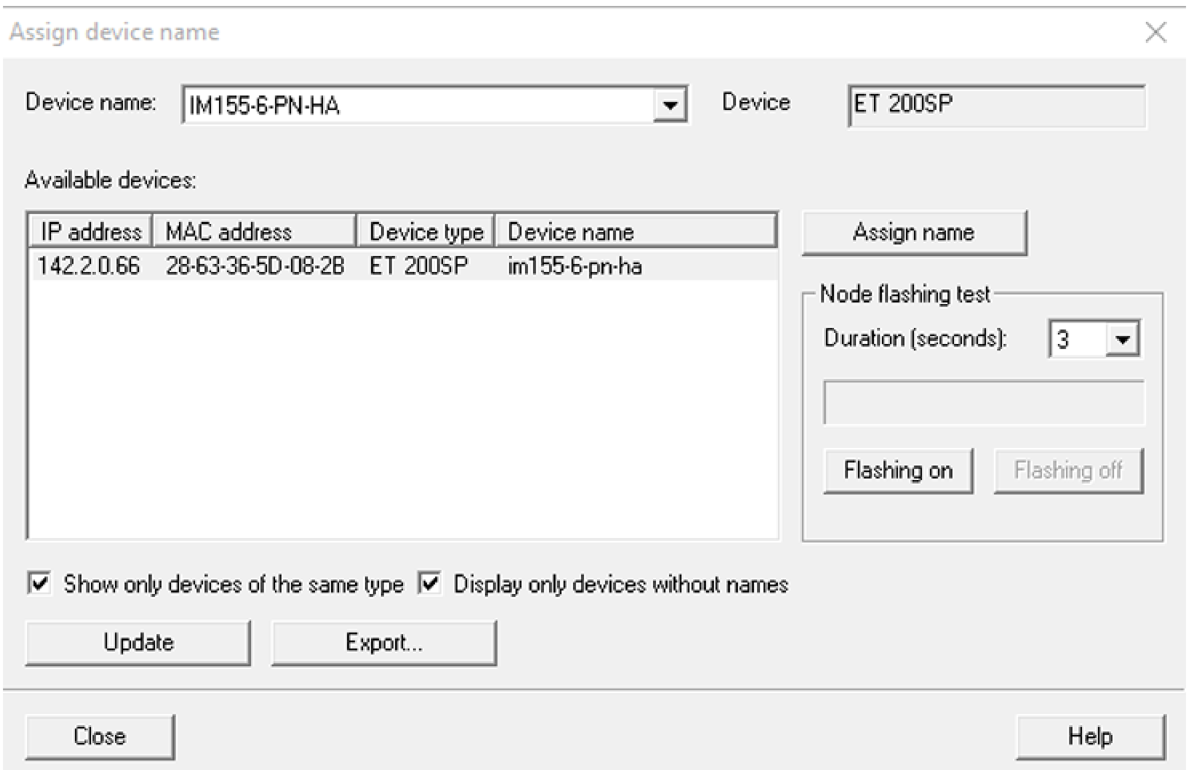


Figure 9-1 Sample: Configure a PROFINET node

Device names without project planning

If you want to assign a device name to an IO device without projected device name into HW Config, you execute the following steps.

Requirements

- The PG interface must be attached directly to the PN-IO subnet.
- The MAC address of the IO device is known.

Procedure

1. Find out the MAC addresses of the available devices using the "Browse" button or enter the MAC address (assuming you know it).
   – If this is the case, select the module with the known MAC address from the list displayed in the dialog after browsing the network.
   – Within the plant you can select the desired device by clicking the button "Flash".
   The LED on the selected device starts flashing.
2. **Set the IP configuration**
   Select from the following alternatives:
   – Use IP parameters
   If you opened the dialog based on a selected module, the IP address already has the values configured for the module. Otherwise, you must enter the IP address, subnet mask and if applicable the gateway.
   You will find more information on the ranges of values and on special IP addresses in: Range of Values of the IP Address, Subnet Mask, and Gateway Address -
   – Obtain IP address from a DHCP server
   If you select this option, the IP address is obtained from a DHCP server.
   Depending on the selected option, the DHCP server is informed of the MAC address of the CP, the device name, or the client ID that you can enter here.
   The client ID is a string with a maximum of 63 characters. Only the following characters can be used:
   a-z, A-Z, 0-9 and - (dash)
   If you specify here that the DHCP server should obtain the IP address using a device name, you must first assign the device a device name.
3. Click the "Assign IP Configuration" button.

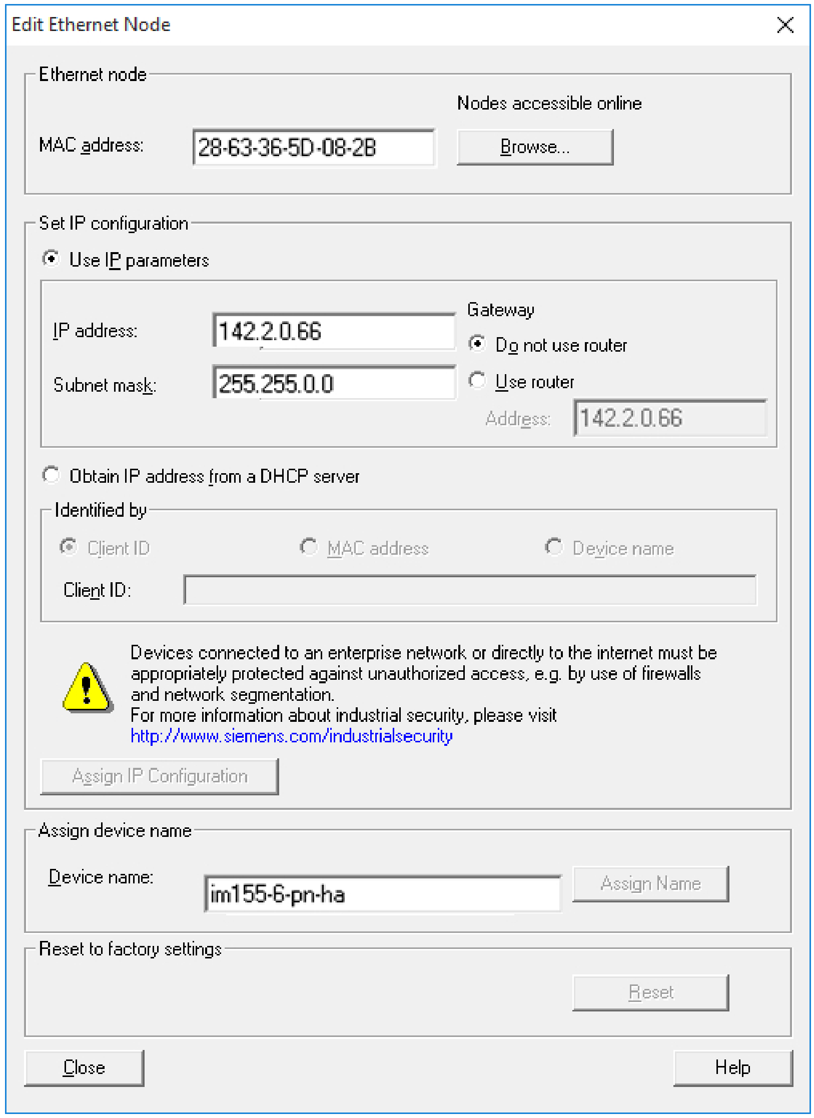


Figure 9-2 Sample: Configure a PROFINET node without project planning

Configuration connection to IO devices

We recommend using the "Topology Editor" to establish the connection to IO devices.

Resetting to Factory Settings

With the "Reset" button, you can reset the device to the factory settings. The IP address is then deleted.

NOTICE
Resetting
Changing the device name or resetting while the addressed device is operating can lead to operational problems depending on the type of device. Check the information in the device documentation.

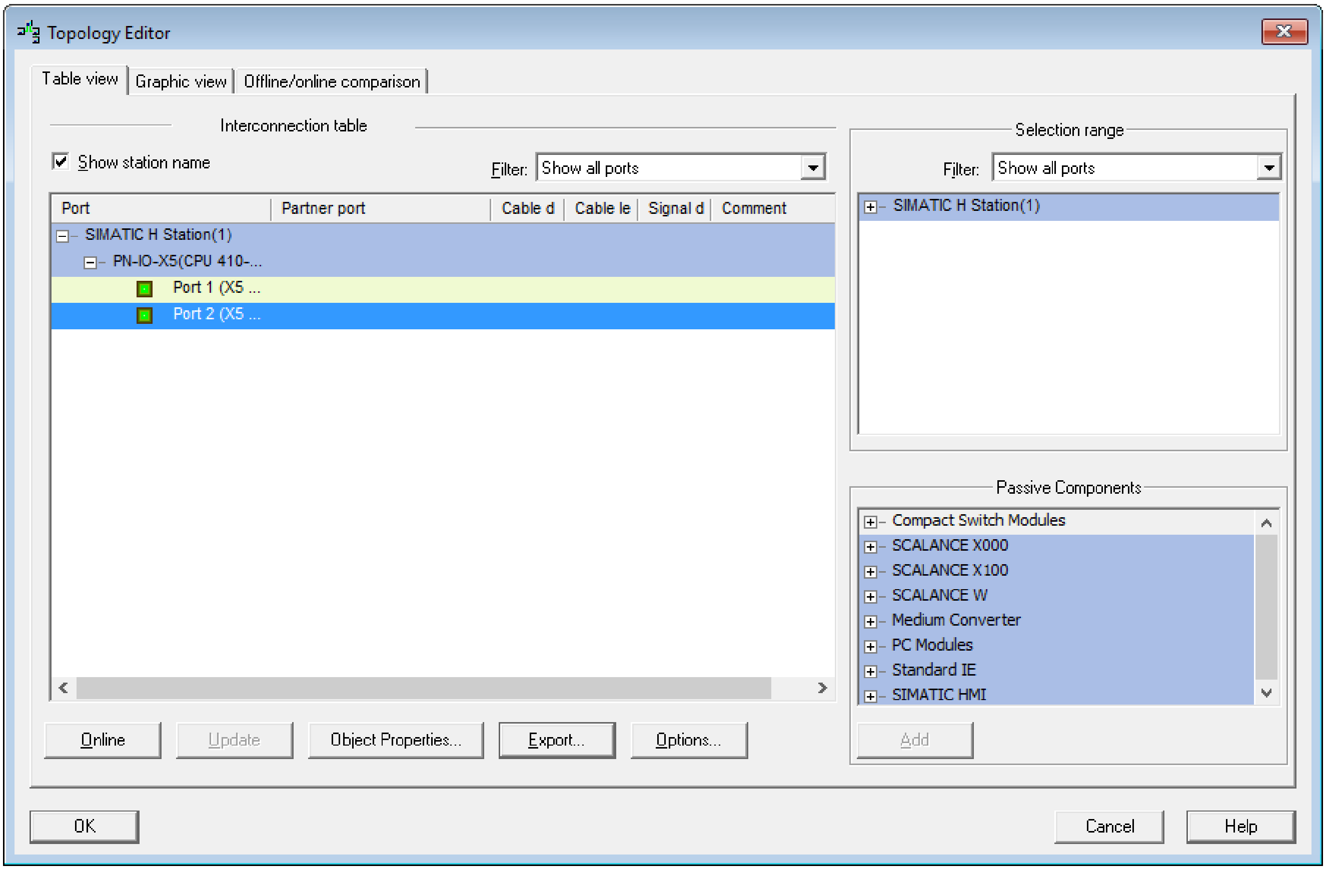
Note

After resetting to the factory settings, the device name on the module is deleted.

9.10.2.7 How to use the "Topology Editor"?

Configuring Topology in HW Config

1. Select any one member on PROFINET IO.
2. In HW Config, select the menu **Edit > PROFINET IO > Topology...** . The "Topology Editor" opens.



Based on the operation that you need to perform, select the respective tab.

"Table view" Tab

The "Table view" tab" provides the following options:

- "Station name" - if it is enabled, then the port name will be preceeded by the station name under "Partner port".
- Non-interconnected and connected ports - This can be selected using the filter provided under the "Selection range" section.
- Editing or disconnecting the existing interconnections:
  - Editing the parameters of an existing interconnection can be done by double clicking on the corresponding port entry in the table.
  - To disconnect the existing connection:
    Select the interconnected port in the table
    Open the shortcut menu and select "Disconnect Port Interconnection"

- "Options" - Provides the following:
  – Measurement of lengths for cables
  – Whether the online view needs to be updated automatically
  – Selecting the search method
  – Columns that need to be visible in the "Table view"
- "Online" - You can run a check to determine whether the configured devices are connected. This will provide you with the available interconnections in the connected system and allow you to check their current status.
- "Object Properties..." - On selecting this option the "Properties - PN-IO-X5-Port1 (R1/S3/X5 P1R)" dialog box opens and the corresponding parameters such as name, address and so on can be configured.
- "Export" - Using this option the configuration can be saved on the local drive in the form of a .CSV file.

"Graphic View" Tab

Using the "Graphic View" tab the following functions can be carried out:

- Creating, changing or deleting the interconnection of ports
- Editing properties of the devices, modules and port interconnections
- Adding or deleting the passive comments
- Changing the view

In the online view of the "Graphic view" you can see the devices of the connected plant that were detected and assigned to project devices. Click "Online" to activate the online mode.

"Offline / online comparison" Tab

The configured topology in offline mode can be compared with the detected topology in online mode and the report can be saved in the form of a.csv file on the local drive.

9.10.2.8 How to configure the "Media redundancy"?

Quick overview for configuration

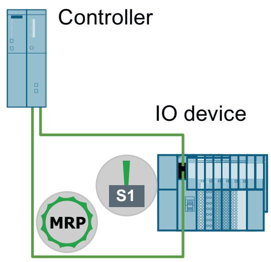
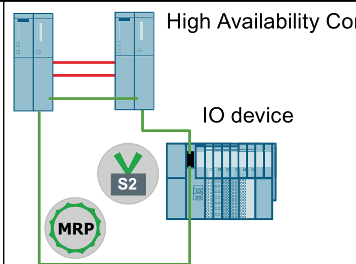
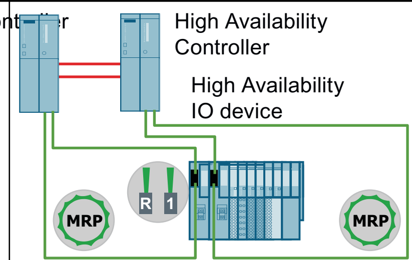
Note

Using media redundancy protocol

Note the following:

- Each node is connected to two other nodes in a ring configuration.
- When you use media redundancy protocol with a network in an H system, an additional connection between the two IO controllers must be implemented.

Configurations

Configuration object	Media redundancy	Media redundancy with H system	
	1 subnet ring	System redundancy + subnet ring	System redundancy (2 subnet rings)
principale hardware configuration			
Example (network connections):	• Network1: CPU (0) X5 port 1 + CPU (0) X5 port 2	• Network1: CPU (0) X5 port 1 + CPU (1) X5 port 1 • Separate connection for media redundancy required: CPU (0) X5 port 2 + CPU (1) X5 port 2	• Network1: CPU (0) X5 port 1 + CPU (0) X5 port 2 • Network2: CPU (1) X5 port 1 + CPU (1) X5 port 2
Network addresses	All node addresses are located in a subnet.		

Use of the "Topology Editor" to configure network connections as build

Information for the use the "Topology Editor" can be found in the section "How to use the "Topology Editor"? (Page 362)".

Configuring domain management in HW Config

Note

Media redundancy

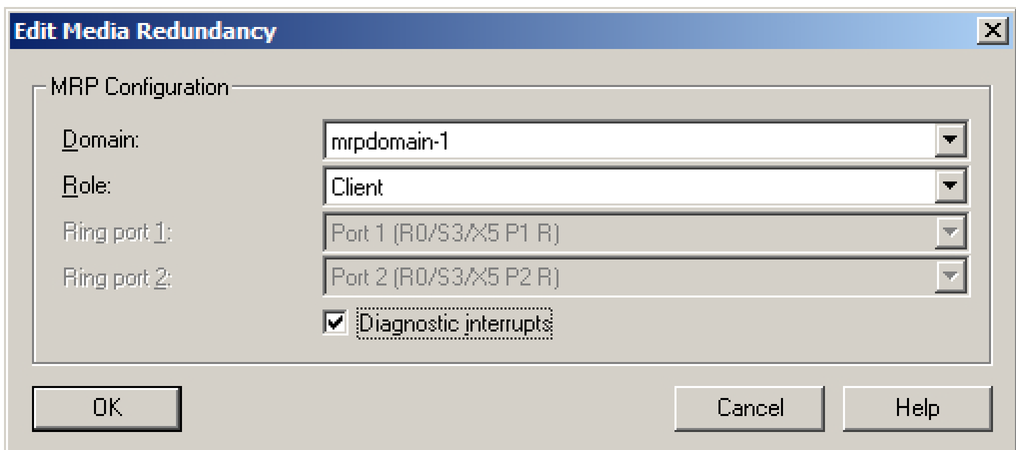
Only one MRP ring can be operated on a PROFINET interface.

If you are operating multiple MRP rings on a CPU with multiple PROFINET interfaces, you must not connect the MRP rings to one another.

If you are operating multiple MRP rings, the MRP manager must be configured. In most cases the CPU is configured as MRP manager.

1. Select any one member on PROFINET IO.
2. In HW Config, select the menu **Edit > PROFINET IO > Domain Management...** .
3. Select the tab "MRP-Domain".
4. In the Area "MRP Domain" choose the MRP Domain (mark the used domain in the tab "MRP Domain", if more then one are available).

5. On PROFINET IO select the member which should be configured as MRP-Manager.
   - Click "Edit".
     The dialog box "Edit Media Redundancy" opens.
   - In the "Role" drop box select the entry "Manager".
     Check the settings and click "OK".
6. Select the members on PROFINET IO whitch should be configured as MRP client. (You can select more then one).
   - Click "Edit".
     The dialog box "Edit Media Redundancy" opens.
   - In the "Role" drop box select the entry "Client".
     Check the settings and click "OK".



9.10.2.9 How to configure the "System redundancy"?

Quick overview for configuration

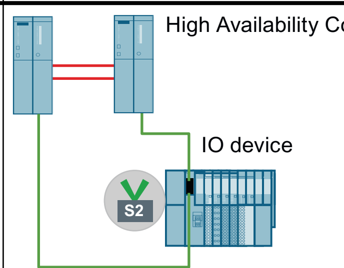
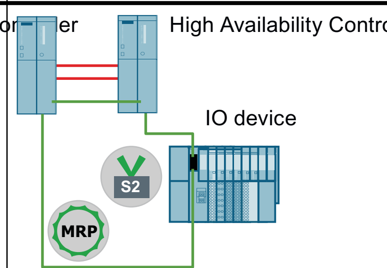
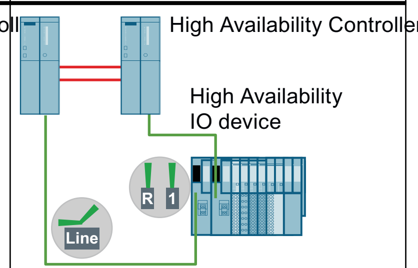
Note

Using system redundancy

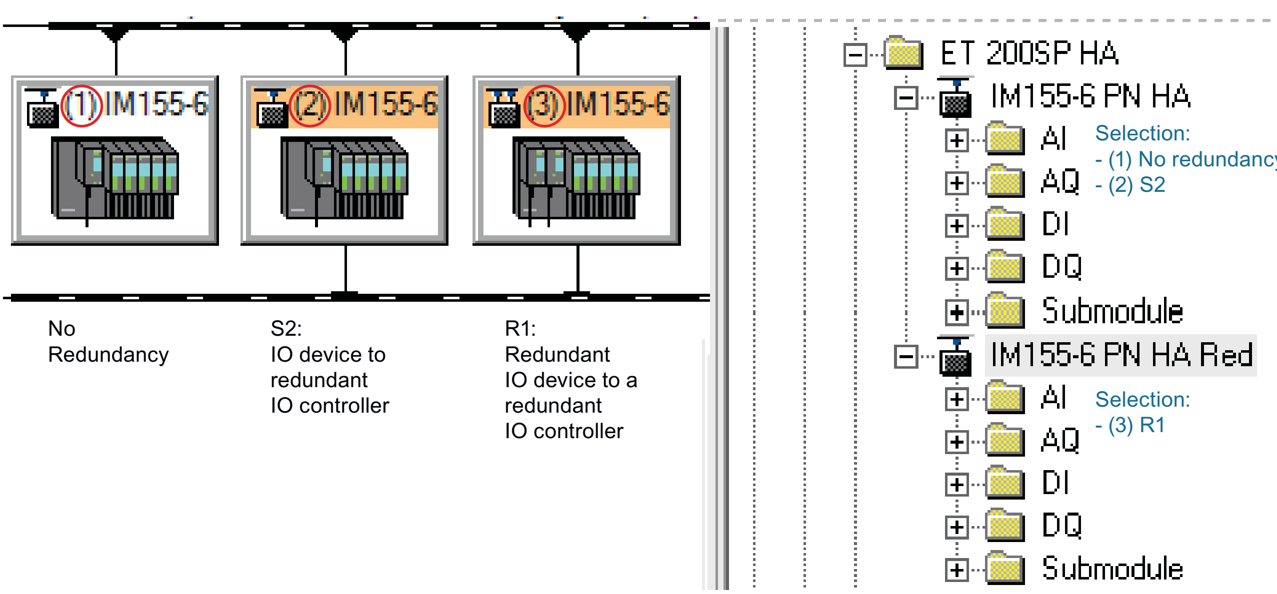
You must note the following:

- The IO controller is redundant.
- Each IO device is connected to each of the two IO controllers.

Configurations

Configuration object	System redundancy (1 subnet ring)	System redundancy + media redundancy (subnet ring)	System redundancy (2 subnet lines)
			
Example (network connections):	• Network1: CPU (0) X5 port 1 + CPU (1) X5 port 1 • No separate connection for media redundancy required	• Network1: CPU (0) X5 port 1 + CPU (1) X5 port 1 • Separate connection for media redundancy required: CPU (0) X5 port 2 + CPU (1) X5 port 2	• Network1: CPU (0) X5 port 1 • Network2: CPU (1) X5 port 1
Network addresses		Each IO device is connected to each of the two IO controllers.	

Hardware configuration:



Selection and representation of the IO device in HW Config

Use of MRP

Information can be found in the section "How to configure the "Media redundancy"? (Page 364)".

Use of the "Topology Editor" to configure network connections as build

Information for using the "Topology Editor" can be found in section "How to use the "Topology Editor"? (Page 362)".

9.10.2.10 How to configure the "Redundant IO" with ET 200SP HA

Introduction

Note

Using redundant IO

You must note the following:

- Using suitable modules of ET 200SP HA
- For the ET 200SP HA terminal blocks for redundant IO (TB45R...) must not be plugged over two adjacent carrier modules.
- Only terminal blocks for individual I/O modules **or** for redundant IO may be plugged in a potential group.

Assigning redundant modules

Hardware rules

- The I/O modules must be approved for redundant operation. You can find this information in the manual for the respective module.
- Redundantly deployed I/O modules must be identical, i.e. they must have the same article number, the same hardware version and the same firmware version.

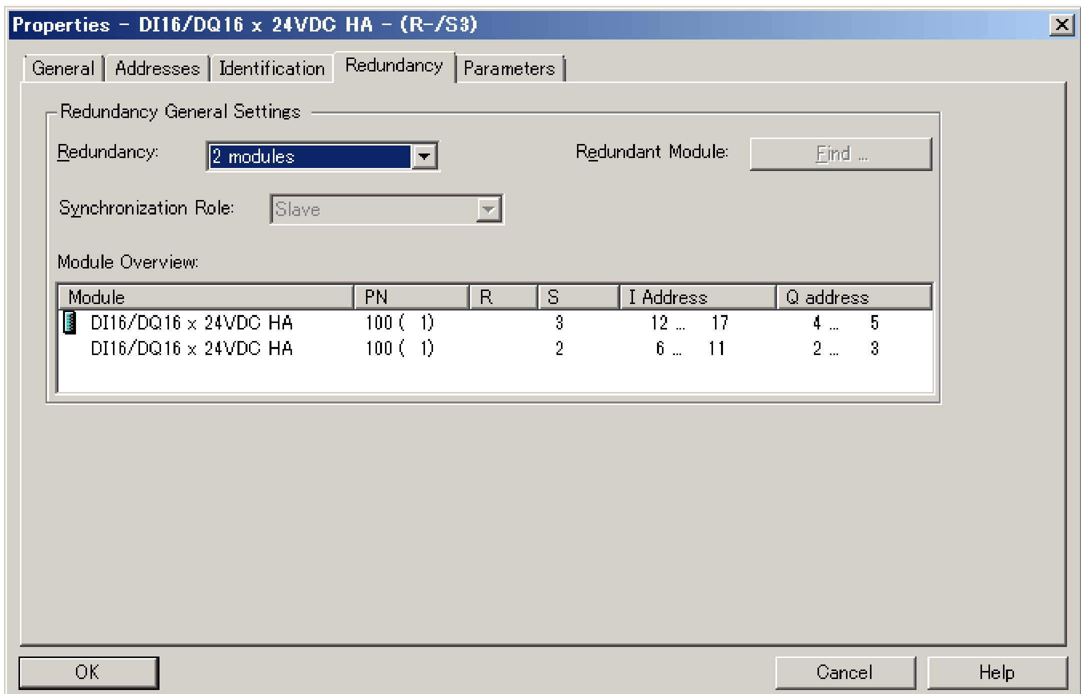
Mounting rules

- I/O modules of the same type are plugged in pairs next to each other in the same IO device.
- redundant IO:
  - Both slots are located in the same adapter module.
  - Both slots are in the same terminal block (TB45R).

For more Information, see system manual *SIMATIC; Distributed IO; ET 200SP HA*.

Configuration with a ET 200SP HA on PROFINET IO

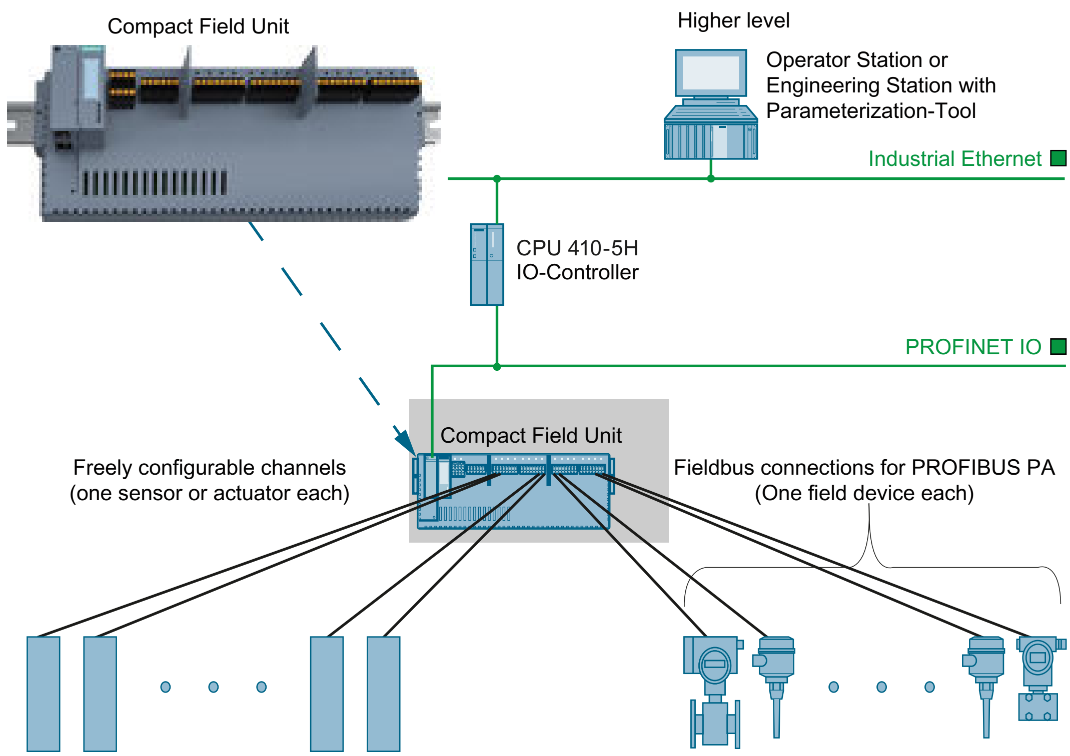
Configuration object	Procedure	Parameters in PCS 7
I/O modules	Selection of the redundant module **HW Config > Properties of the I/O module >** "Redundancy" tab; "Redundancy, general" area	"Redundancy" drop-down list: 2 modules (see figure below)



9.10.2.11 How to configure Compact Field Unit?

Procedure

Compact Field Unit (CFU) is a device on PROFINET IO.



Note

Engineering of the CFU

For the engineering of the CFU you must use the following channel blocks:

- For freely configurable channels:
  - **Pcs7Di...** (Digital <input/output> channel block)
- For devices on fieldbus spur:
  - **Fb...** (... channel block for field devices)

Additional Information

- section "How to configure PROFIBUS DP with communication via IE/PB Link on PROFINET IO (Page 393)"
- For more information on using Compact Field Unit, refer to the *Distributed I/O devices; Compact Field Unit PA* manual.

9.11 Configuring the connected I/Os for configuration changes in RUN mode (CiR)

9.11.1 Configuring distributed I/O devices on PROFIBUS DP for configuration changes in RUN mode (CiR)

9.11.1.1 Principle of configuration changes in RUN

Introduction

There are some process cells that must not be shut down during operation. This may be due to the complexity of the automated process or the high cost of restarting. Nevertheless, it may be necessary to extend or modify the plant.

Using CiR (Configuration in RUN), it is possible to make certain changes to the configuration in RUN mode.

Principle

To be able to make changes to the process cell during operation using CiR, you must make provision for subsequent extending the hardware of your automation system specially for the master system in your original configuration. You define suitable CiR objects that you can later replace with real objects (slaves and/or modules) in the RUN operating state. You can then download a configuration modified in this way to the CPU while the process is running.

Validity

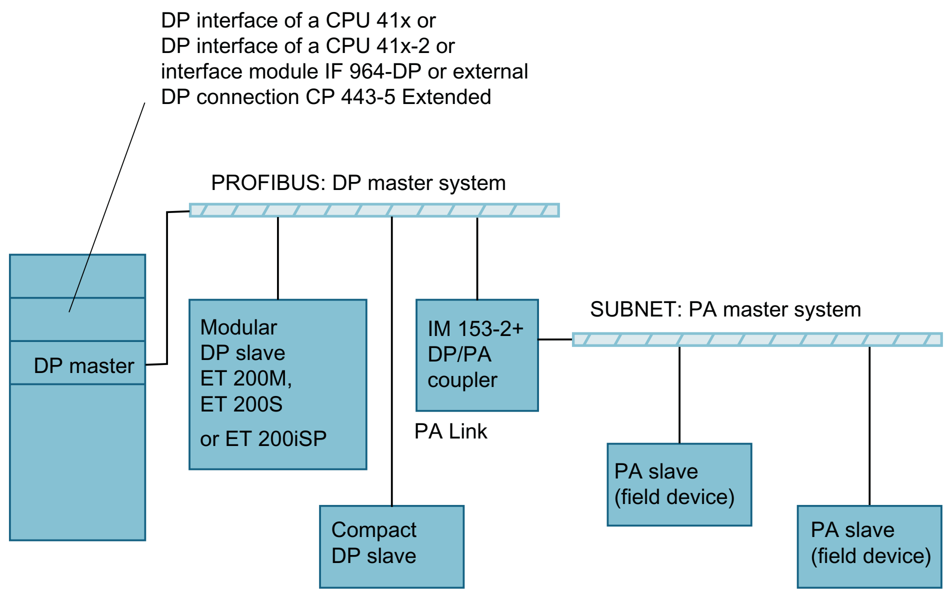
You can make modifications to the plant during operation with CiR in sections of the plant with a distributed I/O.

CiR requires the configuration shown in the figure below. For the sake of clarity, the illustration shows only a DP and a PA master system.

The configuration consists of the following components:

- CPU (as of firmware version V3.1)
- CP 443-5 Extended (firmware version 5.0 or later)
- ET 200M: IM 153 (as of 6ES7153-2BA70-0XA00)

- ET 200iSP: IM 152 (as of 6ES7152-1AA00-0AB0)
- PA Link: IM 153 (as of 6ES7153-2BA70-0XA00)



Steps involved

The steps required for a program and configuration change and the associated process cell status are illustrated below.

Step	Meaning	CPU operating mode	Plant status
1	Configure the actual (real) configuration of your plant	STOP	Offline configuration
2	Initial configuration of suitable reserves (CiR elements) for future plant expansions	STOP	Offline configuration
3	Downloading the configuration	STOP	Commissioning
4	Conversion of the CiR objects to real objects as necessary. Plant modifications are only possible at master systems with a CiR object or for ET 200M/ ET 200iSP stations with a CiR module.	RUN	Permanent operation

If necessary, repeat the CiR procedure (step 4 in the table above) several times in succession. The only thing you then need to take into account is that you have adequate numbers of slaves and I/O volume in reserve so that you can implement all your plant expansions.

Recommendations for CiR

Below, you will find several tips on making configuration modifications in RUN:

- Following each modification to the configuration, create a backup copy of your current plant configuration. Only this back-up version will allow you to continue to work on the project without any loss of CiR capability.
- Whenever possible, make the configuration modification in several steps and only make a few changes in each step. This means that you have a clear picture of the situation at all times.
- To minimize the CiR synchronization time (CPU response after downloading the configuration in RUN), we recommend that you change only one DP master system in each reconfiguration step.
- Take the number of CiR objects into account when defining the process image (address area).
- Remember that the number of CiR objects influences the CiR synchronization time. You should therefore only configure as many CiR objects as necessary and as few as possible.
- Make sure that you can also attach additional DP slaves in RUN.

9.11.1.2 Types of CiR objects

Terminology

Term	Meaning
CiR element	Generic term for CiR object and CiR module
CiR object	Placeholder for slaves to be added to the DP or PA master system later
CiR module	Placeholder for modules to be added to an ET 200M/ET 200iSP station later

CiR elements

Components	CiR elements
Available modular DP slave type ET 200M/ ET 200iSP	CiR module This contains the additional I/O volume and can be edited by the user.
Existing DP master system	CiR object This contains the number of additional DP slaves and can be edited by the user.
Existing PA master system	CiR object This contains the number of additional PA slaves and can be edited by the user.

Note

When calculating the bus parameters, PCS 7 takes into account both the configured slaves and the CiR elements. As a result, when converting the CiR elements into real slaves and/or modules with the CPU in RUN, the bus parameters do not need to be changed.

CiR objects

Specify the following properties for a CiR object:

- The guaranteed number of slaves that can be added
  (Default: 15 on the DP master system; 6 on the PA master system)
- Number of input and output bytes for future use
  They relate to future user data addresses. Diagnostic addresses are configured separately from them.
  Default: 1220 each on the DP master system, 80 each on the PA master system).

CiR modules

For the modular I/O device ET 200M/ET 200iSP, define additional I/O volume using a CiR module by specifying the total number of additional input and output bytes. This information relates to future user data addresses. You can configure diagnostic addresses regardless of this.

You do not have to fully utilize the additional user data volume. The currently available user data volume must not, however, ever be exceeded. PCS 7 makes sure this is the case.

9.11.1.3 Overview of permitted configuration changes

Overview of supported configuration changes

The following table lists all the configuration changes that are supported and not supported:

Configuration change	Supported	
	Yes	No
Adding modules to the modular DP slave ET 200M, provided you have not included it as a DPV0 slave (using a GSD file)	X	
Modifying parameters of ET 200M modules, for example, selecting other alarm limits or using previously unused channels	X	
Replacing reserve modules with the electronic modules of the ET 200iSP	X	
Changing parameter settings of ET 200iSP modules	X	
Adding DP slaves to an existing DP master system, however, not I-slaves	X	
Adding PA slaves (field devices) to an existing PA master system	X	
Adding DP/PA couplers after an IM 153-2	X	
Adding PA links (including PA master systems) to an existing DP master system	X	
Assigning added modules to a process image partition	X	

Configuration change	Supported	
	Yes	No
Changing the arrangement of process image partitions for existing modules or compact slaves	X	
Changing the parameter settings for existing modules in ET 200M stations (standard modules and fail-safe signal modules in standard mode)	X	
Reversing changes: added modules, DP slaves and PA slaves (field devices) are removed again.	X	
Changing CPU properties		X
Changing properties of central I/O modules		X
Adding and removing DP master systems		X
Changing properties of existing DP master systems, including the bus parameters, settings relating to constant bus cycle time		X
Changing parameter settings of fail-safe signal modules in safety mode		X
Changing the following parameters of a DP slave: • Bus address • Assignment to the DP master • Parameter assignment data • Diagnostic address		X
Removing any modules from modular DP slaves (Only the module that was plugged in last can be removed.)		X
Removing any DP slaves from an existing DP master system (Only the slave with the highest address can be removed.)		X
Changing the configuration of an I slave interface		X

Note

If you want to add or remove slaves or modules or make a change to the existing process image partition assignment, this is possible for up to four DP master systems.

9.11.1.4 How to define CiR elements for future plant expansion (CPU-STOP)

Defining CiR elements

For DP master systems, the "Activate CiR Capability" function is available. With this function, a CiR object is generated in the selected DP master system and in every lower-level PA master system with CiR capability. A CiR module is inserted in each modular slave with CiR capability of the type ET 200M/ET 200iSP of the selected DP master system.

You can add CiR elements either automatically or individually.

Activating the CiR capability

Before the download of configuration data only in RUN is possible in your plant, you must prepare your project for CiR capability. You are supported in this by a system wizard. The wizard automatically creates a CiR object for each DP chain and a CiR module for each configured station with CiR capability (ET 200M, ET 200iSP, DP/PA).

The wizard sets the following I/O areas for future CiR activities.

The listed values are examples for CPU410-5H and may vary for other CPU-Types:

- 3660 bytes I and Q each per DP chain with CiR capability
- 15 slaves per DP chain with CiR capability
- 180 bytes per ET 200M line
- 180 bytes per ET 200iSP line
- 6 CiR-capable slaves per CiR object on the equipotential bonding line (address space max. 80 bytes total)

The default settings were selected so that they are sufficient for typical applications and do not need to be adapted. Check if these default values are sufficient for your application and modify them if necessary at individual stations or on a chain before the first download.

Note

The rule of thumb for the reserves is: As little as possible – as much as necessary, since the CiR synchronization time depends on the size of the reserves.

The CiR synchronization time is relevant when you activate a configuration change in RUN. A CiR action interrupts operation on the AS at a maximum for this time. This is limited on the system side by an upper limit of **1 second** and is monitored by the system. During this time, process outputs and process inputs are kept at the last valid values.

Make sure that you do not exceed a CiR synchronization time of **1 second**.

The SFC 104 **must not** be used to set the CiR synchronization time with PCS 7 (it can cause the CPU to STOP).

- We recommend that you only make the changes on one DP chain at a time, using small steps and when starting a CiR. This will make it easier to monitor the changes in RUN.
- If your changes in RUN relate only to a DP chain, the maximum CiR synchronization time is displayed when you select the CiR object.
- If you want to make changes to more than one chain at the same time, add the times of the individual chains together.
- When you download the configuration data to the CPU, you can once again be informed whether the CiR synchronization time is possible with the settings you have made.

Note

H-CiR

To ensure the H-CIR capability of the H-system, you need to enable the "Save connections before download" option in STEP7 Netpro.
You can find additional information on H-CIR in the documentation *Process Control System PCS 7; High Availability Process Control Systems*.

Inserting CiR elements automatically

1. In HW Config, select the desired DP master system in the upper section of the station window.
2. Select the menu command **Edit > Master System > Activate CiR capability**.
   PCS 7 adds the following CiR elements to the selected DP master system:
   – (provided there are still free slots) a CiR module on every ET 200M/ET 200iSP-type modular slave with CiR capability
   This CiR object contains as many input and output bytes as necessary to ensure that there is a sensible number of input and output bytes available on the modular slave for later use.
   – a CiR module on every lower-level PA master system with CiR capability
   This CiR object contains as many input and output bytes as necessary to ensure that the maximum number of input and output bytes (maximum 80 each) is occupied on the PA master system.
   – a CiR module on the selected DP master system
   PCS 7 attempts to guarantee 15 slaves for the CiR object and to make 1220 input and 1220 output bytes available.
   If the previous highest address in this master system is greater than 111, the number of slaves that can be guaranteed is reduced accordingly. If fewer than 1220 input and 1220 output bytes are available, the number is reduced accordingly.

   Note

   Please note the following:
   - CiR elements can only be added automatically if there is no CiR object already in the selected DP master system.
   - CiR elements cannot be automatically added to DP master systems downstream of an IM 153-2.
   - If CiR capability is activated, slaves containing a CiR module and CiR objects (for example, DP/PA link) are indicated in orange.

3. The defaults of the CiR objects are identical for all CPUs. Therefore, after activating the CiR capability of a master system, each corresponding CiR object should be checked for the following:
   Does the CiR synchronization time of the master system specified in the properties window for the CiR object match the high limit for the CiR synchronization time of the CPU set on the CPU?
   If necessary, you can have to reduce the number of guaranteed slaves in one or more CiR objects.

Inserting a CiR Object to the DP or PA Master System

1. In HW Config, select the desired master system in the upper section of the station window.
2. Use the menu command **View > Catalog** to open the hardware catalog.

3. Drag the associated CiR object from the hardware catalog to the master system.
   The CiR object then appears as a placeholder slave at the top of the station window. The following default values are set for the CiR object:
   – Number of guaranteed additional DP slaves: 15 on the DP master system; 6 on the PA master system
   – Maximum number of additional slaves: 45 DP slaves, 36 PA slaves
   – Number of input bytes: 1220 for a DP, 80 for a PA master system
   – Number of output bytes: 1220 for a DP, 80 for a PA master system
4. The defaults of the CiR objects are identical for all CPUs. Therefore, after defining a CiR object, check the following:
   Does the CiR synchronization time of the master system specified in the properties window for the CiR object match the high limit for the CiR synchronization time of the CPU set on the CPU?
   If necessary, you can have to reduce the number of guaranteed slaves in the CiR object.

   Note

   If there are no longer enough resources available on the master system, these values are reduced accordingly. The resulting bus parameters "Target Rotation Time", "Target Rotation Time Typical" and "Watchdog" are displayed in the properties window for the CiR object.

Changing the number of additional slaves and/or number of input and output bytes

1. In HW Config, select the desired CiR object.
2. Select the menu command **Edit > Object Properties...**
   The "Properties" dialog box opens.
3. You can change the guaranteed number of additional slaves as required.
   The resulting bus parameters "Target Rotation Time", "Target Rotation Time Typical" and "Watchdog" are displayed at the bottom of the station window.
4. Change the number of input and output bytes as required.
   To do this, select the "Advanced Settings" check box (default). Do not increase the number as this will increase the CiR synchronization time.

Inserting a CiR Module in a Modular ET 200M/ET 200iSP Slave

1. In HW Config, select the desired DP slave in the upper section of the station window.
2. Use the menu command **View > Catalog** to open the hardware catalog.
3. Drag the CiR module from the hardware catalog to the slot immediately after the last configured module of the DP slave at the bottom of the station window.
   The CiR module appears at the bottom of the station window as a dummy module.
   The number of input and output bytes appears in the properties window of the CiR module. For ET 200M stations, this is as follows:
   - Number of input bytes = Number of free slots * 16
   - Number of output bytes = Number of free slots * 16

   In an ET 200M station that only contains one CiR module, these values are 8 x 16 = 128 (if the CiR object in the DP master system still has enough free input and output bytes).

   Note

   A maximum of 244 input and output bytes are available for ET 200iSP. You can find more information about this in the manual *SIMATIC; Distributed I/O Device ET 200iSP*.

Downloading the configuration in STOP mode

Once the CiR elements have been defined, the configuration is downloaded with the CPU in STOP mode.

Numerous modules can be used in an S7-400 automation system. To make sure that none of the modules used prevents future CiR activities, keep to the following procedure:

Once you have downloaded the configuration to the CPU in STOP mode, download the configuration again immediately, this time with the CPU in RUN mode.
PCS 7 and the CPU both check CiR capability during this. With older modules or modules from other vendors, this check is not yet possible offline.

9.11.1.5 How to delete CiR elements (CPU-STOP)

Introduction

In STOP mode, you can delete CiR objects in DP and PA master systems or CiR modules in modular slaves of the type ET 200M/ET 200iSP that you are defined earlier.

The configuration change does not depend on the operating state. It can only be downloaded in STOP mode, however.

Deleting all the CiR elements of a DP master system

1. In HW Config, select the desired DP master system in the upper section of the station window.
2. Select the menu command **Edit > Master System > Deactivate CiR Capability**.
   The following CiR objects are deleted:
   – All CiR objects in lower-level PA master systems are deleted.
   – All CiR modules in modular slaves are deleted.
   – The CiR object in the selected DP master system is deleted.

Note

Please note the following:

- CiR elements can only be deleted if there is a CiR object in the selected DP master system.
- You cannot delete all CiR elements on the DP master system below an IM 153-2 (DP/PA link).

Deleting an individual CiR element

If you want to delete the CiR module in a PA master system or in a modular DP slave of the type ET 200M/ET 200iSP, proceed as follows:

1. In HW Config, select the CiR element you want to delete.
2. Select the menu command **Edit > Delete**.

If there is no further CiR element in the DP master system except for the CiR object, you can delete the CiR object using the same procedure.

9.11.1.6 How to convert CiR elements into real objects (CPU-RUN)

Default settings for a new station

When you add a new station to a chain, the following I/O areas are set for this station by default:

- 80 bytes I and Q each for an ET 200M per CiR module
- 80 byte I and Q for a DP/PA station for each CiR object in the DP/PA chain.

These default settings were selected so that they are sufficient for typical applications and do not need to be adapted. Before you download first-time, check whether these station-specific

I/O settings are adequate for your application. You can modify these values prior to downloading for the first time without losing the CiR capability of the project.

Note

If you attempt an illegal operation when adding real slaves or modules to the configuration, you can only be made aware of this by an error message when you download the configuration.

After any change to the process cell, you should use the menu command **Station > Check CiR Capability** to check that the CiR capability still exists.

Rules

When adding components, keep to the following rules:

- Within a type ET 200M/ET 200iSP modular DP slave, you may only insert a CiR module at the slot immediately after the last configured module.
  This rule is automatically taken into account when you add CiR elements automatically.
- Within a master system, you must assign a higher PROFIBUS address to the added slave than the highest address used up to now.
- With the ET 200iSP, you can insert or remove only one module per station and download.

Adding a DP or PA Slave

1. Use the menu command **View > Catalog** to open the hardware catalog.
2. Drag the slave you want to add from the hardware catalog and onto the relevant CiR object at the top of the station window.

The added slave appears at the top of the station window. The name of the slave is displayed on an orange background to indicate that this slave was created from a CiR object.

Note

When you add a new slave, PCS 7 updates the guaranteed and the maximum number of slaves and number of input and output bytes of the CiR object.

We recommend you select the station number of the added DP slave as follows:
Station number =
highest station number of all previously configured DP slaves + 1

If you add a type ET 200M/ET 200iSP CiR-compliant modular DP slave, this will have a CiR module right from the start.

Inserting Modules in a Modular ET 200M/ET 200iSP Slave

1. Use the menu command **View > Catalog** to open the hardware catalog.
2. Drag the module you want to add from the hardware catalog and onto the relevant CiR module at the bottom of the station window.

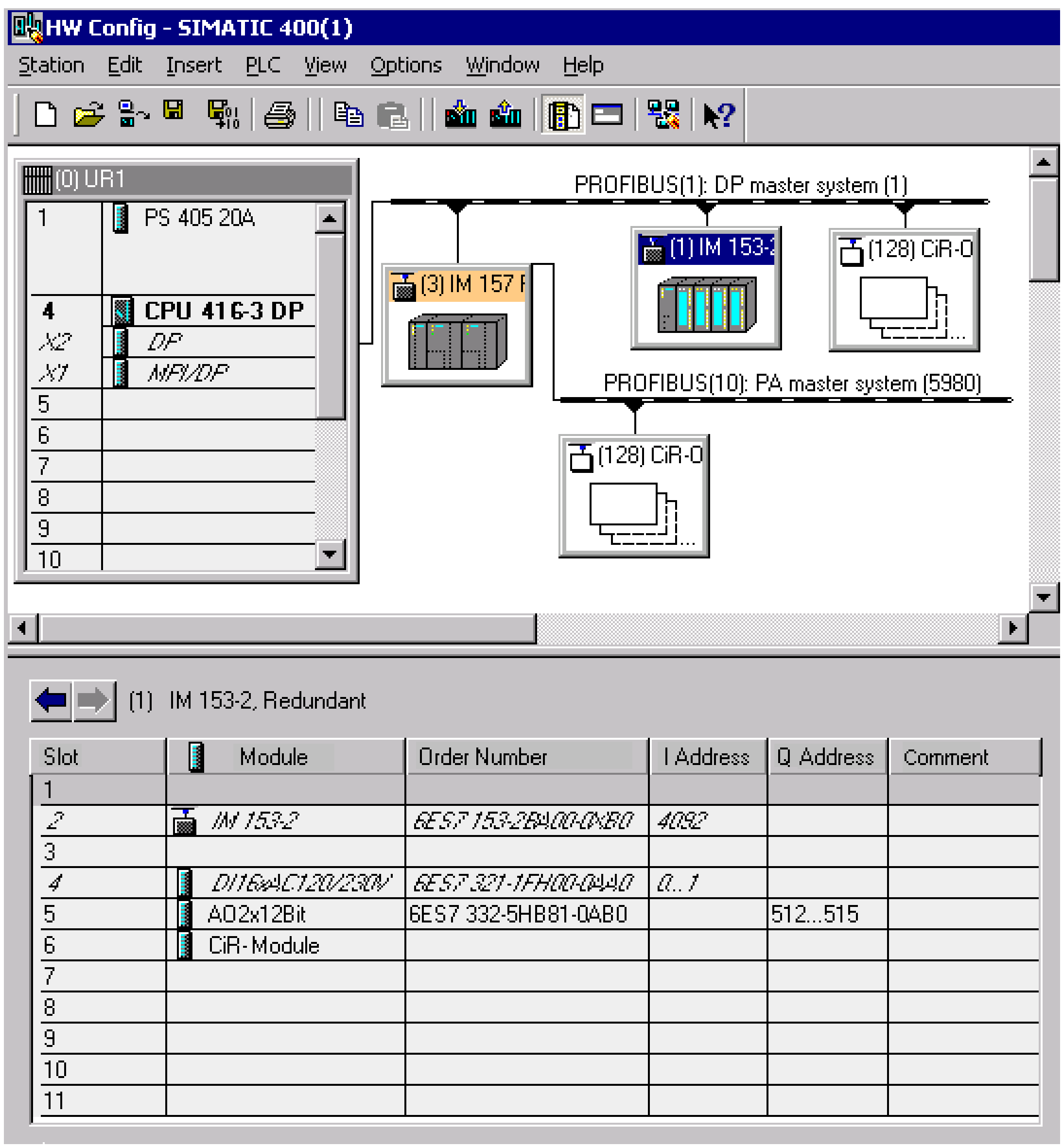
The module you have added appears at the bottom of the station window at the location previously occupied by the CiR module. The CiR module is moved one slot down.

Note

When you add a module to an ET 200M-/ET 200iSP station, PCS 7 updates the number of input and output bytes of the corresponding CiR module.

Result

In the following figure, you can see the configuration in HW Config view after placing a module on the CiR module.



Downloading the configuration in RUN mode

The following steps are used to download a modified configuration in RUN mode:

1. Check that the current configuration can be downloaded with the menu command **Station > Check CiR Capability**.
2. Download the configuration to the CPU with the menu command **PLC > Download to Module...**.

   Note

   When you download the configuration to the CPU, the INTF LED lights up and then goes off again, the EXTF LED is lit permanently. First begin to add the real stations or modules when the INTF LED goes out again. The EXTF LED then also goes off again.

   ---
3. Back up your current configuration every time you download the station configuration from HW Config (regardless of the operating state of the CPU).
   This is the only way to make sure that you can continue working and not lose CiR capability if an error occurs (loss of data).

9.11.1.7 How to undo used CiR elements (CPU-RUN)

Introduction

You can reverse previous configuration changes that you have downloaded to the CPU by removing the slaves or modules that you added.

Rules

The following rules apply when removing modules and slaves:

- Remove **at most** slaves or modules from a maximum of 4 master systems.
- Within a DP or PA master system, start by removing the slave with the **highest** PROFIBUS address.
  Then continue with the slave with the next highest PROFIBUS address.
- Within a type ET 200M/ET 200iSP modular DP slave, start by removing the module with the highest slot number. In HW Config, this is the lowest module.
  PCS 7 offers the following diagnostic features: The module to be removed next is entered in the lower section of the station window in the standard font, all other modules are in italics.
  Then continue with the module with the next highest slot number.

Procedure

1. Select the object to be removed in the upper section of the station window .
2. Select the menu command **Edit > Delete**.
3. If necessary, repeat steps 1 and 2 for every other object that you want to remove.

4. Select the menu command **Station >** Check **CiR Compatibility**.
5. Download the modified configuration to the CPU.

Note

Please note the following:

- When you delete a slave, PCS 7 updates the guaranteed and the maximum number of slaves and the number of input and output bytes of the associated CiR object.
- When you delete a module in a modular slave of the type ET 200M/ET 200iSP, PCS 7 updates the number of input and output bytes of the corresponding CiR module.

9.11.1.8 Changing the parameter settings for existing modules in distributet IO system (CPU RUN)

You can use the CiR functionality for stations with the following families of distributed IO systems:

Families of distributed IO system	Stations on DP master system
ET 200M	yes
ET 200iSP	yes
ET 200SP	yes

Changing the Module Parameter Assignments in RUN Mode

PCS 7 allows you to change the module parameters during operation without a CPU STOP, e.g.:

- Enabling reserved channels
- Changing operating modes
- Changing measuring modes

Depending on the performance class of the module, the module parameters can be changed in RUN mode without affecting other modules or, with some restrictions, even without affecting the channels of the module at which the parameters are to be changed.

When you add a module to PCS 7 projects using HW Config, remember to activate the general module-oriented diagnostic alarm.

Note

The addresses of existing modules must not be changed with CiR .

Requirements for stations on DP master system

- A CiR object is located in the DP master system to be configured.
- The number of modules to be modified is less than 100.

For details of the ET 200-modules that can have parameters changed while the CPU is in RUN mode, refer to the information text in the hardware catalog (text: online configuration)

Module response when parameters are changed

Input and output modules respond as follows when parameters are changed:

- With input modules, the following three reactions are possible when changing parameter settings:
  - Channels that are not affected continue to return the current process value.
  - Channels that are not affected return the last valid process value prior to changing the parameter settings.
  - All channels return value "0" (on digital modules and FMs) or W#16#7FFF (on analog modules).
- Output modules react as follows when parameter settings are changed:
  - Channels that are not affected output the last valid output value prior to changing the parameter settings.

CPU response when parameters are changed

Once you have changed the parameters in PCS 7 and have downloaded them to the CPU in RUN mode, the response is as follows:

1. The CPU performs the checks described in the section "Reaction of the CPU after Downloading Configuration Changes in CPU RUN (Page 554)".
2. The CPU starts OB 80 with the event W#16#350A.
3. The CPU starts OB 83 with the start event W#16#335A.
   This indicates that the input or output data for the modules concerned may no longer be correct - with immediate effect.
   You must not call any more SFCs that trigger new jobs to send data records to the affected modules (for example, SFC57 "PARM_MOD"), otherwise there may be a conflict between the data records sent by the system and those sent by the user.

   Note

   in PCS 7, the input and output values have the status "BAD" after this OB 83 start.

4. Once the CPU has ended OB 83, it sends the parameter data records. Every affected module receives all of its data records, regardless of how many data records are affected by your change.
5. OB 83 is then started again (start event W#16#325A if sending was successful, or W#16#395B if it was not successful). No other priority class is interrupted by running this OB 83.

   Note

   In PCS 7, the input and output values have the status "OK" after the OB 83 start with the start event W#16#325A.

   You can only access values in the process image that belong to the process image partition of the OB currently executing.

6. If the data records were transferred successfully, the DP master identified the modules as available in the module status data..
   If the data records were not transferred successfully, the DP master identified the modules as unavailable in the module status data. In the second situation, an I/O access error occurs when the module is accessed (while updating the process input image or while transferring the process output image to the module or when accessing the module directly. This starts OB85.)
7. The input or output data from the modules reacts as it does after a plugging-in alarm: At the current time they are not correct because the module may not have analyzed its data records yet. The restriction that data record SFCs must no longer be active for the module does not, however, apply any longer.

Note

If changing the parameter assignments for a module consists of deactivating the diagnostic alarm, for example, it is possible that the module may still send an alarm that has already been prepared.

Possible errors when changing parameter assignments

The same errors can be made as when transferring data records with SFCs:

- The module receives the parameter data records but cannot evaluate them.
- For PROFIBUS DP:
  Serious errors (particularly protocol errors on the PROFIBUS DP) can cause the DP master to suspend the associated DP slave completely. All the modules of this station would then fail.

How CPU operating states affect changes to parameter assignments

The parameter setting change takes place following SDB evaluation in RUN. While the parameters are being changed, the INTF LED is lit.

If there is a change to the HALT state, the parameter change is interrupted. It is continued if the CPU changes to STOP or RUN. In STOP, only the OB83 calls are omitted.

If there is a network failure, the parameter change is aborted. When the network returns, the parameters of all existing DP stations/IO devices are reassigned.

Coordination between master systems

In some situations, the following sequence may run in parallel in the affected master systems.

- OB83 start (start event W#16#335A)
- Data record transfer
- OB83 start (start event W#16#325A or W#16#395B)

9.11.1.9 How to change the parameter assignments of a channel (CPU-RUN)

Procedure - Using an unused channel

1. Change the hardware configuration and check the CiR compatibility with the menu command **Station > Check CiR Compatibility**.
2. Download the hardware configuration to the CPU in RUN mode.
3. Change the wiring.
4. Modify the user program and download it to the CPU.

Procedure - Reprogramming a used channel

The procedure depends on whether changes to the user program and the corresponding hardware are necessary due to be changed parameters. The individual situations are described below.

The user program may not be changed:
This is the case, for example, when changing an alarm limit or when deactivating the diagnostic interrupt.

1. Change the hardware configuration and check the CiR compatibility with the menu command **Station > Check CiR Compatibility**.
2. Download the hardware configuration to the CPU in RUN mode.

The user program must be changed:
This is the situation, for example, if you change the measuring range of the channel of an analog input module and you compare the corresponding analog value with a constant in your program. In this case, the constant must be adapted.

1. Set the values of the channel for which you want to change parameters to simulation (at the corresponding driver).
2. Change the hardware configuration and check the CiR compatibility with the menu command **Station > Check CiR Compatibility**.
3. Download the hardware configuration to the CPU in RUN mode.
4. Adapt the user program to the changed module and download it to the CPU.
   Cancel the simulation for the channel with the changed parameter assignment again (at the corresponding driver).

User program and hardware must be changed
This is, for example, the situation when you change the parameters of an input channel from "0 mA to 20 mA" to "0 V to 10 V".

1. Set the values of the channel for which you want to change parameters to simulation (at the corresponding driver).
2. Change the hardware configuration and check the CiR compatibility with the menu command **Station > Check CiR Compatibility**.

3. Download the hardware configuration to the CPU in RUN mode.
4. Adapt the user program to the changed module and download it to the CPU.
Cancel the simulation for the channel with the changed parameter assignment again (at the corresponding driver).

Change the address range of an electronic module (ET 200iSP)
This is the case, for example, when IEEE values of a HART electronic module are used.

1. Set the values of the channel for which you want to change parameters to simulation (at the corresponding driver).
2. Delete the module in the hardware configuration and download it to the CPU.
3. Insert the module again and assign the parameters as required.

Note

Never save your hardware configuration at this point; otherwise, the CiR download capability will be lost.

4. Download the hardware configuration to the CPU in RUN mode.
5. Adapt the user program to the changed module and download it to the CPU.
Cancel the simulation of the module with the changed parameter assignment again (at the corresponding driver).

Procedure - Removing a used channel

If you no longer need a channel that has been used up to now, you do not have to change the hardware configuration. In this case, follow the steps below:

1. Change the user program so that the channel to be removed is no longer evaluated, and download it to the CPU.
2. Change the hardware configuration and check the CiR compatibility with the menu command **Station > Check CiR Compatibility**.
3. Download the hardware configuration to the CPU in RUN mode.
4. Modify the associated hardware (e.g. remove sensor or actuator)

9.11.2 Configuring distributed I/O devices on PROFINET IO for configuration changes in RUN mode (CiR)

9.11.2.1 Changing the parameter settings for existing modules in distributet IO system (CPU RUN)

There are some process cells that must not be shut down during operation. This may be due to the complexity of the automated process or the high cost of restarting. Nevertheless, it may be necessary to extend or modify the plant.

Using CiR (Configuration in RUN), it is possible to make certain changes to the configuration in RUN mode.

For more information, refer to the system *Process Control System PCS 7; CPU 410 Process Automation* manual.

Overview

You can use the CiR functionality for stations with the following families of distributed IO systems:

Families of distributed IO system	Stations on PROFINET IO system
ET 200M	no
ET 200iSP	no
ET 200SP	no
ET 200SP HA	yes

CiR specific rules (Single AS)

- IO devices from type S1 and S2 are supported (S2 with CiR support for changes within the device)
- The IO data of the ET 200SP HA is limited to 1000 bytes input and 1000 bytes output for CiR.
- If possible use STOP download, to provide network parameter optimization
- Do not change LLDP Modus (if necessary fix the LLDP Modus via specific option)
- Do not change parameter of the IO controller
- Do not insert or remove IO controller
- Minimum update time of 1 ms required

H-CiR specific rules (Redundancy AS)

- IO devices from type S2 and R1 are supported
- Insert and remove IO controller (change CPU internal interfaces to PROFINET)
- Up to 64 R1 devices (limited because of test effort)

Referenz

For more information on PROFINET IO with CiR/HCir and ET 200SP HA, refer to the *Process Control System PCS 7; CPU 410 Process Automation* manual.

9.11.2.2 Configuring distributed I/O devces on PROFINET IO for configuration changes in RUN mode (CiR)

Overview

There are some process cells that must not be shut down during operation. This may be due to the complexity of the automated process or the high cost of restarting. Nevertheless, it may be necessary to extend or modify the plant.

Using CiR (Configuration in RUN), it is possible to make certain changes to the configuration in RUN mode.

For more information, refer to the system *Process Control System PCS 7; CPU 410 Process Automation* manual.

CiR specific rules (Single AS)

- IO devices from type S1 and S2 are supported (S2 with CiR support for changes within the device)
- The IO data of the ET 200SP HA is limited to 1000 bytes input and 1000 bytes output for CiR.
- If possible use STOP download, to provide network parameter optimization
- Do not change LLDP Modus (if necessary fix the LLDP Modus via specific option)
- Do not change parameter of the IO controller
- Do not insert or remove IO controller
- Minimum update time of 1ms required

H-CiR specific rules (Redundancy AS)

- IO devices from type S2 and R1 are supported
- Insert and remove IO controller (change CPU internal interfaces to PROFINET)
- Up to 64 R1 devices (limited because of test effort)

Referenz

For more information on PROFINET IO with CiR/HCir and ET 200SP HA, refer to the *Process Control System PCS 7; CPU 410 Process Automation* manual.

9.12 Configuring the Field devices

9.12.1 How to configure the diagnostic repeater

Introduction

The diagnostic repeater provides simple diagnostics for communication errors in PROFIBUS DP chains using the DPVx protocol.

Requirements

- The diagnostic repeater is installed and wired up.
- The PROFIBUS address is set.
- The diagnostic repeater is configured (configuration and parameter assignment).
- The DR switch behind the flap is set to ON (as supplied).
- The power supply for the DP master is turned on.

Configuring hardware

1. Select the required SIMATIC 400 station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Drag the diagnostic repeater from the "PROFIBUS DP > Network Components" hardware catalog to the DP master system of your CPU.
   The "Properties - PROFIBUS Interface Diagnostic Repeater" dialog box opens.
3. Set the address and the properties (bus parameters), and click "OK".
4. Double-click the diagnostic repeater.
   The "Properties – DP Slave" dialog box opens.
5. In the "Parameter Assignment" tab, set the DP alarm mode to DPV0 (OB 82 is called for diagnostic events).
   Requirement: The mode on the DP master must be set to DPV1.
6. Select the menu command **Station > Save and Compile**.
7. Select the menu command **CPU > Download to Module...**.
   The current configuration is loaded.

This completes the hardware configuration of the diagnostic repeater. Now carry out the topology identification.

Requirements for the topology identification

- The programming device/PC whose topology is to be identified must be connected to the PROFIBUS DP.
- A configured PROFIBUS DP module must be present.

Determining the topology

1. Connect the programming device/PC to the programming device interface of the diagnostic repeater for the network concerned.
2. Switch to SIMATIC Manager and select the project for which you wish to identify the topology from the component view.
3. Select the DP master system in which the diagnostic repeater is located.
4. Select the menu command **Options > Set Programming Device/PC Interface...** and select the "Interface parameter assignment used" as in your configuration (for example, CP 5611 (PROFIBUS)).
5. Click "Properties" and set the required properties in the "Properties" dialog box. Make sure that the address is set to "0".
6. Click "OK" and then acknowledge the warning message that appears.
7. Select the menu command**Target system > PROFIBUS > Prepare Line Diagnostics**. The "Prepare Line Diagnostics" dialog box opens.
8. Click "Restart". The system data is determined.
9. Click "Close" once the identification is complete.
10. Select the menu command **Options > Set Programming Device/PC Interface...** and reset the interface parameter assignment to "PC internal (local)".
11. Click "OK" and then acknowledge the warning message that appears.
12. Select the required diagnostic function with the menu command **Target system > Diagnostics/Settings > ....**

Note

If several PROFIBUS networks exist, the topology must be identified for each individual network.

Additional information

- Manual *SIMATIC; Diagnostic Repeater for PROFIBUS DP*

9.12.2 How to configure the Y link and Y coupler

Introduction

To implement the changeover from a PROFIBUS master system to a single-channel PROFIBUS master system, the Y link is preferred.

From the point of view of the programmable controller, the Y link is a DP slave, and from the point of view of the underlying DP master system, it is a DP master.

Procedure

1. Select the required SIMATIC H station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Drag an IM 153-2 from the "PROFIBUS DP > DP/PA Link" hardware catalog to the redundant DP master system on your CPU.
   The "Properties - PROFIBUS Interface IM 153-2" dialog box opens.
3. If necessary, change the suggested address for the IM 153-2 in the higher-level DP master system and click "OK".
   The dialog box for selecting the lower-level master system opens.
4. Select "Interface module for PROFIBUS DP" and click "OK".
   The Y link is inserted into the redundant DP master system. The transmission rate of the lower-level DP master system is set to 1.5 Mbps as default.
5. If you want to change the transmission rate of the lower-level DP master system, double-click the DP master system.
   The dialog box with the properties of the lower-level master system opens.
6. Click "Properties". The "PROFIBUS properties" dialog box is displayed.
7. Enter the name of the lower-level DP master system and select the "Network Settings" tab.
8. Select the transmission speed 45.45 Kbps to 12 Mbps and click "OK".
9. Then configure the DP slaves for the lower-level DP master system.

Additional information

- Manual *SIMATIC; DP/PA Link and Y Link Bus Couplers*

9.12.3 How to configure PROFIBUS DP with communication via IE/PB Link on PROFINET IO

Introduction IE/PB Link

PCS 7 allows PROFIBUS DP to connect to a PROFINET IO system via a IE/PB Link.

Procedure

1. Select the required SIMATIC 400 station from the component view and double-click on the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Configure a PROFINET IO system in HW Config.
3. Drag the IE/PB Link from the hardware catalog to the PROFINET IO system.
   The dialog box for "Properties - PROFIBUS interface PROFIBUS DP" opens.
4. Select or add the table "Subnet:" into the PROFIBUS DP system.
   Change parameters if required.

Additional information

- section "How to configure Compact Field Unit? (Page 370)"
- Online help for HW Config
- Manual *SIMATIC; DP/PA Link and Y Link Bus Couplers*

9.12.4 How to configure PA devices with communication via PROFIBUS DP

Introduction

PCS 7 communicates with PA field devices via a DP/PA adapter or a PA Link. A PA Link is configured below and preparations are made for the further configuration of the PA devices with SIMATIC PDM.

Requirement

- The SIMATIC PDM (Process Device Manager) add-on package must be installed.

Procedure

1. Select the required SIMATIC 400 station from the component view and double-click the "Hardware" object in the detail window.
   The hardware configuration of the automation system is opened.
2. Configure a DP master system in HW Config.
3. Drag the PA Link (IM 153-2) from the hardware catalog to the DP master system.
   The dialog box for "Properties - PROFIBUS Interface" opens.
4. Set the PROFIBUS interface parameters.
   The dialog box for defining the master system opens.
5. Define the master system (DP or PA) and click "OK".
6. Select the PA Link so that you can view the DP slave structure in the bottom part of the station window.
   Slot 2 represents the ”master” for the PA devices.
7. Double-click Slot 2 to configure the PA subnet.

8. Click "Properties" in the "Interface" group on the "General" tab and select the subnet with a transmission rate of 45.45 Kbps. Then click "OK".
9. Configure the PA devices.
   You can find the PA devices in the "Hardware catalog" under "PROFIBUS PA" (standard profile).

   Note

   The "PROFIBUS PA" entry is only visible if SIMATIC PDM is installed.

   You must configure at least one PA device in PROFIBUS PA. Otherwise errors will occur during compilation or the consistency check.

   The rest of the configuration for the PA devices takes place in SIMATIC PDM (double-click the device).

Additional information

- Online help for HW Config
- Manual *SIMATIC; DP/PA Link and Y Link Bus Couplers*
- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*
- Section "Configuring the SIMATIC 400 station (CPU, CPs, central I/O)"

9.12.5 How to configure HART devices on distributed I/O

HART field devices can be connected on distributed IO based on PROFINET IO or PROFIBUS DP.

Recognizing HART field devices via a peripherial module

If you are cofiguring a HART capable peripherial module, you have to consider the following:

1. Configure a HART capable peripherial module which is suitable for the type of field device you are using.
2. Insert the HART field device into the configuration table in a slot of the peripherial module.

Parameterization of the HART field devices

In PCS 7 you parametrize the HART field devices with SIMATIC PDM. You can find further information in the help documentation of SIMATIC PDM.

9.12.6 How to configure HART devices with SIMATIC PDM

Introduction

HART devices are intended for distributed operation on a distributed IO station:

- IM 155-6 (ET 200SP HA)
- IM 153-2 (ET 200M)
- IM 152 (ET 200iSP)

Configuration with an ET 200M is illustrated below.

Start SIMATIC PDM to assign parameters to the HART measuring signal generators attached to the HART devices.

Representing HART transducers

The signal generators for HART modules are displayed like interface modules in the configuration table.

Requirements

- You have opened the distributed IO station in HW Config.
- A free slot is in the configuration in HW Config, in the distributed IO station.

Procedure - Using the ET 200M as an example

1. Add a HART module (e.g. AI HART) from the hardware catalog into the free slot of the distributed IO station.
   You will find the HART module in the hardware catalog in the following path:
   "<your fieldbus system>\<your distributed IO station>\<your distributed IO station\<your selected interface module>"
2. Drag "HART field device" from the hardware catalog into the channel in the analog input module.
   You will find the "HART field device" in the hardware catalog in the following path:
   "<your fieldbus system>\<your distributed IO station>\<your distributed IO station>\<your selected interface module>\AI"
3. Select the menu command **Station > Save**.
   The hardware configuration is saved.
4. Double-click the field device.
   The Device Catalog opens.
5. Choose the required HART device.
6. SIMATIC PDM opens.
7. Configure your HART device in SIMATIC PDM.

Basic procedure - HART field devices on redundant HART AI/AO modules

The following basic configuration steps are to be carried out:

1. Open HW Config and configure the 2 identical HART modules.
2. Make the required settings in HW Config for module redundancy.
3. Configure the channels of the modules with HART field devices.
   A field device needs to be configured on each of the two module channels that are redundant to each other.
4. Open SIMATIC PDM.
   Opening SIMATIC PDM defines which device is being used. As a result, this also implicitly installs the relevant device on the redundant channel.
   The "Redundancy" area is displayed for field devices which are capable of redundant interconnection.

SHC mode

A few HART field devices assist a fast HART communication with SHC mode. This results in shorter reading and writing times for the parameter data of HART field devices.

For the consistency of configuration you must enable SHC mode in **HW Config** and in **SIMATIC PDM**.

If the "SHC mode enabled" option is activated, SIMATIC PDM detects the following for the analog channels of HART remote I/Os :

Whether the SHC function is supported (uninterrupted HART command sequence), as per the "HART on PROFIBUS" specification from the "PROFIBUS & PROFINET International (PI)" fieldbus organization).

- If the HART module of the remote I/O supports the SHC mode, the SIMATIC PDM is able to use this mode.
- If the HART module of the remote I/O does not support SHC mode, the conventional communication method is used instead.

Note

Communication with 3rd Party HART field devices

If communication with individual HART field devices is interrupted repeatedly when this option is used, you should deactivate it.

Additional information

- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*

9.12.7 How to configure intelligent field devices with SIMATIC PDM

SIMATIC PDM

SIMATIC PDM is a complete and heterogeneous tool for configuration, parameter assignment, commissioning, and diagnostics in conjunction with intelligent process devices. You can use SIMATIC PDM during all phases of a project (engineering, commissioning, and runtime). SIMATIC PDM allows a number of process devices to be configured with a single software package using a standardized user interface.

SIMATIC PDM is used as an integrated tool in SIMATIC Manager and HW Config.

Integration in HW Config allows you to edit devices that are attached to Field bus. All other devices are edited in the process device network and plant view of SIMATIC PDM.

The display of device parameters and functions is uniform for all supported process devices and does not depend on their communications connection, for example, whether they use distributed IO system or the HART protocol.

The following key functions are particularly useful for testing and commissioning process device data:

- Creating process device data
- Changing process device data
- Validating the process device data
- Managing process device data
- Simulating process device data

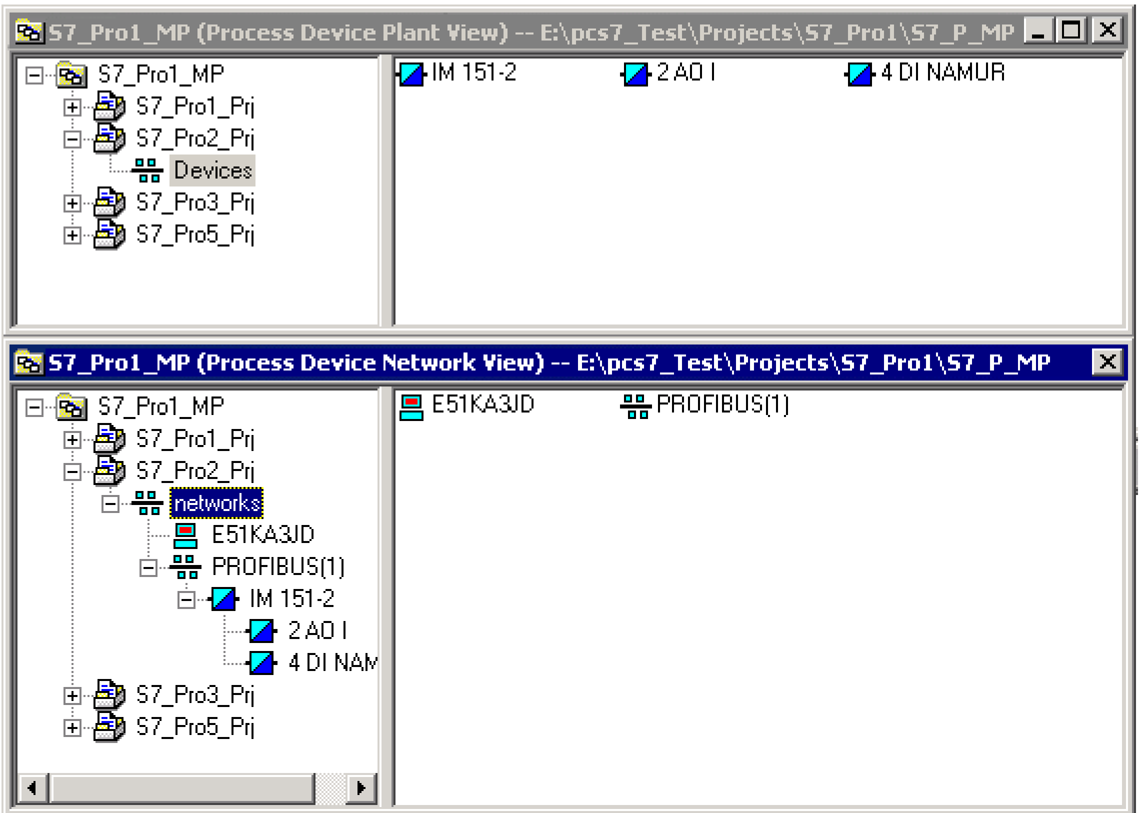
You can also display selected values, alarms and status signals for the device on screen and thus monitor the process. Process-related values can also be manipulated using simulation or with the devices in manual mode.

User Interface of SIMATIC PDM

The user interface of SIMATIC PDM supports several views:

- View within HW Config
- Process devices network view within the SIMATIC Manager
  (Open using the **View > Process Devices Network View** menu command)

- Process devices plant view within the SIMATIC Manager
(Open using the **View > Process Devices Plant View** menu command)
- Configuration, commissioning and runtime view
(see SIMATIC PDM. Open the call via Search from the Windows Start menu: **SIMATIC PDM** and the menu command **LifeList**)



Communication

SIMATIC PDM supports several communications protocols and components for communication with the following devices:

- Devices with PROFIBUS DP communication
- Devices with PROFIBUS PA communication
- Devices with FOUNDATION Fieldbus communication
- HART devices
These devices can be connected in various ways. In its basic form, we distinguish between:
  - HART devices on distributed IO
  - HART devices connected to HART multiplexers or HART interface

System requirements

- You have created a device in HW Config that is configured with SIMATIC PDM.
- To work online with SIMATIC PDM: Check manual SIMATIC PDM.

Procedure in HW Config

1. Double-click the device you want to configure with SIMATIC PDM in HW Config.
   The "User" dialog box opens.
2. Select the desired role of the user.
3. Click "OK".

SIMATIC PDM opens.

Procedure in the process devices plant view

1. In SIMATIC Manager, select the menu command **View > Process Devices Plant View**.
   The process devices plant view opens.
2. Select the required station and the "Devices" object.
   All the existing devices are displayed.
3. Select the required object and select the menu command **Edit > Open Object**.

SIMATIC PDM opens.

Additional information

- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*
- Online help on STEP 7

9.12.8 How to use the diagnostics of SIMATIC PDM

Configuration Support

Apart from the diagnostic options provided by the maintenance station, you can also use the diagnostic options provided by SIMATIC PDM to support you when configuring.

Use "SIMATIC PDM - LifeList" to test which DP devices and HART device are accessible on the network.

Information on the causes of any connection errors can be found in the online help for SIMATIC PDM.

Note

SIMATIC PDM requires device-specific information for devices with diagnostic capability. After installing SIMATIC PDM you can supplement this information through the "Manage Device Catalog" tool.

Additional information

- Online help on STEP 7
- Online help on SIMATIC PDM
- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*
- Manual *Process Control System PCS 7; Service Support and Diagnostics*

9.13 Creating network connections

Introduction

Networks – known as subnets in PCS 7 – are used, on the one hand, for communication between automation systems and SIMATIC PC stations (Industrial Ethernet) and, on the other hand, between automation systems and the distributed I/Os.

Overview

Creating network connections in PCS 7 involves the following topics:

Note

S7 connections over network boundaries

If S7 connections (for PCS 7 this is the default connection to the AS) are to be established via a router, the activation of NAT on the router is not permitted. If NAT is active, no S7 connections across network boundaries can be established.

9.13.1 How to display networked/non-networked stations

NetPro display of the project

NetPro graphically displays all configured stations and networks of a project. You can immediately recognize if a subnet is connected to a specific station based on the connection lines.

You specify the network assignment of components capable of communication during hardware configuration of a station. You can change this assignment later in NetPro.

Procedure

1. In the component view of the SIMATIC Manager, select the project for which you want to display the network.
2. Select the required network in the detailed window.
3. Select **Edit > Open Object** from the menu.

Result

NetPro opens and all the stations of the project are displayed graphically with their network assignment.

Additional information

- Section "How to create and assign parameters for the network attachment of a station (Page 404)"
- Online help for NetPro

9.13.2 How to create and assign parameters for a new subnet

Where and How Can Subnets Be Created ?

The following table provides an overview of the various options for creating subnets:

Where?	How ?	Application
HW Config	When you insert a communications processor You can find information about this in the section "How to insert a communications processor (Page 323)".	Standard plants
NetPro	**Insert > Network Objects** menu command	Complex networked plants
SIMATIC Manager	Menu command **Insert > Subnet** menu command	Complex networked plants

Note to reader

You can create subnets while configuring the station and connect modules (more precisely: their interfaces) to a subnet. You are already familiar with this option.

With complex networked plants it is better to work in the network view (NetPro). This is described below.

Procedure

1. Select the station in the Component View of the SIMATIC Manager.
2. Select the menu command **Options > Configure Network**.
   NetPro opens and the network configuration of the selected project is displayed.

3. Click "Subnets" in the "Catalog" window.
   If it is not visible, open the "Catalog" Window with the menu command **View > Catalog**.
4. Drag the required subnet into the window for the graphical network view.
   Positions which can not be used for attaching the subnet are indicated when the mouse pointer takes on the shape of a "Forbidden" sign.
   The subnet is displayed as a horizontal line.
5. Double-click the symbol of the subnet.
   The "Properties" dialog box for the subnet opens.
6. Set the parameters for the subnet (for example, assign a unique name).

Tip

If you hold the mouse cursor over the icon for the subnet, a tooltip is displayed with the properties of the subnet.

9.13.3 How to create and assign parameters for a network connection to a station

Requirements

- NetPro is open.
- The configured stations are visible.

Procedure

1. Use the mouse to select the interface icon of the node (small box with the same color as the corresponding network type) and pull it toward the subnet to establish a connection.
   Network connections which are not permissible (for example connecting an PROFIBUS PA interface to an Ethernet type subnet), are indicated by the mouse pointer taking on the shape of a "Forbidden" sign.
   The network connection is displayed as a vertical line between the station of distributed IO system and subnet.
2. Select the network connection, followed by the menu command **Edit > Object Properties...**.
3. Make the settings for the node properties (for example, name and address of the node).

Tip

If you hold the mouse cursor over the icon of the interface, a tooltip is displayed with the properties of the interface (name of the module, subnet type, and, if already networked, the node address).

9.13.4 How to change the node address

Node address

You specify the node address in the object properties of the ethernet node (e.g. CP or CPU 410). The following properties are defined:

- MAC address
- in addition for the IP protocol:
  IP address/subnet mask/address of the gateway

MAC address

Each ethernet node is assigned a unique MAC address. You can find the MAC address on many module outside printed.

- Please note that when using PC modules with a fixed MAC address, you must accept this MAC address.
- The freely available MAC address initially recommended by the system may differ from the address of the module.

With more recent ethernet nodes, a check box allows you to decide if you want to set the MAC address and use the ISO protocol. You only need to enter a MAC address if you intend to use the ISO protocol. Otherwise, the field remains disabled; the address assigned to the ethernet node in the factory is then not overwritten when you download the configuration data.

IP protocol

The IP parameters are displayed only when the current module supports the TCP/IP protocol.

PCS 7 assigns default settings for "IP address", "Subnet mask" and the "Address of the gateway" for the interface of the node depending on the subnet mask and gateway of the subnet.

Enter a new IP address/subnet mask/address of the gateway if you do not want to use the default setting.

Requirement

- NetPro is open.
- The configured stations are visible.

Procedure

1. Select the ethernet node whose addressing you want to change.
2. Select the menu command **Edit > Object Properties...**.
3. Select the "General" tab in the "Properties" dialog box and click "Properties".

4. Enter the MAC, IP address and, if necessary, the subnet mask address into the following dialog box.
5. Click "OK".

Additional information

- Online help on NetPro (or HW Config)

9.13.5 How to change the transmission rate and operating mode in the PC network

Introduction

In order to guarantee communication in a network, ensure that the following parameters are set uniformly for all the network nodes:

- Transmission rate
- Operating mode

Note

The factory settings for Siemens devices are set so that parameters for the transmission rate and operating mode are identified **automatically** (autonegotiation).

This setting **only** needs to be changed if nodes which do not have access to the "Autonegotiation" setting must be communicated with in the network.

Automatic identification of the transmission rate and operating mode

Make sure there are no inconsistencies in Ethernet CPs, CPU, switches and network adapters in terms of their settings/properties for data transmission rate and bus access procedure.

We recommend using the default **Autonegotiation** setting (procedure for the automatic negotiation of the best transmission mode between two network interfaces which are directly connected to one another).

The term autonegotiation denotes the automatic identification and negotiation of transmission rate and operating mode (full duplex/half duplex).

- Full duplex is an operating mode with bidirectional data communication, where the communication partners can send data on the transmission link independently of one another.
- Half duplex is an operating mode with bidirectional data exchange, in which only one communication partner at a time can send data on the transmission link.

Requirement

The "Autonegotiation" setting needs to be changed if nodes which do not have access to this setting must be communicated with in the network.

Configuring network nodes

Location of use	Network node	Opening the configuration dialog window	Parameter setting
PC	Communication module e.g. CP 16xx	Configured for automatic negotiation of the network parameters (autonegotiation).	Activate option buttons for duplex mode and transmission rate.
PC	Set INTEL network adapter (or similar standard network adapter)	1. Use the search box in the start menu to open the **"Device Manager".** 2. Select network adapter. 3. **File > Properties** 4. "Advanced" tab	Set values for the property. Typical name for the property (depends on the network adapter used): • Speed and duplex mode • Link speed & duplex
Switches	SCALANCE X ... e.g.: SCALANCE X-400	• Configuration via Telnet or Web Based Management (WBM) • Open the configuration dialog box for the switch via Internet Explorer: http: \\<TCP-IP address>	Port configuration
AS	Communication module e.g. CP 443-1	HW Config: CP 443-1 properties > "Options" tab > "Individual Network Settings" group	In the "Transmission medium/ Duplex" drop-down list (default setting: "Automatic setting")
AS	Network adapter to Ethernet e.g.: PROFINET connection for a CPU 410-5H	1. HW Config 2. Select port 3. Object properties 4. "Options" tab	Default setting: "Automatic setting" (Autonegotiation)

You can find information on approved hardware in the product overview *Process Control System PCS 7; Released Modules*.

9.13.6 How to save the network configuration

Introduction

To save the network configuration and the connection tables, you can use the **Network > Save** and **Network > Save and Compile...** menu commands.

Save

If you have created network objects in NetPro or changed their properties in NetPro, NetPro saves the following:

- Node addresses
- Subnet properties (for example, transmission rate)

- Connections
- Modified module parameters (for example, of CPUs)

Save and compile

After calling the menu command **Network > Save and Compile...**, you can select in the next dialog box whether you want to compile everything or changes only. Regardless of the option you select, NetPro checks the consistency of the configuration data throughout the project; messages are displayed in a separate window.

Option	What?
Compile and check everything	The loadable system data blocks (SDBs) of the complete network configuration are generated; these contain all the connections, node addresses, subnet properties, input/output addresses and module parameter assignments.
Compile changes only	The loadable system data blocks (SDBs) of modified connections, node addresses, subnet properties, input/output addresses or module parameter assignments are created.

9.13.7 How to check the consistency of the network

Introduction

We recommend that you check the consistency of the network prior to saving.
The following are examples of states which are displayed during the consistency check:

- Nodes that are not connected to a subnet
  (exception: non-networked MPI nodes)
- Subnets with only one node
- Inconsistent connections

Alternative procedures

A consistency check takes place during the following actions:

- **Network > Check consistency** menu command
- **Network > Check consistency project-wide** menu command
- **Network > Save and Compile...** menu command (in the next dialog box, select the option "Compile and check everything")
- Download to the target system (consistency check of the stations and connections to be downloaded)

Procedure

1. In NetPro, select the menu command **Network > Check Consistency**.

Result

The consistency check is carried out.

Following this, the window "Outputs for consistency check for <path + project name>" opens. If necessary, errors and warnings are displayed in this box such as those concerning hardware configuration, network or connection configuration .

Messages in the "Outputs for Consistency Check" window

Messages are displayed as errors if no system data (SDBs) can be generated by saving and compiling or prior to download to the target system. Without generated system data, the hardware/network and connection configuration can not be downloaded to the target system.

Messages are displayed as warning when the reported problem nevertheless allows generation of system data (SDBs).

To obtain help on an error or warning, select the error or warning and press the <F1> key.

Tip
The window with the results of the last consistency check can be opened at any time with the menu command **View > Outputs**.

Consistency of cross-project subnets

After merging subnets in the multiproject (see section "Cross-project networks (Page 409)") and before downloading, you should ensure the consistency throughout the multiproject with the menu command **Network > Check Cross-project Consistency** in NetPro. In this check, all projects of the multiproject are subjected to a "total consistency check" one after the other. This takes into account all the objects in the multiproject.

The quality of the consistency check is the same for both menu commands (**Network > Check Consistency** and **Network > Check Cross-project Consistency**). In both cases, duplicate node addresses are searched for in merged subnets. When checking connections for consistency, cross-project connections are also taken into account in both cases.

9.13.8 Cross-project networks

Cross-project networks

With PCS 7 you can configure cross-project Ethernet networks and then use these networks to configure connections. Networks running through multiple projects are not created in one step. The subnets already configured in the individual projects are merged in the multiproject and assigned to a logical "total network". The "total network" represents the shared properties of all assigned subnets. The individual subnets of a merged network still remain.

Merged and therefore cross-project networks have one and the same subnet type and identical S7 subnet IDs. In NetPro, they are represented by the name extension "Part of: Ethernet cross-project".

Cross-project network view

For a better overview, you can activate the "Cross-project network view" in NetPro with the menu command **View > Cross-Project Network View**. This feature is especially helpful in the multiproject.

Additional information

- Section "How to merge subnets from different projects into a multiproject (Page 571)"
- Online help for NetPro

9.13.9 Network configuration of redundant networks

Redundant networks

In PCS 7 both field bus systems can be configured redundantly

See samples for configuration:

- Section "Layout of redundant PROFIBUS DP networks (Page 77)"
- Section "Configuration of a IO device with PROFINET (Page 89)"

Basic procedure

1. Use the PCS 7 wizard to create a project with a CPU (e.g. CPU 410-5H or CPU 417H).
2. The fieldbus is attached either manually or automatically depending upon the configuration you have selected:
   – Create a new fieldbus system manually when using the following interfaces:
     - PROFINET interface of the CPU at a SIMATIC H station
     - PROFINET interface of the CP 443-1 at a SIMATIC H station
     - PROFIBUS DP interface of the CP 443-5 ext at a SIMATIC H station:
   – When using PROFIBUS DP interface of the CPU in a SIMATIC H station, two fieldbus systems are automatically created within the corresponding PROFIBUS DP interface of the CPU.

When you continue with the configuration, make sure that you assign other redundant components (for example, redundant OS servers) to the correct plant bus.

Result

You have created a redundant fieldbus and a redundant plantbus.

Additional information

- Function manual *Process Control System PCS 7; High Availability Process Control Systems*

9.13.10 Tips for editing the network configuration

Introduction

Below you will find tips on how to edit existing network configurations.

Highlighting the communication partners of a module

Proceed as follows after you have configured the connections:

1. Select a programmable module (CPU, FM) in the network view.
2. Select the menu command **View > Highlight > Connection Partner**.

Note

Only the communication partners of a programmable module can be highlighted.

Displaying/modifying the properties of components

To display or modify the properties of stations or modules, proceed as follows:

1. Select the component (station icon or module)
2. Select the menu command **Edit > Object Properties...**.

Copying subnets and stations

1. Select the network objects to be copied. Use the keyboard/mouse combination <Shift> + left mouse button to select several network objects for copying at the same time.
2. Select the menu command **Edit > Copy**.
3. Click the location in the network view where you want to position the copy and select the menu command **Edit > Insert**.

Note

You can copy individual network objects or entire subnets with network connections, stations, and DP slaves. When copying, remember that all the nodes of a subnet must have a different node address. Therefore it may be necessary for you to change the node addresses.

Deleting network connections, stations and subnets

1. Select the symbol of the network connection or subnet.
2. Select the menu command **Edit > Delete**. When you delete a subnet, the stations previously connected to the subnet are retained and can be connected to another subnet.

9.14 Creating the SIMATIC connections

Overview

Several automation systems are inserted into a plant unit when configuring middle- and large-size plants. The automation systems share the automation tasks and therefore must be able to exchange data. Data communication between the automation systems and the PC stations is also necessary.

The following sections explain how to define these communication connections and which special features must be taken into account.

9.14.1 Connection types and connection partners

Introduction

Communication connections (connections, for short) must always be configured, when data exchange between the automation systems or the automation system and a PC station (for example, an OS station) is required in the user program using communication blocks.

Connection

A connection is the logical assignment of two communication partners for the purpose of carrying out communication services (for example, the exchange of process values). A connection specifies the following:

- The communication partners involved (for example, two SIMATIC 400 stations)
- The connection type (S7 connection, S7 connection fault-tolerant)
- Special properties such as:
  - Whether a connection remains permanently configured
  - Which one of the partners initializes the connection configuration
  - Whether operating state messages should be transmitted

Connection Configuration

During connection configuration, a unique local identifier is assigned per connection, the "local ID". The local ID can also be a symbolic name (named connection). This local ID is required when assigning parameters to the communication blocks.

For each programmable module that can be the end point of a connection, there is a separate connection table.

You can find additional information about this in the section "Creating network connections (Page 402)".

Special features

PCS 7 automatically assigns a local ID for both end points of the connection if both communication partners are S7-400 stations or if one of the communication partners is an S7-400 station and the other is a SIMATIC PC station.

You configure the connection only in the connection table of one partner; the other communication partner then automatically has the matching entry in its own connection table.

Selecting the Connection Type

The connection type depends on the subnet and the transmission protocol with which the connection is established. Which communication blocks you use depends on the connection type.

In PCS 7, the following connection types are used:

- S7 connection
- S7 connection, fault-tolerant

9.14.2 How to configure connections between two SIMATIC 400 stations

Requirement

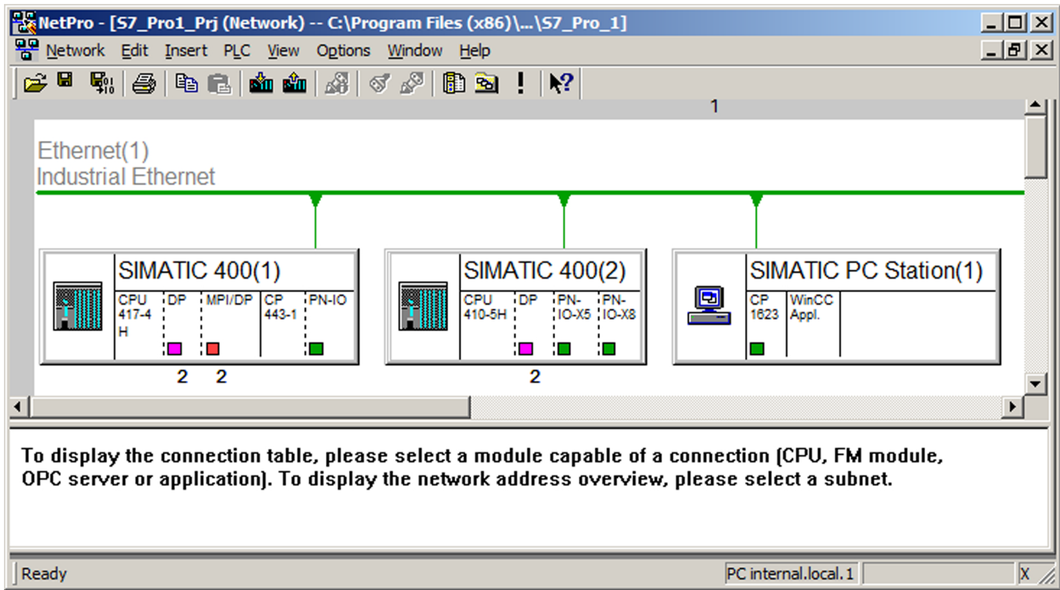
Two SIMATIC 400 stations have already been created.

Note

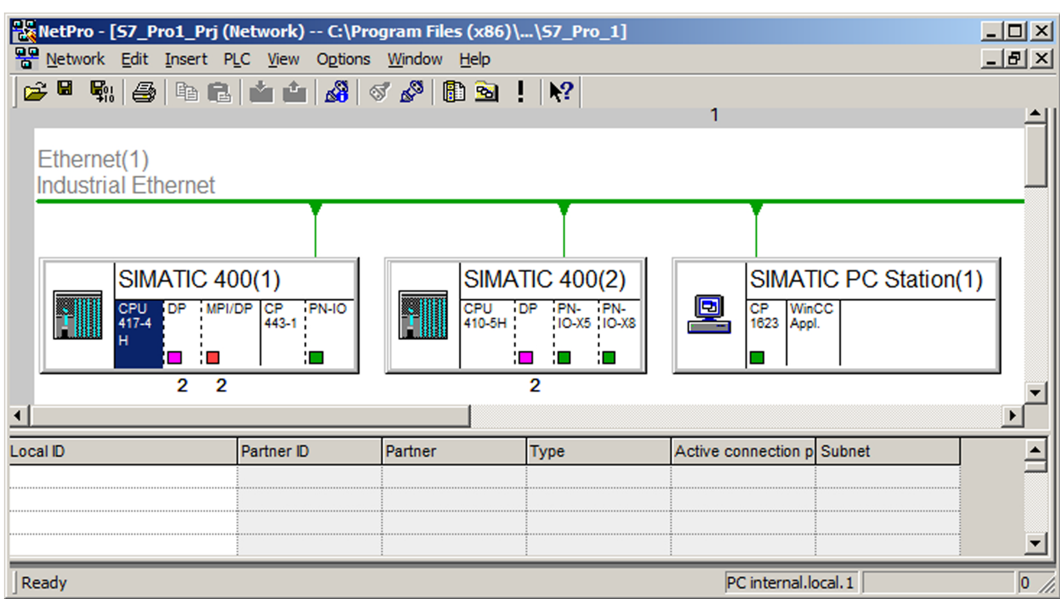
Make sure that there are no duplicate node addresses in your project (if uncertain, check with NetPro).

Procedure

1. Select the required project in the component view of the SIMATIC Manager.
2. Select the menu command **Options > Configure Network**.
   The network view opens. The SIMATIC 400 stations, the corresponding ET 200M I/O devices, the operator stations, and the networks existing in your projects are displayed in the network view.

3. Select the module for which the connection is to be created in the network view, for example, the CPU of the SIMATIC 400(1).
   The connection table of the selected module is displayed in the lower part of the network view.

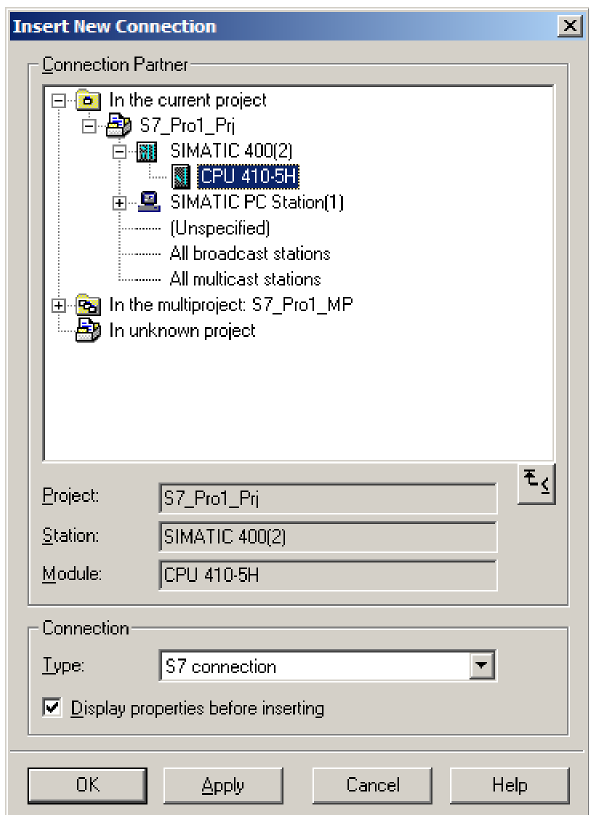
4. Select an empty row in the connection table and select the menu command **Insert > New Connection...**.

5. Select the required connection partner in the "Insert New Connection" dialog box. Here, select the CPU of the SIMATIC 400(2).

Note

If you create a connection to a partner in another project of the multiproject, you must enter a connection name (reference). Based on the connection name, cross-project connections can later be merged.

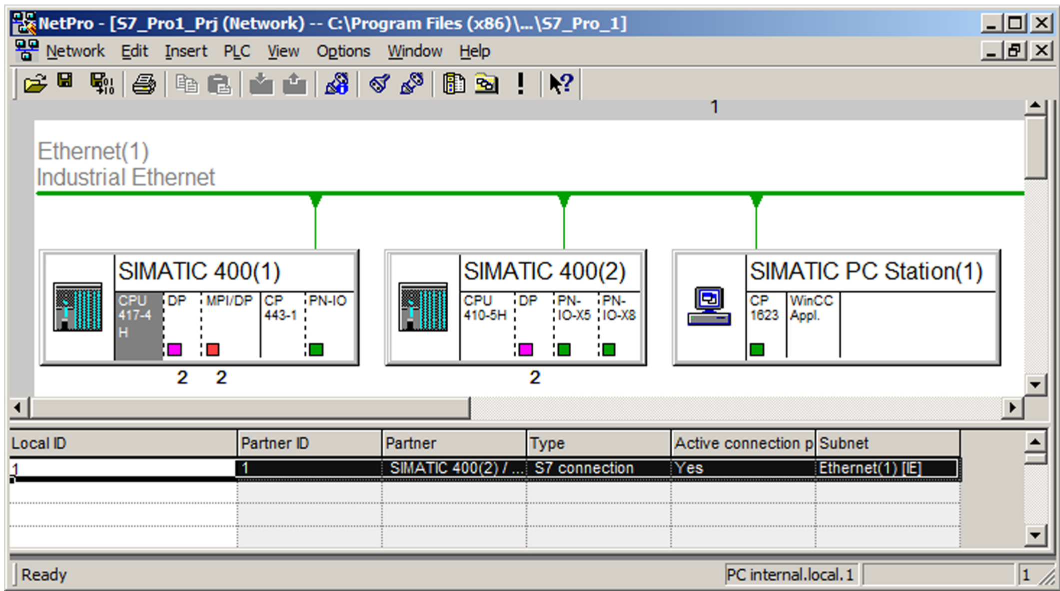
You enter the connection name in the "Properties" dialog box for the connection when configuring the corresponding PC station (OS) (group: "Connection Identification"; field: "Local ID").



6. Select the "S7 connection" entry from the "Type" drop-down list.
7. Select the "Show properties before inserting" if you want to view or change the properties of the connection after "OK" or "Add".
   The content of the "Properties..." dialog box depends on the selected connection.

Result

PCS 7 enters the connection in the connection table of the local (selected) partner and assigns the local ID (can be changed) for this connection and, if necessary, the required partner ID you can need for programming the communication function blocks. The partner ID is the value for the block parameter "ID".



Downloading connections

Download the connection into the CPUs of the corresponding stations after the new connection is configured.

1. Select the menu command **Network > Save and Compile...**.
   The "Save and Compile" dialog box opens.
2. Select from the options "Compile and check everything" and "Compile changes only".
3. Select the CPU in one of the stations where you configured the connection.
4. Select the menu command **PLC > Download in the current project > Connections and Gateways**.
   All connections and gateways are downloaded.

Note

The configuration data of the partner station must also be downloaded.

Additional information

- Section "Cross-project connections in a multiproject (Page 423)"
- Online help for the dialog box

9.14.3 How to configure a connection between PC and SIMATIC 400 station (named connection)

Symbolic connection name (named connection)

Instead of a connection ID, you can assign a symbolic name to a connection between an OS and an AS. This procedure is also referred to as "named connection". We recommend assigning the name of the AS. Once the OS has been compiled, this name will appear in the "SIMATIC S7 Protocol Suite".
You can find more information about this in the configuration manual *Process Control System PCS 7; Operator Station*.

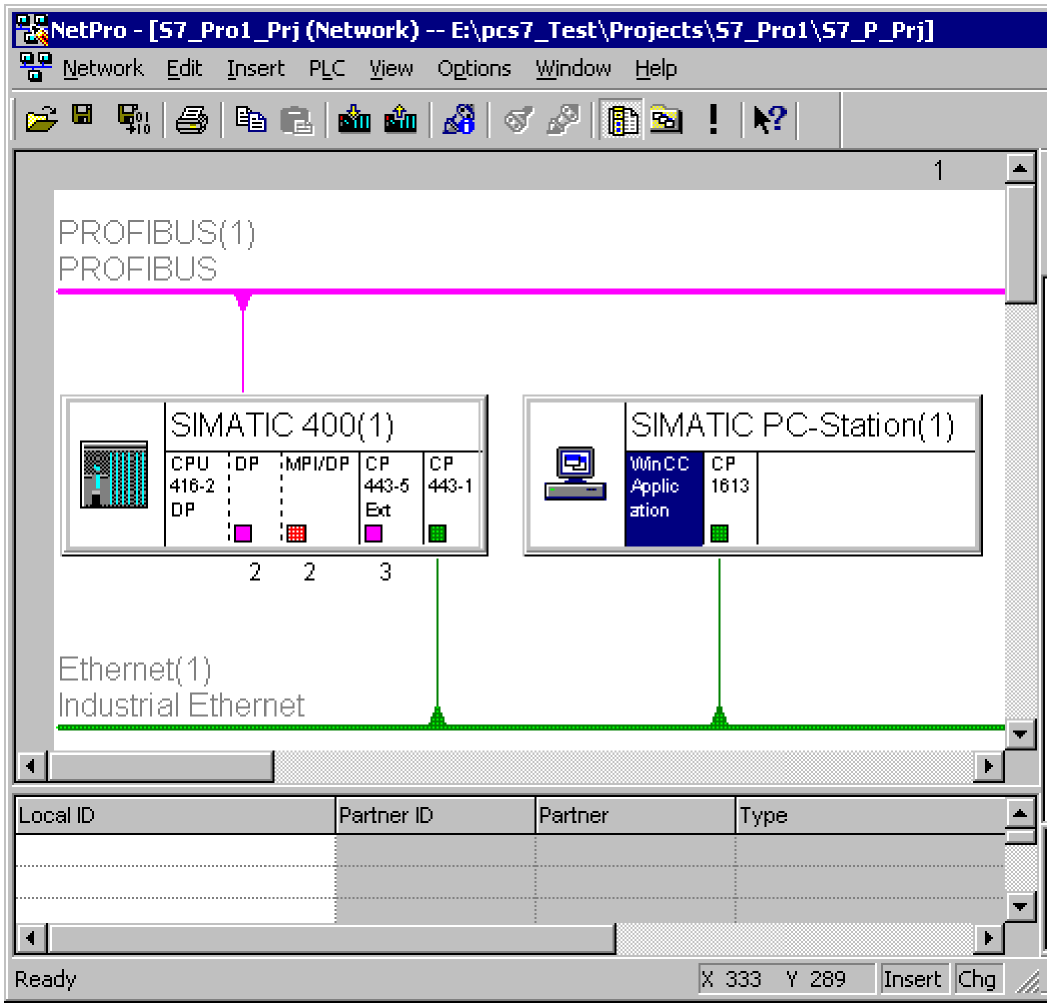
Note

If several connections are configured between PC stations to **one** AS, these connections must all have the same name.

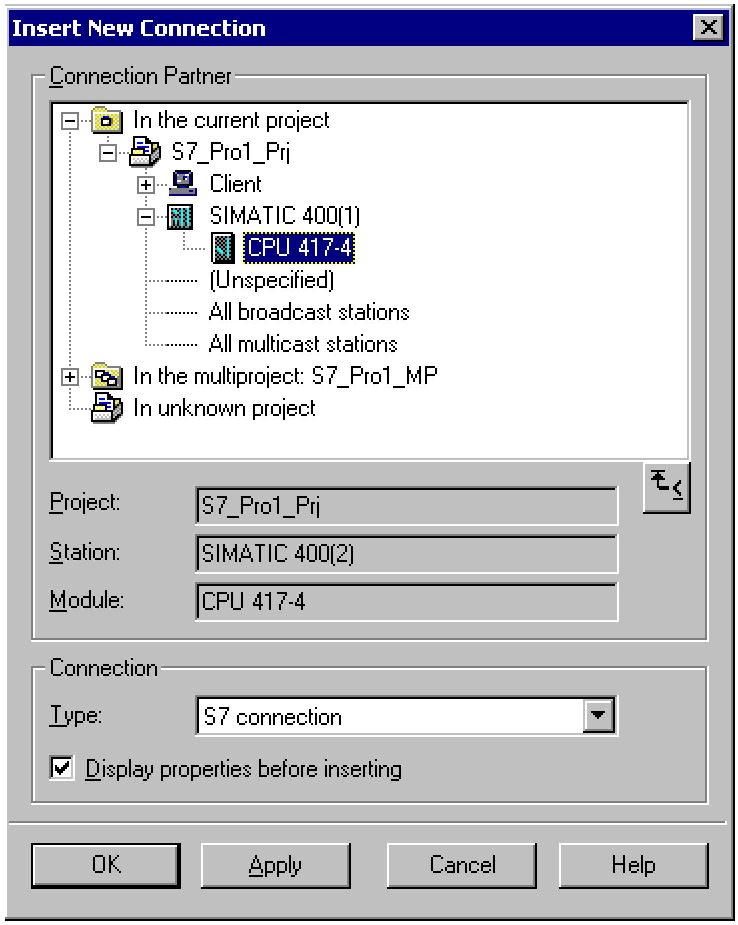
Procedure

1. Select the required project in the component view of the SIMATIC Manager.
2. Select the menu command **Options > Configure Network**.
   The network view opens. The SIMATIC 400 stations, the corresponding ET 200M I/O devices, the operator stations, and the networks existing in your projects are displayed in the network view.

3. Select "WinCC Application" in the symbol of the "SIMATIC PC station".
   The connection table is displayed at the bottom of the NetPro window.



4. To insert a new connection, select the menu command **Insert > New Connection...**.
   The "New Connection" dialog box opens.



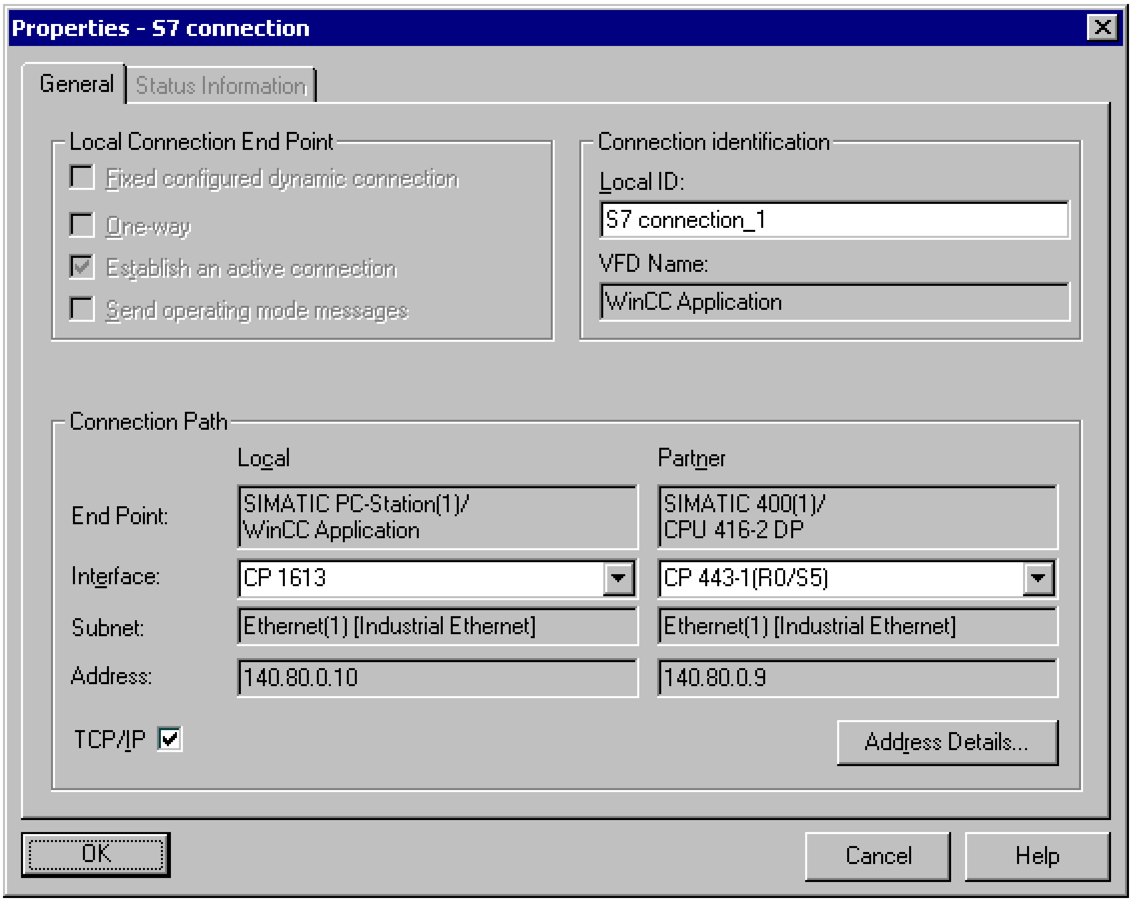
5. Select the CPU in the "Connection Partner" field that should be coupled with the OS.

Note

If you are working in a multiproject, use the multiproject folder to select the target project and the required CPU found there.

6. Select the "Display properties before inserting" check box.

7. Click "OK".
   The "Properties - S7 connection" dialog box opens.



Note

A connection name is entered as a default (S7 connection_1) in "Local ID:".

8. Adapt the name of the local ID to the project requirements (for example, the name of the AS). This helps to avoid errors and maintain an overview.
   You can find the connection name once again in the connection table (named connection).
   When compiling the OS, the corresponding S7 program can now be transferred to the OS using this path (depending on the settings for compiling the OS).
9. Click "OK".

Note

To avoid errors and improve clarity, you should change the default connection name (S7 connection_1) to match your project (for example, name of the AS).

10. Select the menu command **Network > Save and Compile...**.
    The connection configuration closes.
11. Select the PC station and then the menu command **Target system > Download in Current Project > Selected Stations**.
    The configuration is downloaded.

    Note

    After the initial download of the hardware configuration from HW Config (CPU-STOP), download the changes to the configuration only using the "Compile and Download Objects" function or from within NetPro.

Only change the local ID

The local ID can be changed directly in the "Local ID" column of the connection table.

Go to partner station

Requirements:

- The project where the connection partner is located is open.
- The subnets of the participating projects are merged.

When you are editing in the connection table, go directly to the connection table of a connection partner as described below.

1. Select a connection in the connection table.
2. Select the menu command **Edit > Go to Connection Partner**.

This function is also possible for cross-project connections in the multiproject.

Note

To avoid the AS generating messages during operation when the OS simulation starts or terminated on the engineering station, the connection ID for the engineering station should be higher than 0xc00.

Additional information

- Section "Cross-project connections in a multiproject (Page 423)"

9.14.4 How to work with the connection table

Requirements

- NetPro is open.
- A CPU or a WinCC application is selected.

Showing and hiding columns

1. From the connection table shortcut menu, select the menu command **Display/Hide Columns > ...** and then the name of the column you want to show or hide from the next shortcut menu.

The names of the visible columns are indicated by a check mark. If you select a visible column, the check mark disappears and the column is hidden.

Optimizing the column width

In order to adjust the width of a column to its content (all texts legible) follow these steps:

1. Position the mouse pointer in the header row of the connection table on the right beside the column you want to optimize until the mouse pointer changes to two parallel lines (as if you wanted to change the width of the column by dragging with the mouse pointer).
2. Double-click this position.

Tip: If the columns are set too narrow, the entire content of individual fields is displayed when the mouse pointer is positioned briefly over a field.

Note

The column widths and the selection of displayed columns is stored according to the specific project after the project is closed. The project settings remain valid even when the project is opened on a different computer.

Sorting the connection table

To sort the connection table in ascending order according to a particular column, click the title of the column.

Clicking the title of the column again sorts the connection table in the opposite order.

Changing the properties of the connection

If you want to change a connection that has already been configured, for example, to set a different connection path (interface), follow these steps:

1. Select the connection you want to change.
2. Select the menu command **Edit > Object Properties...**.
   You can change the connection properties that allow editing in the dialog box that opens.

Going to the connection partner

Requirement:
The project where the connection partner is located is open in NetPro.

If you are working in the connection table, you can go directly to the connection table of a connection partner:

1. Select a connection in the connection table.
2. Select the menu command **Edit > Go to Connection Partner**.

This function is also possible for cross-project connections in the multiproject.

Highlighting a connection partner

Requirements:
Connections have already been created.

If you want the connection partner to be displayed in the graphical network view as well, you can use the following view option:

1. Select a programmable module (CPU, FM).
2. Select the menu command **View > Highlight > Connection Partner**.

Additional information

- Online help for connection table.

9.14.5 Cross-project connections in a multiproject

Introduction

If cross-project subnets are configured then connections can also be configured over all of the subnets. The end points of these connections can be in different projects.

PCS 7 provides support both when **creating** cross-project connections within the multiproject and when **synchronizing** connections configured without the multiproject context.

Cross-project connections to a specified partner

Cross-project connections to a specified partner (for example, a CPU) are created just like connections within a project. The dialog box for selecting the connection partner allows not only the selection of the end point (for example, module) but also the selection of the project within the multiproject in which the end point is located.

To allow this, the projects must be part of a multiproject and the subnets must have been merged (for example, using the "Synchronize Projects" wizard of the SIMATIC Manager).

Properties of cross-project connections

The consistency of cross-project connections is retained when manipulating projects of the multiproject. Cross-project connections within a multiproject remain functional and can be compiled even when the project with the connection partner has been removed from multiproject.

Rule for S7 connections:
Prior to opening the "Properties" dialog box, PCS 7 will only ask whether the connection should be broken only once you have displayed the properties of the connection. Only after responding with "Yes" to this question may you change the properties of the connection. If you modify the properties, you must make sure that the connection properties are synchronized yourself.

Note

Only the local ID of a connection can be changed without breaking the connection (changes made directly in the table).

Fault-tolerant S7 connections cannot be broken.

If you have broken connections at both ends, you can merge them again with the menu command **Edit > Merge Connections...**.
You can find additional information on this topic in the online help for the dialog box.

Cross-project connections to an unavailable partner

If the connection partner in the multiproject is "unavailable", because the relevant project is being created elsewhere or because it is being edited and is therefore locked, select "in unknown project" as the connection partner. In the path the project, "Partner in unknown project" is also selected as the connection partner.

This procedure reserves a connection in both projects that can be synchronized with system support when the partner project is later included in the multiproject.

To allow this, the same connection name (reference) must be configured in both projects in the properties of the connection. Based on the connection name, it is possible to assign the connection partner and synchronize the connection properties using the menu command **Edit > Merge Connections...**.

You can find additional information on this topic in Section "How to merge cross-project connections (Page 572)".

Points to note when downloading

If you have configured cross-project subnets and connections, you must download the network configuration to all modules involved. These are the end points of the connections and the required routers.

When you upload (upload to programming device), the configured network configurations and connections are automatically merged assuming that the requirements are met (for example, both end points are uploaded).

The download functions in NetPro are **not cross-project** operating and only take effect within a single project. This affects the functions:

- **Download to Current Project > Selected Stations**
- **Download to Current Project > Selected and Partner Stations**
- **Download to Current Project > Stations on the Subnet**
- **Download to Current Project > Selected Connections**

- **Download to Current Project > Connections and Gateways**
- **Save and Compile** is also restricted to the project currently active.

If an S7 connection, for example, is cross-project, the network configurations of both projects involved must be compiled.

Additional information

- Section "How to merge cross-project connections (Page 425)"

9.14.6 How to merge cross-project connections

Requirements

The following conditions must be met in order to merge connections within a multiproject:

- The exact same connection name is used in the projects for the corresponding connections. This name also functions as a reference.
- S7 connections to an unspecified partner can be merged to a cross-project S7 connection only in NetPro. These connections are ignored in the SIMATIC Manager.

Procedure

1. Select the required multiproject in the SIMATIC Manager
2. Select the menu command **File > Multiproject > Synchronize Projects**.
   The "Synchronize Projects in the Multiproject<name of the multiproject>" dialog box opens.
3. Select the "Merge connections" entry in the left window.
4. Click "Execute".
5. If the "Result" dialog box does not indicate an error, click "Save".

Result

The connections are merged and synchronized in the multiproject.

9.14.7 Configuring connections of redundant connections

Redundant connections

The high availability connection is a separate connection type. The following partners can communicate over high availability connections:

- SIMATIC H station (two H-CPUs) communicates with SIMATIC H station (2 H-CPUs)
- SIMATIC PC station communicates with SIMATIC H station (2 H-CPUs)

The properties of high availability connections correspond to those of the S7 connections; however restricted to H-CPUs and OPC servers of SIMATIC PC stations.

With a high availability S7 connection, two connection paths between the connection end points are normally possible.

Requirements

- The hardware configuration for the two subsystems of a high availability system is identical.
- The participating communication partners are H-CPUs or a suitably configured SIMATIC PC station.
- The S7-REDCONNECT software package is installed on the SIMATIC PC station to use high availability S7 connections between a SIMATIC PC station and a high availability automation system.

Procedure

1. Select the CPU of an H station (H-CPU) from which you want to configure a new connection.
2. Select the menu command **Insert > New Connection...**.
3. Select the required connection partner in the opened "Insert New Connection" dialog box.
4. Select the "Fault-tolerant S7 connection" entry from the "Type" drop-down list.
5. The remaining steps are the same as for configuring an S7 connection.

Additional information

- Manual *Process Control System PCS 7, High Availability Process Control Systems*

9.15 Configuring AS functions

9.15.1 Overview of the programming steps

Overview

Define the AS functions in the plant hierarchy by inserting and programming CFC/SFCs after you have created the S7 programs including the chart folder in the component view. The following table provides you with an overview of the basic steps in programming that are described in greater detail below.

What?	Man-datory	Optional
Creating CFCs (Introduction) (Page 431)	X	
Configuring the interface to the I/O (channel and diagnostic blocks) (Page 468)	X	
Creating process tags from process tag types (multiproject) (Page 474)		X For mass data processing
Creating sequential control systems (SFC) (Page 486)		X
Creating models (multiproject) (Page 518)		X For mass data processing

You can also find information on the following topics:

- Configuration by several users (textual interconnections) (Page 427)
- Editing mass data (Page 526)
- Overview of data exchange (Page 575)

Additional information

- Information on the access protection for CFC and SFCs can be found in section "How can the plant be protected from unauthorized access? (Page 36)".
- Information on the versioning of CFC and SFCs can be found in section "Versioning CFC and SFCs (Page 652)".

9.15.2 Configuration by several users (textual interconnections)

Basic procedure

Prior to programming the CFC and SFCs, you should decide whether the project will be edited by more than one engineer. To allow this, branching and merging at the chart level is possible (S7 program).

The distribution within the project is made according to technological aspects (for example, unit with the relevant charts is copied to a different project). Existing cross-chart interconnections are automatically replaced with textual interconnections.

On completion of editing copy the parts back into the original project. Any charts with the same name are replaced following a prompt for confirmation. The textual interconnections are then reestablished.

Textual interconnections that cannot be closed because a block was deleted are indicated in a log. The interconnections can then be systematically edited by hand.

Distributing and merging project data

1. Copy a technological part of the project (for example, chart folder or charts) to a different project.
   The copy contains textual interconnections to all sources that were not copied.
2. Edit the copied section separately (add, delete, modify blocks and charts).
3. Copy this edited technological section back to the original project.
   When copying the charts into the chart folder of the component view, the handled charts are overwritten after a prompt. There are now textual interconnections to the charts that had connections to the copied charts.
4. In the CFC editor, select the menu command **Options > Close Textual Interconnections**.
   All "open" interconnections are closed.
   The interconnections are closed in the charts edited in the other project and traced back to the original project, as well as in the charts where textual interconnections arose as a result of deletion.

Note

Always copy the charts in the component view.

If you copy a chart in the plant view, a copy of the chart is created instead of being replaced.

Rules for textual interconnections

- Charts are inserted into other projects through **Copying**. In this way a completely functioning original project is maintained until the edited charts are returned.
- When an interconnection is broken, neither of the interconnection partners may be renamed, otherwise the textual interconnection cannot be closed again.
- Changes to charts in the original project are discarded when charts of the same name are returned to the original project from temporary projects.

- An unwanted interconnection can result in the original project if, for example, cross-chart interconnections are modified in the temporary project and only one of the charts involved is returned to the original project.
  Example: Chart CFC_A contains an interconnection to a block in the CFC_B chart. Both charts are copied to a temporary project and edited further. During editing, the interconnection between the charts is deleted. Only CFC_A is returned to the original project. A textual interconnection is created in the CFC_B of the original project; this can also be closed.
  Result: The interconnection deleted in the temporary project reappears in the original project.
- Textual interconnections created before copying/moving are included in the target project (temporary project). This might be a concrete path reference (that can be closed) or a character string (required connection that will only be configured in the target project).

Merging several S7 programs into one S7 program

To merge S7 programs on workstations that are not networked, the individual blocks or sources must be copied and inserted in the target. Global data for the project, such as the symbol table of variable table must be edited manually.

Follow the steps outlined below:

1. In the SIMATIC Manager, copy the blocks and sources to the appropriate folders of an S7 program.
2. Export the symbol tables of the individual S7 programs in ASCII format and import them into the symbol table of the merged S7 program.
3. Check if any symbols are used twice.
   Tip: You can also integrate short symbol tables using the clipboard (copy and paste).
4. Copy the variable tables you want to use or integrate the various variable tables using the Clipboard (copy and paste) into a new variable table.

Copying the S7 programs with message attributes

If you have provided blocks with message attributes, pay attention to the following restrictions (which are independent of the message number assignment procedure) when copying S7 programs:

Project-wide assignment of message numbers
The message numbers may overlap. Pay attention to the following in order to avoid conflicts:

- In the SIMATIC Manager, assign a fixed message number range to each S7 program using the menu command **Edit > Special Object Properties > Message Numbers...**.
- When copying S7 program make sure that S7 programs are not overwritten.
- Only message types (FBs) can be programmed separately from the S7 program.

CPU-wide assignment of message numbers

- Programs can be copied within the project and from other projects without changing the message numbers.
- When copying individual blocks, the message number changes and you must recompile the block to link the modified message number into the program.

Copying a Program with Project-Wide Assignment of Message Numbers to a Project with CPU-Wide Assignment of Message Numbers

- If you want to copy a program in which message numbers are assigned project-wide to another project in which the message numbers were assigned CPU-wide, select the required program in the SIMATIC Manager, followed by the menu command **File > Save As...**, and activate the "With reorganization" check box. This also applies if the project contains more than one program (more than one AS).
- Default entries are made for the message attributes when they are copied.

Copying a Program with CPU-Wide Assignment of Message Numbers to a Project with Project-Wide Assignment of Message Numbers

You can only copy individual FBs with messages.

Note

The assignment of message numbers in the programs must be uniform within a project!

If a block with messages that references a text library is copied to another program, you must also copy the corresponding text libraries or create another text library with the same name or change the reference in the message text.

Changing between CPU-wide and project-wide assignment of the message number

If you change between CPU-wide and project-wide assignment of the message numbers, you have to update the blocks in the CFC for every AS.

1. Open a CFC from the S7 program in which you have changed the library blocks.
2. Select the menu command **Options > Block Types...**.
   The "Block Types" dialog box opens.
3. Select all the blocks for which a new version is to be imported in the "Chart folder" list.
4. Click "New Version...".
   A warning message is displayed with information about the old and new version and the query whether you really want to update the block type. If you click "Yes", a central type change is carried out. All the instances of the block type are also changed within the chart folder.
5. Close the dialog box.
6. Repeat Steps 1 to 5 for all the stations in your project/multiproject.

Inserting S7 Connections to Unspecified Connection Partners

If you insert existing projects with S7 connections to unspecified partners into a multiproject, you can easily convert these S7 connections to cross-project S7 connections:

1. Merge the subnets along which the S7 connection runs:
   You can find additional information on this topic in Section "How to Merge Subnets from Different Projects into a Multiproject (Page 571)".
2. In the SIMATIC Manager, select the menu command **Options > Configure Network**.
   NetPro opens.
3. Select the menu command **Edit > Merge Connections...**.

PCS 7 automatically merges matching S7 connections.

Additional information

- Online help on STEP 7

9.15.3 Creating CFCs (general)

CFCs and CFC editor

To configure continuous processes in a plant, you use CFCs that you create and edit with the CFC Editor. You insert blocks from the master data library or from the *PCS 7 Advanced Process Library* into these CFCs.

The *PCS 7 Advanced Process Library* contains blocks for controlling a process or for monitoring measured values, for example. The inputs and outputs of these blocks are interconnected directly in the CFC Editor and are given parameter values. During this procedure, you are supported by the CFC Editor graphic user interface.

Store the CFCs in the plant hierarchy. They are always located in the hierarchy folders in which they have their technological significance.

The *PCS 7 Advanced Process Library* also provides process tag types. They are complete CFCs for different process tags, such as motors and valves.

Note

We recommend that you store all the blocks, charts, process tag types, etc. used in the project in the master data library and then only access the master data library during configuration. This applies in particular to objects you have copied from a library and then modified for the project.

For detailed information about the CFC Editor, refer to the Online help and the corresponding manuals.

Functions in the form of blocks

In CFC, you work with ready-made blocks that have a specific function. You place these function blocks in the CFC, interconnect them, and assign parameters to them.

Block type

For every function block a type definition exists that specifies the following:

- The algorithm
- The type name
- The data interface (these are the input and output parameters)

The type definition also specifies the data types of the input and output parameters. These input and output parameters are known as block inputs and block outputs since this is how they appear in the graphic display of the block.

Block Instance

A block instance is created from the block type after the block type is placed into your CFC.

You can create any number of block instances from a particular block type. Depending on their individual use, separate block instances can be named, interconnected, and assigned parameters without changing the way the specific type function.

One useful aspect of this type instance concept, for example, is that following later central changes to the block type, these changes can be automatically made in all block instances.

Compound blocks (multiple instance mlocks)

Functions can consists of different partial functions. Blocks used to perform the partial functions can be added together to form a multiple instance block which carries out the entire function. This could be for example, a control block which functions as an internal block and contains both a message and operator control block.

Multiple instance blocks can be created in CFC by interconnecting different blocks (functions) and assigning parameters. This chart is then compiled as a block type.

Master data library

In multiproject engineering, you work with the master data library. This contains the project master data (block types, process tag types etc.) for all projects of this multiproject. You can find additional information in the section "Introduction to the master data library (Page 280)".

Additional information

- Creating process tags from process tag types (multiproject) (Page 474)
- Manual *CFC for S7; Continuous Function Chart* and in the online help.

9.15.3.1 Overview of the configuration steps

Requirement

A project structure (plant view) is created in the SIMATIC Manager which allows you to configure CFC/SFCs.

Overview of configuration tasks

The following table contains the steps you must execute during the configuration process.

Note

When entering units, ensure that the following special characters are not used: ['] [$].

Step	What?	Description
1	Creating the project structure	A chart folder for CFC must be created below the hierarchy level of the program folder in the SIMATIC Manager. CFCs are stored in the chart folder.
	Creating blocks (optional)	CFC works with ready-made blocks. These can be blocks from libraries, other programs, or block types created by you.
2	Importing the blocks (if they were not imported implicitly by inserting the block)	Block types required for the project are inserted and if necessary imported in various ways depending on the CPU. By importing blocks, they are made known to CFC. The block types should be stored in the master data library.
3	Creating, importing or opening the CFC	To implement an automation function, create CFCs or import them, for example, from existing projects. Open existing charts in the CFC Editor. **Caution:** If a chart has already been opened for configuration, this chart can be opened by other users for editing. These other users receive the following information: Chart x opened by <logon name> on <name of engineering station>
4	Inserting the blocks (into a CFC)	Blocks are inserted in the CFC by dragging them from a master data library or the block catalog. This creates a block instance with a name that is unique throughout the chart. You can create any number of block instances from each block type.
5	Assigning parameters and interconnecting the blocks	You can assign parameters and interconnect the block inputs and outputs to other blocks, nested charts, or to shared addresses. You can specify textual interconnections at block/chart inputs whose interconnection target is not yet in the chart folder. These interconnections remain open until the referenced interconnection partner exists, and the interconnections are then closed with a menu command. Interconnecting means that values are transferred from one output to one or more inputs during communication between the blocks or other objects.
6	Adapting the runtime properties	The runtime properties of a block determine how the block is included in the processing of the entire structure on the CPU. These properties are decisive for the response of the target system in terms of reaction times, dead times, or the stability of time-dependent structures, for example, closed loops. When it is inserted, each block is assigned default runtime properties. A block is installed in an OB task for this at a position you have determined. You can change the position at which the block is installed and other attributes later if necessary.

Step	What?	Description
7	Compiling the CFCs	During compilation as a program, all the charts of the active CPU are converted to machine code (compiler). If you compile as a block type, only the individual chart is compiled.
8	Loading the CFC program	After compilation, you can download the CFC program to the target system (automation system).

Rules for the interaction between CFC and SIMATIC Manager

When working with the SIMATIC Manager, remember the following points:

- You can only delete charts, chart folders, and projects in the SIMATIC Manager when no chart in the particular chart folder or project is currently being edited in CFC.
- Removable data media cannot be configured as the storage location for projects with CFCs, neither using the menu command **New Project** nor **Save Project As...**.

Additional information

- Online help on CFC
- Manual *CFC for S7; Continuous Function Chart*
- Getting Started *CFC for S7; Continuous Function Chart*
- You can find information on versioning in the section "Versioning CFC and SFCs (Page 652)"
- You can find information on access protection in the section "How can the plant be protected from unauthorized access? (Page 36)".

9.15.3.2 How to create a new CFC

Introduction

The project structure is specified when you create the plant hierarchy. Here, you will find all CFCs. The assignment to the plant sections is specified in the plant view.

Requirement

A project with an S7 program has been created in the SIMATIC Manager.

Procedure

1. Select the desired hierarchy folder in the plant view of the SIMATIC Manager.
2. Select the menu command **Insert > Technological Objects > CFC**.
   A blank CFC with a default name is created. A new CFC consists of a chart partition with 6 sheets without further chart partitions.
3. Change the name according to your requirements.

   Note

   The chart name may not exceed 22 characters. The name may not contain the following characters: \ / . " %

Chart-in-chart method

You can provide a CFC with chart I/Os so that it can be inserted into other charts and interconnected with any blocks or CFCs. By using the chart-in-chart method, you are creating nested charts.

A chart without chart I/Os can also be inserted into a different CFC. This may be the case, for example, if you prefer to create the chart I/Os at a later time.

Additional information

- Section "How to define CFC I/Os (Page 446)"
- Online help for CFC
- Chart-in-chart method: Manual *Process Control System PCS 7, Getting Started - Part 2*

9.15.3.3 How to insert additional blocks into the CFC

Introduction

When inserting a block, select a block type in the master data library or in the block catalog and then place it into the CFC. The block will then be assigned a name that is unique within the chart. The block that is inserted is an instance of the block type. You can create any number of block instances from each block type.

Note

The comment of the block type is not included in the block instance. The comment field does not accept an empty value.

Procedure

1. Select the CFC in the SIMATIC Manager.
2. Select the menu command **Edit > Open Object**.
   The CFC opens in the CFC editor. A new CFC consists of a chart partition with 6 sheets without further chart partitions.
3. Select the "Libraries" tab in the block catalog.
   Here, you can also see the master data library.
4. Select the block type you want to insert from the master data library and drag into the chart.
   An instance of the block type is created in the CFC.
5. Insert further blocks into the CFC in the same way.

The runtime properties of a block are predefined. If necessary, you can change the runtime properties: You can find additional information about this in section "Runtime groups and runtime properties (Page 439)".

Searching for blocks

You can search for a block by specifying a block name in the input field of the block catalog and then searching for it using the "Find" button (binoculars). If the text you entered is not found as a block name, CFC searches for a block with a corresponding comment. The folder containing the block opens and the block is selected.

Use the check box "Search for initial letter" to choose between two different search modes:

- free search (default)
  The program searches for a specific part of the name or comment.
- restricted search
  The search begins with the initial letter.

The block catalog in the CFC Editor

If the block catalog is not open, open it with the menu command **View > Catalog**.

You can see the following three tabs in the block catalog :

Tab	Description
Blocks	Here, the blocks are sorted according to block families. You also find the blocks which are in use, below the name of the S7 program.
Charts	Here, you can find all the charts that you have created in the chart folder of the S7 program. A small open folder icon is used to symbolize the chart which is open in the CFC Editor.
Libraries	Here, you can normally find all the libraries provided by PCS 7 along with your master data library. Hide all the libraries that you do not need for project engineering by using the ""Hide" function (see Section "Using Libraries (Page 286)"). The master data library is always displayed.

Additional information

- Online help on CFC

9.15.3.4 How to assign parameters to and interconnect the blocks

Block I/Os

Each block has a number of different I/Os.

The I/Os of a block can be "visible" or "invisible": You can only see any "invisible" parameters in the properties of the block but not in the representation in the CFC.

Use the properties of the block to specify which I/Os in the CFC will remain visible or hidden. If connections interconnected to a block are switched invisible, this is indicated by a small triangle in the block header.

Procedure

1. Select the block in the CFC and then select the menu command **Edit > Object Properties...**.
   The "Properties - Block" dialog box opens, and the "General" tab is active.
2. Enter a unique name for the block instance in the "Name" box. The names of block instances must be unique in a CFC.

   Note

   The maximum length of a block name is 16 characters (for nested charts 22 characters). The name may not contain the following characters: \ / . " %

   ---
3. Open the "Inputs/Outputs" tab.
4. Here, you can set the parameters for all the I/Os of a block (values of the I/Os, visible/hidden, released for testing, relevant for archiving etc.).
   The "Name" column lists the names of all inputs and outputs.
   Click the column heading of the table as a simple way of finding an I/O: The column is sorted in ascending or descending order.

   Note

   If you change units or operator texts, these are no longer taken into account during block type importing.

   ---
5. Click "OK" once all the parameters have been assigned.
   The name is displayed in the CFC in the block header; parameters are assigned to the block.
6. Follow the same procedure to configure additional blocks in the CFC.
7. To interconnect, click on the required output of the block.

8. Click on the input of the block with which you want to interconnect the output.
   The CFC editor automatically creates a line indicating the interconnection.

   Note

   Steps 7 and 8 can be carried out in reverse sequence.

   You can create further interconnections in the shortcut menu if the I/O is selected:

   - **Interconnection to address...**
   - **Interconnection to a runtime group...** (only for data type BOOL)

9. Make the other parameters settings and create the interconnections in the same way.

   Note

   Select a connection line to facilitate follow-up. The line blinks in a different color in both the chart and in the chart overview.

   Click on the chart to stop the blinking.

Configuring archive tags

Block I/Os intended for operator control and monitoring can be marked for archiving in WinCC. You make the setting in the "Inputs/Outputs" tab in the "Archive" column.

Possible identifiers are:

- No archiving
  The value of the connection is (no longer) to be archived.
- Archiving
  The value of the connection are to be archived on an OS.
  This setting also applies for archiving to an archive server.
- Long-term archiving
  The values archived on the OS are to be stored for long-term archiving on a archive server.

The interconnections marked as relevant for archiving are created as archive tags when the OS is compiled and, if it does not already exist, a process value archive with the name "Process value archive" is created. This is where the archive tags are stored.

Interconnecting with process pictures

When you create the process pictures, you can interconnect the I/Os of the blocks from the CFCs with objects in the process pictures. The tag name is formed from the plant hierarchy, the CFC name, and the block name. You can find the name again as part of the tag name. The values of the inputs/outputs are entered.

After compilation, you will find the tag names in the WinCC tag management. When you compile (with the option active), the block icons are created in the pictures and the block instances interconnected to the mimic diagrams.

Additional information

- Online help on CFC
- Interconnecting with process pictures: Manual *Process Control System PCS 7, Getting Started - Part 2*
- Archive tags: Configuration manual *Process Control System PCS 7; Operator Station*

9.15.3.5 Runtime groups and runtime properties

Creating runtime groups

A separate runtime group is automatically created for each CFC. All the blocks of a chart are inserted in the respective runtime group. This reduces the time required when compiling changes of the CFCs.

The run sequence can be optimized with PCS 7. You should only change any run sequence that was optimized in this manner in exceptional cases.

The sequence model ensures optimum support when configuring the run sequence, the multi-user use and therefore distributed engineering.

You can find additional information about this in the section "How to adapt run sequence (Page 444)".

Optimizing the run sequence

The "Optimize Run Sequence" function is used to optimize the program run sequence according to the data flow in order to reduce dead times to a minimum during program runtime in the CPU. OBs/execution levels (tasks) and runtime groups are optimized separately.

You can find additional information about this in the section "How to optimize the run sequence (Page 443)".

9.15.3.6 Runtime properties of blocks

Introduction

This section describes some of the basics required to understand the runtime properties of blocks.

Runtime properties

The runtime properties of a block determine how the block is executed in the run sequence within the entire structure of the CPU. These properties are decisive for the response of the target system in terms of reaction times, dead times, or the stability of time-dependent structures, for example, closed loops.

The runtime properties of the blocks have default settings that can be adapted individually for each block.

When it is inserted, each block is assigned default runtime properties. This is achieved by installing the block in a task (OB) within the run sequence. The tasks form the interface between the operating system of the CPU and the S7 program. Blocks can also be installed in runtime groups that are themselves installed in tasks (OBs).

Note

When you create a new chart, a runtime group is created automatically in which all the blocks of this chart are integrated.

Runtime groups

Runtime groups are used to structure or split tasks (OBs). The blocks are installed in sequential order in the runtime groups. Runtime groups allow, for example, individual handling of the blocks of a CFC.

You can do the following with runtime groups:

- Activating and deactivating selected blocks within an OB
  If a runtime group is deactivated, the blocks it contains are no longer passed through. Runtime groups are activated or deactivated using a block output of the "BOOL" data type.
- Process selected blocks with a specific reduction ratio (after a specified number of cycles and/or with a phase offset) to achieve better load distribution on the CPU.
- If OBs contain a large number of installed blocks, these can be grouped into smaller units.
  Advantage: Instead of creating one "large" FC when you compile each OB, "smaller" FCs are created depending on the number of runtime groups.
  If the program is modified later, only the runtime groups/FCs that actually contain modified blocks are given the "modified ID".
  This means a subsequent compiling of changes and online download of changes can be executed in significantly less time.

  Note

  For the reasons listed above, make sure that you do not install too many blocks in an OB or in a runtime group. Only then will you see a noticeable improvement in performance when you compile or download changes in comparison to compiling and downloading the entire program.

  You must also take into account the startup OB (OB 100), the error OBs (OB 8x) and any special OBs you may use.

Insertion point

When you insert a block, the insertion point of the block in the run sequence is fixed.

The default rule is as follows: The block is inserted after the block displayed in the status bar of the CFC.

The following is displayed in the status bar (alternative):

- When you first create a chart, the default of the specific target system
- The last new block to be inserted (color marking: black text on a light green background)
- The block specified by the run sequence

The current insertion point is displayed to the right in the status bar. It displays the task name (OBx), the chart and block name after which the next block will be installed in the run sequence when a block is inserted in the CFC.

Displaying runtime properties

You have the following options for obtaining information about runtime properties:

- For an individual block
- For the entire CPU

Runtime properties of individual blocks

The runtime properties of each block are displayed in the part of the block header on a colored background.

- Top row: Name of the task in which the block is installed
- Bottom row (to the left of the slash): Position of the block or runtime group in the task
- Bottom row (to the right of the slash): If the block is installed in a runtime group, the position of the block in the runtime group; otherwise "-"

If a block is installed more than once, information is displayed for only one insertion point of this block; this is the insertion point in the task located first alphabetically.

The block header can also include additional color symbols at the top left that indicate the processing status of the block:

- Yellow exclamation mark against a red background -> not being processed
  For example, EN input is static 0.
- Black question mark against a yellow background -> processing unclear
  For example, EN input is interconnected.

A double-click on the field shown above in the block header launches the processing sequence of the block. In the processing sequence, you can change the runtime properties of the blocks directly. You can find additional information on this in the section "How to adapt the run sequence (Page 444)".

Runtime properties of all blocks of a CPU

For a complete overview of the run sequence, select the menu command **Edit > Open Run Sequence** in the CFC Editor (you can also edit the run sequence in this window), or the menu command **Options > Chart Reference Data** in the "Run Sequence" window.

Additional information

- Online help for CFC

9.15.3.7 Setting up AS-wide interconnections

Overview

You can use the CFC Editor to set up interconnections to partners located on other automation systems. This is a so-called AS-wide interconnection.

These interconnection partners are always block I/Os or I/Os of hierarchical charts.

Requirements for AS-wide interconnections:

- The PLCs involved are located in a common project or multiproject.
- The network has already been configured.
- The charts containing the interconnection partners are open in the CFC Editor.

Setting up AS-wide interconnections

You make the interconnection as you would for a chart-wide interconnection.

To do this, open both charts and arrange them in the CFC in such a way that you can connect the source to the destination, in other words, click on the I/O to be connected in one of the charts and then click on the I/O partner in the other chart.

For connections, an interconnection line is drawn to the sheet bar. The AS-wide interconnection is marked as a green triangle in the small field of the sheet bar. The project/station/CPU type or hierarchical path and chart name/block/connection is entered in the large box.

Configuration steps for the associated communication

An S7 connection is created automatically in NetPro for each AS pair for which an AS-wide interconnection has been created.

Once you have created AS-wide interconnections, you need to compile and load the affected S7 programs.

The blocks required for the data transfer are made available and loaded by the engineering system when loading is performed.

These blocks are not instanced in the chart and cannot be seen in the catalog.

The data transfer is called directly from the corresponding OBs of the AS (OB1, OB3x). The handling instructions are located in special DBs created by the code generator and transferred from the loader to the CPU.

Additional information

- Online help on CFC

9.15.3.8 How to optimize the run sequence

Note

When you insert blocks in the CFC, they are automatically installed in the run sequence.

Procedure

1. Start optimization in the runtime editor with the menu command **Options > Optimize Run Sequence...**;
   for selected tasks or runtime groups in the shortcut menu with the menu command **Optimize Groups/Tasks...**.

With this function, you can optimize the run sequence of a program based on the data flow. This keeps the dead time to a minimum while the sequence is running in the CPU. Tasks and runtime groups are optimized separately.

Selecting single elements

Enable the elements for optimization in the runtime editor or exclude them. You can choose the selected task from your object properties. An extra symbol is used to identify the selected element in the runtime editor (blue circle with slash).

The following optimizations can be carried out:

- You optimize an entire task including all enabled runtime groups (setting: OB/execution level and runtime groups). This is the default setting.
- You only optimize the enabled runtime groups of a task (setting: Runtime groups only).
- You exclude the entire task - including the runtime groups it contains - from the optimization (setting: None).

The release of an **individual** runtime group for optimization can be set under object properties for each runtime group by activating the "Optimize run sequence" check box (default). Individual runtime groups are excluded from optimization when you deactivate this check box.

Rules

- The content of runtime groups, created by the driver generator ("Generate Module Drivers" function) (@......), is not optimized since the correct order is already set here.
- If optimization is executed after creating the module drivers, there is no guarantee that the runtime groups of the driver blocks are in the order specified by the driver generator. The module driver is therefore restarted during the next compilation (the "Create module driver" check box is selected).

What happens during optimization?

All tasks are optimized separately. The runtime groups of a task are treated separately. The reduction ratio and phase offset of a runtime group are not taken into consideration.

The data flow is determined by the number of interconnections. These include all block-block interconnections as well as those to SFCs and interconnections of block outputs to ENABLE a runtime group.

The following interconnections are ignored:

- Global and textual interconnections
- Interconnections to blocks located in other tasks
- Access from SFCs to block I/Os located in other tasks
- Interconnections to the chart interface are taken into account up to the actual interconnection source. If this does not exist, which means the interconnection ends at an interface, this interconnection is ignored.

Interconnections into a runtime group or out of a runtime group are considered to be interconnections of the runtime group itself. The runtime group forms a virtual block at task level. Interconnections between internal blocks of a runtime group are only used for optimization processes within the runtime group. This ensures the correct arrangement of the actual runtime groups and an optimal position of the runtime group itself within the task.

Changes are only carried out if they are necessary during subsequent optimization. Consequently the amount of changes is kept to a minimum when compiling and downloading changes.

Note

If blocks are interconnected over INOUT parameters, the data flow may be reversed (from input to output). This is not taken into consideration when optimizing the run sequence.

Remedy: In this case, you have to optimize the run sequence manually and remove the corresponding runtime group from the optimization.

Note

During cascaded interconnections and other connections with several return jumps, deactivate runtime group optimization at the runtime group.

9.15.3.9 How to adapt the run sequence

Introduction

Blocks are automatically inserted into the chart in their run sequence. The insertion point is determined in "Predecessor for installation". Certain blocks are also installed more than once in tasks depending on the entry in the task list assigned to the block type by the system attribute (S7_tasklist). Blocks with startup characteristics, for example, are also implemented in OB 100.

You can see the other tasks in which the block is installed in the dialog box of the properties, under the "To be inserted in OB/tasks" group in the "General" tab.

Installation pointer

Installation pointers determine the installation position for the next runtime unit of the run sequence. These are the different pointers:

- Chart installation pointer
- Block installation pointer

Procedure

1. Start the run sequence editor in the CFC Editor with the menu command **Edit > Open Run Sequence.**
   Here, you can make the following adaptations:
   - Move objects (SFC, runtime group or block)
   - Removing a block
   - Inserting blocks
   - Customizing installation pointers

Moving objects

You move an object by selecting it (SFC, runtime group, or block) in the right or left window and then dragging it to the object after which you want to install it.

The following takes place after an object is dropped onto a runtime group:

- The object is installed at the first position within the runtime group when the structure is expanded [-].
- The object is installed after the runtime group if the structure is not expanded [+].
- If the runtime group is empty, you will be asked whether or not to install the block within the runtime group. If you answer with "yes," it is installed inside the runtime group; if you answer with "no", it is installed after the runtime group.

When you drag an object to a task, it is installed before the objects already installed.

Note

Ensure that all the blocks of a chart are located exclusively in the corresponding runtime group when moving blocks. After moving a block to another group, the chart-oriented structure no longer exists and would make it difficult or even impossible to work on a chart-by-chart basis in engineering.

Removing a block

You can only remove (delete) blocks from a task if it is installed more than once in the run sequence. At least one insertion point must be retained.

If this was the only block installed, it will not be deleted. Otherwise, the block is deleted and the run sequence of the next blocks is adapted accordingly.

Inserting blocks

You can also install blocks, runtime groups, or SFCs more than once by copying and pasting. Use the following functions for this purpose:

- The corresponding menu commands
- The toolbar icons
- With drag-and-drop and the <Ctrl> key pressed
- While displaying the CFC, drag them from a CFC to the required place in the run sequence.

> **Note**
>
> Objects with the system identifier "@" are automatically installed in the run sequence while the module drivers are created. They may only be edited in the SIMATIC Manager with the menu command **Options > Charts > Generate Module Drivers...**. Do not delete or move these objects manually.

Customizing installation pointers

You can modify the installation pointers as follows:

- Chart installation pointer (default OB 35)
  In the **run sequence editor** select the required OB or a block from the OB level (not within a runtime group) or a runtime group within the OB.
  Select the **Edit > Predecessor for Insertion Position** menu command in the runtime editor.
- Block installation pointer
  You cannot set up the block installation pointer in the runtime editor.
  In the **CFC Editor** select the block after which all other blocks are to be installed.
  Select the **Edit > Predecessor for Insertion Position** menu command in the chart.

If the block specified as the predecessor for installation is deleted, the block installation pointer is set to the block installed before the deleted block. This also applies if the block is moved to a different chart. The block installation pointer in the target chart is not changed. The moved block retains the insertion position it had in the previous chart.

Additional information

- Online help for CFC

9.15.3.10 How to define the CFC I/Os

Introduction

You can add I/Os to a chart, for example, for the following uses:

- Insert into a different chart and interconnect with other charts or blocks (chart-in-chart method).
- Compile chart as block type

There are two different procedures for creating chart I/Os:

- Create unassigned chart I/Os followed by interconnection
- Create chart I/Os with the interconnection

Creating unassigned chart I/Os followed by interconnection

In the first step, you create the I/Os for a chart without reference to any parameters (for example, because the chart does not yet contain blocks and/or nested charts). You assign the names, attributes, and defaults to the chart I/Os.

In the second step, you place the blocks/charts in the chart, interconnect them and then assign the I/Os of the objects in the chart to the chart I/Os.

1. Select the menu command **View > Chart I/Os**.
   The window for editing chart I/Os opens and is "docked" to the upper section of the chart window.
2. In the hierarchy window on the left, select the desired I/O type (IN, OUT, or INOUT).
3. In the detail window on the right, edit the empty declaration line for the corresponding I/O type (name, data type, initial value, comment).
   Select the data type from a drop-down list.

   Note

   If you use this method, the attributes (for example, S7_m_c) of the block I/O are not applied. You must then assign the attributes to the chart I/Os yourself.

4. Use drag-and-drop to drag a block/chart I/O to a chart I/Os with a compatible data type.

As an alternative with existing chart I/Os,

assign the I/Os of the blocks placed in the chart and/or nested charts to the existing chart I/Os without needing to open the chart I/Os window.

1. Mark the I/O and select the menu command **Insert > Interconnection to Chart I/O...**.
   A dialog box opens containing a list of all the available I/Os for the relevant I/O type.
2. Select the required chart I/O and click "OK".

   Note

   You can only assign unconnected I/Os with a compatible data type.

Creating chart I/Os with the interconnection

In the first step, you create the actual chart. To do so, you insert and interconnect blocks/charts.

In the second step, you open the window of the chart I/Os and define the chart I/Os by connecting them to I/Os of blocks/charts placed in the chart. A new row is created and all the properties of the connected I/O are applied to the connected I/O (name, attribute and initial value). If naming conflicts occur, for example, because the same names are used in different blocks, the name is made unique in the chart I/O by incrementing it.

1. Select the menu command **View > Chart I/Os**.
   The window for editing chart I/Os opens and is "docked" to the upper section of the chart window.
2. In the hierarchy window on the left, select the desired I/O type (IN, OUT, or INOUT).
   The rows with I/Os are displayed in the detail window on the right (it is still empty if you still have to create new chart I/Os).
3. In the working area of the chart, select the required I/O of the block/chart and drag the I/O to the right window of the chart I/Os to the "Name" box.
   The I/O is applied including all of its properties.
   Exception: interconnected I/Os are not reassigned.
4. Follow the same procedure for all other I/Os of the blocks/charts in the chart which you want to interconnect with the chart I/Os.

If you drag an **I/O that already exists in the chart I/Os** with drag-and-drop back to an empty line in the chart I/O window, the name automatically has a number added to it making the I/O name unique.

If you drag an **internally interconnected I/O** (input) with drag-and-drop onto a new line, a copy is created and no interconnection to the internal I/O is made.

Representation in the sheet bar

The sheet bar displays the I/O names and comments, I/O type, and data type applied to the chart I/Os. The "interface I/O" type of interconnection is indicated by a small white triangle above the interconnection line.

Note

If an I/O that is interconnected with the chart interface is hidden, there is no sheet bar entry. These interconnections can only be recognized in the object properties of the block ("Interconnection" column of the "I/Os" tab).

Changing chart I/O names

The chart I/O name does not need to include the name of the assigned block I/O; you can rename it. To do so, select the name in the "Name" box and enter a new one. As an alternative, you can double-click on the start of the chart I/Os' line in the right window and enter the new name in the "Properties" dialog box.

Assigning system attributes

Just like the block I/Os, you can also assign system attributes to the individual chart I/Os.

The following applies:

- If an I/O is re-configured by dragging it to define it as a chart I/O, it applies the system attributes of the block I/O.
- If a predefined chart I/O is interconnected with a block I/O, you must define the system attributes yourself; they are not applied from the block I/O.

A chart with chart I/Os does not have system attributes itself (apart from those of the I/Os).

Assigning I/Os when the charts are already placed

You can also extend a chart with chart I/Os later by adding further chart I/Os. If the chart is a nested chart, in other words, a chart that is already placed in another chart, the added I/Os may cause positioning conflicts. In this case, the nested chart is displayed as an overlapping chart (just like an overlapping block): light gray and without I/Os. The I/Os and the interconnections are made visible if the chart is placed at a free location.

If you have already placed a chart within the chart and interconnected it and have subsequently changed the original chart (for example, by adding an additional I/O), then drag the modified chart over the original chart. The old chart is replaced by the new one. The existing interconnections are retained.

Additional information

- Online help for CFC

9.15.3.11 Configuring logical operations

Logical operations are used in automation systems to implement control signals. The most important applications for logical operations are logical operators for the following functions:

- Permit
- Protection
- Interlock

As of PCS 7 V8.2 you can implement logical operations in objects. These objects are referred to as **Logic Matrix** below. The Logic Matrix Editor is the tool for creating and optimizing the logical operations in PCS 7.

Functions in the Logic Matrix Editor

- Creating the Logic Matrix
- Adapting the Logic Matrix
- Transferring the configured Logic Matrix (CFC, library: APL with blocks for the Logic Matrix)
- Import/export functions for processing of mass data

Compiling Logic Matrix

By compiling the Logic Matrix, charts with special blocks are created in the CFC.

Blocks for the Logic Matrix in the CFC:

- LM_Cause
- LM_Matrix
- LM_Effect

Basic steps for processing mass data

1. Insert a Logic Matrix in the PCS 7 project in SIMATIC Manager.
2. Specify access parameters in the Logic Matrix Editor:
   – Causes (input tags)
   – Effects (output tags)
   – Logical operations (intersections)
   – Connections (Links)
3. Export Logic Matrix
4. Edit .ods file (e.g. with EXCEL)
5. Import Logic Matrix
6. Generate CFCs with logical operations from matrices
7. Compile and download program

Operate and monitor Logic Matrix

- OS picture objects for the Logic Matrix are compliant with the design of the APL library
- Alarm and maintenance functions of PCS 7 OS are supported
- Web client is supported

Additional information

- Configuration manual *Process Control System PCS 7; PCS 7 - Logic Matrix*
- Section "Editing mass data (Page 526)"

9.15.3.12 How to compile the CFCs

Introduction

CFCs must be compiled into a code that the CPU of the AS can understand. Since compilation always includes all the charts of an S7 program, you should only start at the end of the compilation.

Procedure

1. Select the menu command **Options> Customize > Compile/Download...** in the CFC Editor.
2. Define the settings for compilation.
   You can find additional information on this topic in the section "Settings for compilation".
3. Select the menu command **Chart > Compile > Charts as Program....**
   The "Compile program" dialog box appears.
4. Select the following check boxes if necessary:
   – Generate module drivers
     (for additional information, refer to the online help)
   – Generating SCL source

   Note

   If you do not want to use the blocks of the current PCS 7 library, you can use the "Module Driver Settings" button to open a dialog box in which you can select the desired drive library.
5. Click "OK".

Function "Generate Module Drivers"

The "Generate module drivers" check box is set active in the default setting, meaning that the driver generator is also called up before every compiling procedure.

In special cases, such as incomplete hardware, you can deactivate the check box so that the "Generate Module Drivers" function is not executed. The total time of compiling is then reduced.

If the "Generate Module Drivers" function is activated, the module drivers for the existing signal-processing blocks are created by the driver generator and interconnected with them prior to the compiling process.

You can find additional information on this topic in the section "How to generate module drivers (Page 469)".

Settings for compiling

Use the menu command **Options > Customize > Compile/Download...** to open the dialog box which contains information about the resources used in conjunction with compiling charts. The following can be specified:

- The warning limits to be applied so that possible dangers are detected before downloading.
- The resources to remain unused during compilation of the charts of the current chart folder. This can, for example, be useful if you want to solve an automation task partly with charts and partly by programming (for example, STL, LAD or SCL programs) and when you have functions (FCs) or data blocks (DBs) from other sources in your user program.

You can also view the statistics showing how many resources (DBs, FCs) in your CPU are available for compiling the charts and how many are already being used.

Note

If you only work with CFC and SFC in your program, you can leave the standard compilation settings unchanged.

You can find an overview of the blocks generated during compilation in the online help.

Central function "Compile and download objects"

Note

Central compiling and downloading of all objects can be executed in the SIMATIC Manager with the menu command **PLC > Compile and Download Objects...**. This dialog box lists all the objects of the multiproject that can be compiled or downloaded.

The hardware configuration must be downloaded to the CPU before this function can work (initial commissioning of the automation system).

You can find additional information on this in the section "How to download to all CPUs (Page 612)".

Additional information

- Section "How to download CFCs to the CPU (Page 454)"
- Section "Downloading to all CPUs (Page 612)"
- Online help on CFC

9.15.3.13 How to compare the CFCs before downloading

Introduction

During configuration, testing and commissioning, there is often the need to compare a new/changed CFC with the previously loaded version before downloading it.

Requirement

Before the initial download in the CFC Editor with the menu command **Options > Settings > Compile/Download...**, activate the check box "Generate image of downloaded program for comparison" in the "Settings for Compiling/Downloading" dialog box.

Procedure

1. In the CFC Editor, select the menu command **Target system > Download...**.
2. Click "Show Changes".
   The Version Cross Manager opens and the image created by the previous download (see section "Requirements") is compared with the version to be downloaded and displayed accordingly.

   Note

   The "Show Changes" button is only enabled when the "Version Cross Manager" add-on package is installed and an image has been generated for the loaded program.

3. Go back to the "Download" dialog box.
4. Click "OK" or "Cancel".

Additional information

- Online help for CFC

9.15.3.14 How to load individual changed charts into the CPU

As of PCS 7 V8.1, it is possible to selectively download changes to charts of an AS to the CPU.

Note

Preparing multiple changes

You can use the "Selective Download" menu command to selectively apply adaptations and minor chart changes to the AS. Avoid preparing a large number of changes across charts and downloading these changes to the CPU using the menu command "Selective Download".

Requirements

- Configuration and download status of the CPU must match before starting the changes.
- The following program sections remain unchanged:
  - Fail-safe program sections
  - Hardware (without CIR)
- The system has not blocked the download of changes.
  You can find information on this in the explanation of the icons in the chart folder in the SIMATIC Manager.

Procedure

1. Decide which charts you want to load. You have the following options to select the charts you wish to load:

Possible selection	Preselected charts in step 3
Select the hierarchy folder in the plant view.	All modified charts in the hierarchy folder are displayed. All charts are preselected.
In the component view, select the chart folder of the AS.	All modified charts in the chart folder are displayed. No chart is preselected.
In the component view, mark multiple modified charts in the chart folder of the AS.	All modified charts in the chart folder are displayed. All marked charts are preselected.
In the component view, select a modified chart in the chart folder of the AS.	All modified charts in the chart folder are displayed. The marked chart is preselected.

2. Select the menu command **Options > Charts > Selective Download.**
   The "Selective Download" dialog box opens.
3. Select the check box for the desired charts.
4. Make the desired settings for generating the module drivers and SCL sources.
   You can find information on this in the help for the dialog window.
5. Click "OK".
   The charts are compiled and downloaded.
   The log dialog opens when processing is completed. You can find information in the individual tabs about the actions performed.

9.15.3.15 How to download CFCs to the CPU

Introduction

After compiling the charts, download them to the CPU and view the process rate in test mode afterwards.

The program is downloaded to the CPU assigned to the active chart.

Requirement

There must be a connection between the CPU and your programming device/PC.

Procedure

1. Select the menu command **CPU > Download...** in the CFC editor.
   The "Download to CPU" dialog box opens in which you can determine the type of download.
2. Select the scope of the download. You can find additional information on this in the "Options for compiling and downloading (Page 617)" section.
3. Click "OK".
   If you have already made download-relevant changes to the user program prior to the download, a message dialog opens. The message informs you that the program must be compiled. The message dialog offers the "Compile" function followed by the download.

   Note

   To maintain the consistency of the configuration data and the CPU data, the changes must be loaded to the CPU.

   You have the following options to perform this function for loading the changes:
   - From the CFC editor:
     Menu command **CPU > Download…**
   - From the SIMATIC Manager
     - Select the chart folder in the component view:
       Select the menu command **CPU > Download**.
     - Select the multiproject, project or SIMATIC station:
       Select the menu command **CPU > Compile and Download Objects...**.

Additional information

- Section "How to compile CFCs (Page 450)"
- Section "Downloading to all CPUs (Page 612)"
- Section "How to load individual changed charts into the CPU (Page 453)"
- Online help on CFC

9.15.3.16 How to test CFCs

Test mode

The CFC Editor provides test functions that support the commissioning process. These are used to monitor the mode of operation of the sequential control system in the AS, to influence it and change setpoints, if necessary. For this purpose switch the CFC Editor into a test mode.

Operating modes of the test mode

The test mode refers to the CPU which involves the active chart. As an alternative you can test in two operating modes:

Operating mode	Description
Process mode	In process mode, the communication for online dynamic display of the CFCs and CFC instances is restricted and causes only minor additional load on the CP and bus. If an overload occurs in process mode, a message is displayed indicating that the limit of the bus load has been reached. In this case, you should stop the test mode for the CFCs that are not absolutely necessary for the test. When test mode is activated, all blocks have the status "Watch Off".
Laboratory mode	Laboratory mode allows for convenient and efficient testing and commissioning. In contrast to process mode, communication for online dynamic display of CFCs is unrestricted in laboratory mode. When test mode is activated, all blocks have the status "Watch On".

Requirements

- There must be a connection between the CPU and your PC.
- The program has been downloaded.

Activate/deactivate test mode

1. Select the required operating mode with the menu commands in the **Test** menu:
   - **Test > Process Mode**
   - **Test > Laboratory Mode**

   Keep in mind that it is not possible to switch the type of test used while in test mode.
2. Select the menu command **Test > Test Mode** in the CFC.
   Test mode is activated.
3. Select the menu command **Test > Test Mode** once again in the CFC to stop the test mode.

Troubleshooting

From within the CFC, you can open the block type associated with the block instance. Mark the required block in the CFC and select the menu command **Edit > Go To > Block Type**.

If the source file of the block is included in the project, the tool used to create it (LAD/FBD/STL or SCL) opens and the block type can be edited.

If the source file is not included in the project, LAD/FBD/STL is still opened. You can then only read the block information (exception: The system attributes of the I/Os can be edited).

If an SFC instance is marked in the CFC, it is opened in the SFC editor (the associated SFC type can be opened in the SIMATIC Manager or in the SFC editor).

Additional information

- Online help for CFC
- Manual *Process Control System PCS 7, Getting Started - Part 1*
- Manual *CFC for S7; Continuous Function Chart*

9.15.3.17 How to use the "Forcing" function for block I/Os

The "Forcing" function

During commissioning, you can simulate a variety of values for an interconnection by permanently overwriting the value of an interconnection with a forced value.

During forcing, the interconnections between the blocks are temporarily removed and force values are assigned to the corresponding inputs (IN or IN_OUT) of these interconnections.

Forcing involves replacing the value at the block input normally supplied by the interconnection with the "forced value". Such forcing can be activated and deactivated at the input of the block instance at any time.

For performance reasons, not all block inputs can be allowed to support forcing from the outset. You specify which inputs can be forced in the configuration of the CFC or in the process object view. If the attributes "Add forcing" and "Forcing active" are changed at the input after the program is compiled, the program needs to be compiled and loaded again.

A maximum of 8192 standard and 8192 F I/Os can be forced.

Note

If the maximum number of force parameters are registered and downloaded, a download of changes must be carried out after the parameters have been deregistered in order to re-approve the parameters in the CPU as well. Only after the download of changes can new or different force parameters be registered.

Note

If you activate forcing at the chart folder, the program will need to be recompiled and downloaded (compilation of the entire program).

Settings for forcing

Forcing is controlled by the following attributes:

- "Support forcing"
- "Add forcing"
- "Forcing active"
- "Force value"

Procedure

The use of these attributes is enabled with the corresponding check boxes in the SIMATIC Manager and CFC.

In the SIMATIC Manager in the object properties of the chart folder in the "Advanced" tab:

- "Support forcing" check box This enables the force function and the corresponding options in the CFC and the process object view.

In the CFC in the object properties of the block input:

- "Add forcing" check box This enables or disables "Forcing" at this input. Each change requires the program to be compiled and loaded again. This option cannot be changed in test mode.
- "Forcing active" check box When this check box is selected, the value of the interconnection is permanently replaced by the force value. The value of the interconnection becomes active again when forcing is disabled. A change in test mode does not require recompiling.
- "Force value" text box Enter a value here to be applied to the block input if the options "Add forcing" and "Forcing active" are enabled. A change in test mode does not require recompiling. At an INOUT, the force value is also written to the output of the interconnected block.

Alternative procedure

If the "Support forcing" option is activated for the chart folder, you can proceed as follows:

1. You can make settings for multiple block inputs in the CFC. The corresponding columns for the force function are available in the "I/Os" tab of the block object properties.
2. In the process object view, you can make the settings for the desired inputs for all blocks in the project. The corresponding columns for the force function are available in the "Parameters" and "Signals" tabs.

Representation

The interconnection of the forced input is identified in the CFC by means of a colored rectangle at the block input:

- A green rectangle means: "Add forcing" is activated
- A red rectangle means: "Add forcing" and "Forcing active" are activated.

Note

Colored rectangles are only visible for interconnection, as forcing is only possible for interconnected parameters.

In test mode, the force value is distinguished from the other dynamic values by a different background color. The default setting is "light blue" and can be changed in the "Color Settings". (**Options > Settings > Colors...**). Only the first element of a structure is shown in color. Other elements are not visible.

The background color of the force value is identical to the representation in the chart.

Note

All force settings will be lost if a CPU cold restart is performed while forcing is activated. However, the settings will be retained in the offline program. To restore consistency between the offline and online programs, disable "Support forcing" at the chart folder, compile and download the data, re-enable "Support forcing" at the chart folder and once again recompile and download the data.

Although connections with textual interconnections can be registered for forcing, this does not have any effect in test mode.

Message to WinCC with active forcing

In the case of forcing, a new system chart @FRC_CFC is automatically installed with a runtime group of the same name in OB1 during compilation. The message block FRC_CFC is added to this chart, as well as being added to the OB100. This block triggers an incoming message for WinCC if "Forcing active" is set at a parameter. The block triggers a corresponding outgoing message after "Forcing active" has been disabled again. The "Active" control option of the @FRC_CFC runtime group specifies that the block should only be executed after the "Forcing active" function has changed.

If forcing is disabled, the block, the system chart, and the runtime group are removed again from the program the next time you compile and download.

Data types

The following data types can be forced:

BOOL, BYTE, INT, DINT, REAL, STRUCT, WORD, DWORD, DATE_AND_TIME

With the STRUCT data type, only the first level of the structure can be forced. Chart inputs/outputs cannot be forced.

Note

If an EN input or the input of an FC or BOP is registered for forcing, parameters can be set for this input in test mode, making it capable of operator control and monitoring.

Additional information

- Online help on CFC

9.15.3.18 How to use the trend display in test mode

Trend display

The trend display is a tool in the CFC editor that allows you to track the values of one or more signals on a CPU qualitatively over time. The trend display shows the signal continuously over time while it is being recorded. The trend display works with any target system that supports normal online operation.

Rules for the trend display

- Only one trend display can be active in the trend display window at any one time.
- A maximum of 12 values can be recorded simultaneously.
- For each CPU, you can create and manage any number of trend display data records. Each display is given a name that must be specified when it is created (this can be changed).
- Both simple numerical data types (BYTE, INT, DINT, WORD, DWORD, REAL) and Boolean values can be used.
- In the online display, it must be possible to make the value dynamic in the chart.
- In each display, the following data is saved in the chart folder:
  - The name of the display
  - The allocation of the channels
  - The acquisition parameters
  - The display parameters
  - The last curve recorded (if it exists)
- The acquisition cycle can be set in a range from 1 - 90 seconds.

Requirement

The test mode in the CFC Editor is activated for the current CPU.

Procedure

1. Open the trend display window for the desired CPU with the menu command **View > Trend Display**.
2. In the trend display group, click the "Rename" button and enter the desired name for the trend display.
3. Enter the number of measuring points for the time axis in the "Display" group.
4. In the "Recording" group, click the "Change" button and enter the current operating mode for the trend display and the abort conditions.
5. Click "Apply".
6. Open the CFC whose values you wish to display.
7. At the function block level, select the I/O name whose value you wish to display.

8. Click the menu command **Debug > Inputs/Outputs > Insert in Trend Display**.
   The window for the trend display opens.
9. Select the desired channel in the "Select Channel" dialog box and click "OK".
10. Open the Trend Display window. Enter the desired high and low limits here and then click "Apply".
11. Keep repeating steps 6 to 10 until you have finished inserting all the values you want to display into the trend display.
12. Click "Start" in the trend display.
    The selected values start to be displayed.

Export trend display

1. While the trend display is open, select the menu command **Options > Settings > Export Trend Data...**.
2. Enter the desired export format.
3. Click "OK".
   The current trend display is exported.

Additional information

- Online help on CFC

9.15.3.19 How to configure the AS runtime measurement

AS runtime measurement

To avoid runtime errors in new and modified configurations, we recommend that you monitor the execution time of the OBs. In the configuration described below, the warning limits can be set to any value. You can signal the warning limits via the PCS 7 OS.

The runtime is measured with the TIME_BEG and TIME_END blocks (subsequently referred to as block pair). In addition, you can require the MonAnL block for the warning limits.

WARNING

Please note the following warnings:

- All work on the process control system must be performed by trained service personnel.
- Always observe the plant-specific rules and government regulations when making changes to your system.
- Observe the plant-specific boundary conditions and adjust the work accordingly.
- Always bear in mind that changes in a system can impact other sections of the system.

Procedure

1. Create a new chart in CFC (runtime monitoring ASNo x).
2. Place a block pair in this chart - for in each cyclic interrupt OB.
   To view the cyclic interrupt OBs, select the menu command **Edit > Open Run Sequence**.
3. Connect the "TM" I/Os of a block pair.

Assigning blocks to cyclic interrupt OBs

1. Select a TIME_xxx block.
2. Select the menu command **Edit > Open Run Sequence**.
   The "Run Sequence Editor" dialog box opens.
   The selected block is highlighted in the tree view. The other block pairs can also be found in this OB.
   Move a pair of blocks into each of the cyclic interrupt OBs.
3. Place the TIME_BEG block as the first block in the cyclic interrupt OB.
4. Place the TIME_END block as the last block in the cyclic interrupt OB.
5. If you require warning limits, place and interconnect the MonAnL block.
6. Repeat step 3 through 5 for all blocks of the type TIME_BEG and TIME_END.

Assign names to the TIME_BEG and TIME_END blocks

Assign the names before distributing to the individual project editors:

1. Select a TIME_xxx block.
2. Select the menu command **Edit > Object Properties...**.
   The "Block Properties" dialog box opens.
3. Enter a symbolic name for the block in the "Name" field (for example, cyc36ob and cycob36 for the block pair for measuring the cycle time in OB36).
4. Click "OK".
5. Repeat step 1 through 4 for all blocks of the type TIME_BEG and TIME_END.

Display cycle time

1. Compile the chart which was created in step 1 and download the AS.
   In the online mode of the CFC, you will see the runtime of the OB at the TM_DIFF output of the TIME_END block.

Notes on troubleshooting

You can reduce the execution time of an OB by installing the runtime groups with reduction ratios and phase offsets, or starting blocks in other OBs.

If it is possible to increase the cycle monitoring time, then it can be carried out in HW Config (Properties of the CPU, "Cycle/Clock Memory" tab).

If there is a CPU stop due to failure of I/O components, the use of the SUBNET block can help. When an error OB (for example, OB 86, rack failure) occurs, the SUBNET block allows only the driver blocks that signaled the error to execute their routine. This reduces the execution time necessary.

Additional information

- Online help on CFC
- Direct help on the blocks: Click the "?" symbol in CFC and then the block header.

9.15.3.20 How to configure automatic displaying and hiding of messages in process mode

Introduction

The following section describes how to configure the automatic displaying and hiding of messages in process mode.

Requirement

- Configuring of the technological functions in CFC and SFC is completed.
- The block groups of the plant parts whose messages you want to hide are specified.

Procedure

1. Insert the "STRep" block into a CFC from the *PCS 7 Advanced Process Library*.
2. Connect the control signals from a process status logic that was created beforehand to the Status inputs (State 1 to max. State 32).
3. Open the plant view in the SIMATIC Manager.
4. Double-click the "Shared Declaration" folder.
5. Double-click the "Listings" folder.
6. Select the "Operating State" folder.
7. Select the shortcut menu command **Insert New Object > Value** and enter an object name to represent the state.
   Repeat this procedure for all states (state 1 to max. state 31).
8. Select the object name.
9. Select the **Edit > Object Properties** menu command and assign values to the individual states beginning with 1 (please do not use 0).
10. Open the process object view in the SIMATIC Manager.
11. Select the "Blocks" tab.
12. Enter a name for the "STRep" block in the "Block group" column.

    Note

    The name of a block group must be unique throughout the multiproject.

    The names of the block groups must differ from the names that were assigned as the OS area identifier.

    ---
13. Assign this name to all the blocks that are to belong to this group.

14. Now select the "Messages" tab.
15. Select the "Block group" entry from the "Filter by column:" drop-down list.
16. Enter the name of the block group in the "Display" input box.
17. Assign a status (Status 1 to Status 32) to all the messages of the displayed block group that you want to hide. The corresponding column names are replaced by the previous defining of the "Operating state".

Result

The signal assigned to a status input controls the displaying and hiding of all the messages that are assigned to this status.

9.15.4 PCS 7 license information

Introduction

In SIMATIC Manager you can call a function that identifies all objects configured and requiring a PCS 7 license. The result is displayed per license type in the "PCS 7 License Information" dialog box. This enables you to check whether the PCS 7 licenses that you purchased or intend to purchase are sufficient for your project, or ascertain the number of objects that are subject to licenses by which you can expand your project.

In the left box, all components installed which require a PCS 7 license are displayed.
In the right box the accompanying configured license objects are displayed.

PCS 7 components

The PCS 7 component list is determined by the installation. Multiprojects, projects and stations are displayed in the "Configured license objects" box.

The following are displayed in the "Select the desired license:" box:

- **Process objects**
  Process objects that can be counted are all SFCs and all block instances which support reporting, operator control and monitoring. These are the objects that are transferred to the OS and require licenses. Driver blocks are not considered process objects.
  These objects are only included in the count if they can be downloaded to an AS. Block instances in S7 programs without hardware assignment (at the project level or in libraries) are not considered.
- **Diagnostic objects** (maintenance RT)
  Multiprojects or subprojects are displayed. The square bracket [...] includes the number of project licenses. On the next level, AS objects with subordinate ASs, then PC stations, network objects and user objects are displayed.
- **Process objects in WinCC**
  One or more OSs are displayed for each subproject or multiproject; the registered license is indicated in square brackets [...]. OS servers, OS server standby and reference OS servers can be displayed.

- **Archive tags**
  One or more OSs are displayed for each subproject or multiproject. If an archive server is available, it is also displayed. On the next level, those OSs which store data on this archive server are listed. The number of archive tags is displayed in square brackets [...] on the affected objects, differentiating between short-term and long-term archiving.
- **SIMATIC BATCH units**
  The same view as in the case of process objects
- **SIMATIC Route Control**
  The same view as in the case of process objects

Additional information

- You can find additional information about this in the section "Counting and booking process object licenses (Page 465)".

9.15.4.1 Counting and booking process object licenses

Introduction

Countable process objects (PO) may be classed as any SFCs and block instances that support operator control and monitoring and have the "With interrupt" property. These are the objects that get transferred to the OS during the compile and download operation and which require a license.

Driver blocks are not classed as process objects.

You can start a function in the SIMATIC Manager that identifies all of the process objects configured and registered in Automation License Manager (ALM). The result is displayed in the "PCS 7 License Information" dialog. This enables you to check whether the PCS 7 licenses that you purchased or intend to purchase are sufficient for your project, or ascertain the number of objects that are subject to licenses with which you can expand your project.

Sequence

The compile and download operation involves detecting the process objects within the program, and the CPU and memory card serial numbers. Aided by this number, a program is assigned to the CPU. A process object info is created in the ES data management for each CPU that is downloaded; this records identifiers and the number of process object licenses used.

During the download process, the system determines if process object licenses have already been used for the current CPU (and if so how many). The number of process objects determined during the last download is read from the process object info that was saved to the ES database. The difference between this and the current number identified is then compared to the number of licenses available in the Automation License Manager (ALM). If the required process objects are covered by the license, the difference is booked in the ALM and the download is executed.

If the current program contains fewer process objects than the previously downloaded project, the download operation automatically increases the number of available process object licenses. If not enough licenses are available the license violation will generate a corresponding message that must be acknowledged. Now you may either terminate the download or continue it in spite of this message. The number of licenses that are required but unavailable will be recorded as a shortage. If you have purchased additional licenses, these missing licenses are included and registered in the ALM at the next download.

Scenarios that involve counting process objects

The following scenarios are taken into account when counting process objects:

- First full download of a program
- Downloading changes to a program on the same CPU
- Moving a program to a different CPU
- Ceasing to use a CPU

  Note

  Before removing the CPU, if there is an existing connection between the ES and the CPU, you will first need to book back the process objects on the CPU.

- Multiple use of a program on several CPUs

Information regarding the counting of process objects

- Download to S7-PLCSIM and test CPU:
  This does not include a process object count.
- Deleting projects:
  The CFC is not notified when you delete a project.

  Note

  No process objects are booked back within this context. You should therefore deregister the process objects prior to deletion.

- Deleting chart folders or superimposed objects:
  If you delete the chart folder, the S7 program, the CPU or the SIMATIC station, then this order to delete is passed on to the CFC. In this case, a warning message will appear allowing you to abort the deletion process so that you can book back the relevant process objects prior to deletion.

- Faulty CPU:
  The CPU that replaces a faulty CPU is recognized again as the previous download target, provided the data stored in the process object info corresponds with the serial number of the CPU or Memory Card. It will be assumed that the "correct" CPU is connected for older CPU versions that do not allow a serial number query.
- Booking back process objects
  Using the **Options > Charts > Book back process objects** menu command, you can deregister the process objects of a program that you no longer want to run on the CPU by returning these objects to the Automation License Manager.
  The program is thereby deleted from the CPU.

  Note

  It is particularly important to book back licenses if plant engineering is being performed at different locations, but the process object licenses are required for the target plant.

Additional information

- Section "How many objects can be processed in a project? (Page 46)"

9.15.4.2 How to display the PCS 7 license information

Introduction

Process objects are only entered in the count if they can be downloaded to an AS. Block instances in S7 programs without hardware assignment (at the project level or in libraries) are not considered.

Procedure

1. Select either the multiproject or project in the SIMATIC Manager (any view).
2. Select the **Options >PCS 7 license information** menu command.
   The "PCS 7 license information" dialog box opens.

Additional information

- Online help for the "PCS 7 license information" dialog box

9.15.5 Configuring the interface to the I/O

9.15.5.1 Concept of the signal processing

Introduction

The I/O interfacing described below also ensures high performance for capacity. The configuration is fast and easy to execute.

Tasks of the channel blocks

In process control systems, diagnostics/signal processing must meet certain requirements. This includes the monitoring of modules, DP/PA slaves and DP master systems for faults and failures.

PCS 7 provides the necessary blocks in libraries. The interfaces to the hardware including test functions are implemented in these blocks.

These blocks perform two basic tasks:

- They provide the AS with signals from the process for further processing.
- They monitor modules, DP/PA slaves, and DP master systems for failure.

When the process signals are read in, these blocks access the process input image (or process image partition) (PII) and when outputting the process signals, they access the process output image (or process image partition) (PIQ).

Concept

The concept of the signal processing for PCS 7 can be characterized as follows:

- The blocks for the processing of user data and diagnostic data are separate.
  - User data processing
    CHANNEL blocks - These blocks must be configured.
  - Diagnostic processing
    MODULE blocks - These blocks are automatically integrated in the configuration during generation of the code.
- The symbolic addressing of the I/O signals
- The automatic generation of the MODULE blocks by CFC

Using this block concept, all modules from the list of released modules are supported.

You can also use signal processing blocks from another PCS 7 library (for example, custom blocks from a custom library). You can specify this additional library in the "Generate Driver Blocks" dialog box. When you compile the AS charts, a search is first performed in the specified library for the associated data for each block to be imported.

Time-optimized processing

To allow time-optimized processing during runtime, the organization blocks for error handling (for example, OB85, OB86, etc.) are automatically divided into runtime groups and the channel and diagnostic blocks installed in the relevant runtime groups.

If an error or fault occurs, the SUBNET block, for example, activates the relevant runtime group, the RACK block or module block contained in the runtime group detects the problem, evaluates it and outputs a control system message to the OS.

The diagnostic information of the module block is also transferred (output OMODE_xx) to the corresponding CHANNEL block (input MODE). If necessary, this information can be displayed in a process picture (color of the measured value changes or flashing display, etc.) by a PCS 7 block that can be operated and monitored on the OS or by a user block.

Additional information

- Online help of the corresponding blocks (CFC)

9.15.5.2 How to generate module drivers

Automatic generation of module drivers

PCS 7 provides a signal processing function that automatically generates required module drivers, interconnects them and assigns their parameters accordingly after you have configured the hardware using HW Config and the technological functions in CFC. These module drivers are required for diagnostics and reporting errors during signal processing.

The function is called up when the S7 program is compiled if the "Generate module drivers" check box is selected (default setting). If module drivers have already been generated for the project, a check is carried out during processing to determine whether or not the module drivers have to be updated. An update is necessary if the hardware configuration has changed in the meantime.

Manual generation of the module drivers

The "Generate module drivers" functions can also be called up manually in the SIMATIC Manager.

Procedure

1. Open the SIMATIC Manager and the project in which you want to generate the drivers.
2. Select the chart folder of an S7 program in the component view. No charts may be selected in this chart folder.

3. Select the menu command **Options > Charts > Generate Module Drivers...**.
   As an alternative, you can activate the "Generate module drivers" check box in the "Charts as Program..." dialog box in CFC when compiling CFC/SFCs.
   Each time you recompile, only the required module drivers are generated or updated.
4. Select the required options and click "OK".

   Note

   If the address areas for digital input and output modules have been packed in HW Config ("Pack addresses" function), the driver generator cannot supply the corresponding blocks with unique addresses.

   To ensure that each module has a defined slot assignment, the addresses must not be packed.

How the function works

The "Generate module drivers" function generates new system charts (with the name "@..." assigned by the system) in which only driver blocks are inserted by the driver generator that are assigned parameters and interconnected according to the hardware configuration. In addition, the CHANNEL blocks installed in the user charts are interconnected by the driver generator with the driver blocks, given the corresponding symbolic interconnection. Each system chart should not contain more than 50 blocks.

The OB_BEGIN/OB_END blocks for one CPU, RACK blocks for one rack and the MODULE blocks are installed in runtime groups. The runtime groups created by the driver generator are assigned an ID, so that they can be deleted automatically again when they no longer contain blocks, for example. Runtime groups without this ID are not processed by the driver generator. If RACK/MODULE blocks are installed in a different runtime group by the user, they are moved to the runtime groups with the relevant ID by the driver generator.

Note

No changes are allowed to the system charts since these involve system functions (indicated by "@"). The is true for changes to the installation in OBs or runtime groups.

Parameter assignment/interconnection in the CFC

Requirement: You have already assigned a symbolic name for each channel of a module in the hardware configuration.

The signal-processing blocks (CHANNEL blocks) are assigned to the module channels by means of their symbol names.

The signal-processing blocks have a block I/O labeled "VALUE". Specify the symbolic name of the module channel at this I/O (select the I/O in the CFC, shortcut menu command **Interconnection to Address...**).

Additional information

- Section "How to configure the distributed I/O (Page 341)"

9.15.6 Overview of the control module and its type

Overview

In PCS 7, there are process tags and control modules, and their associated types.

A process tag type or a control module type is a CFC configured for a specific process control function for the basic automation of a process engineering plant.

Process tags

The following properties are available for using process tags and their types:

- When an instance is created and configured from a process tag type, instance-specific changes are lost when the process tags are imported again with the Import/Export Assistant.
- Multiple process tag types are required for the same technological function, such as "Measurement", when different input blocks are used, for example. It is not possible to create different variations of process tags from a single process tag type.

Control modules

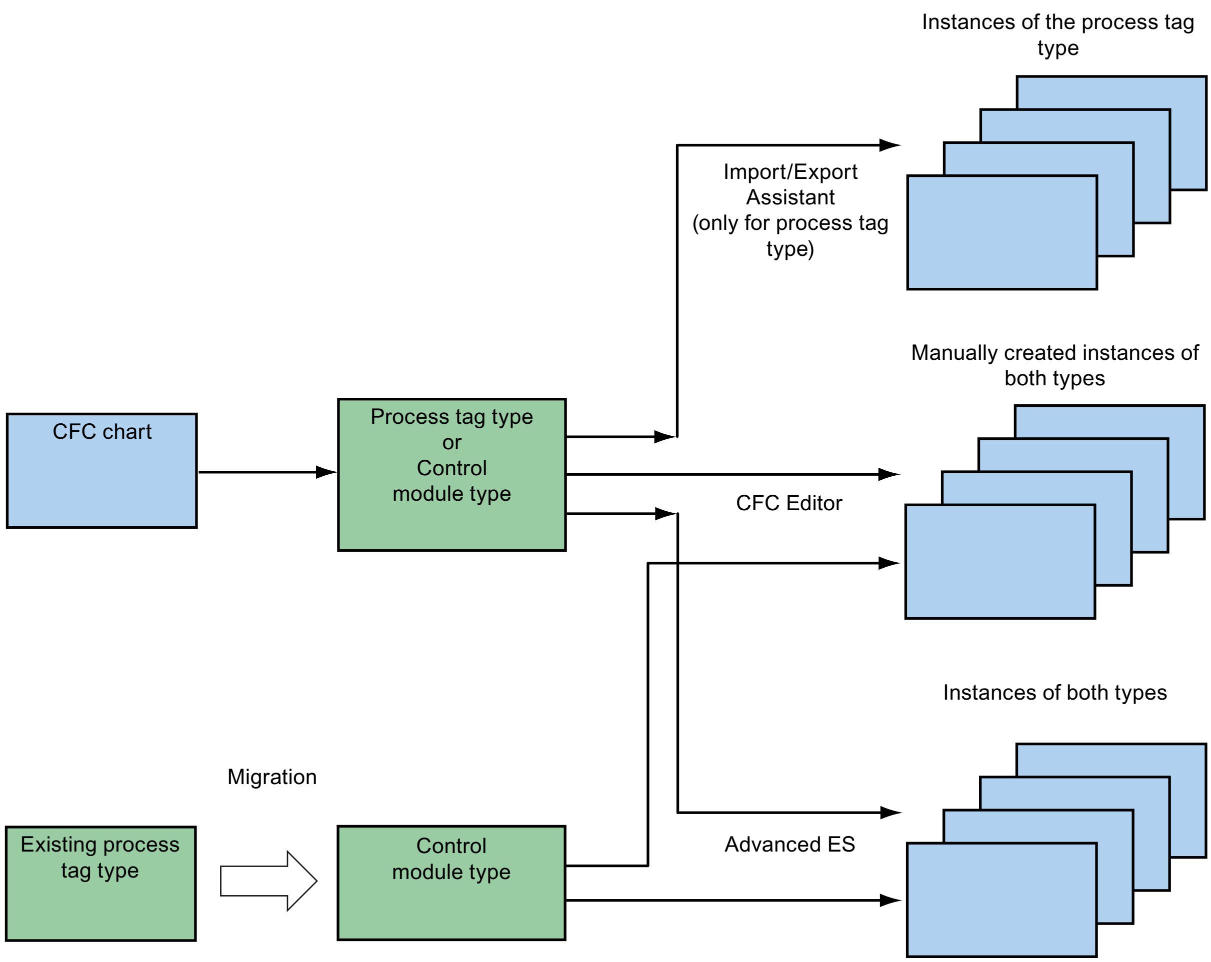
When control modules and control module types are used, the above-mentioned properties do not apply. This is why a control module has the following advantages in comparison to a process tag:

- Instance-specific changes to the instance, the control module, are not lost during synchronization of type and instance.
- It is possible to create different instances from a control module type. The control module type can also include optional blocks. When the instances are created, you can determine which of these optional blocks should be inserted into each instance.

Handling options

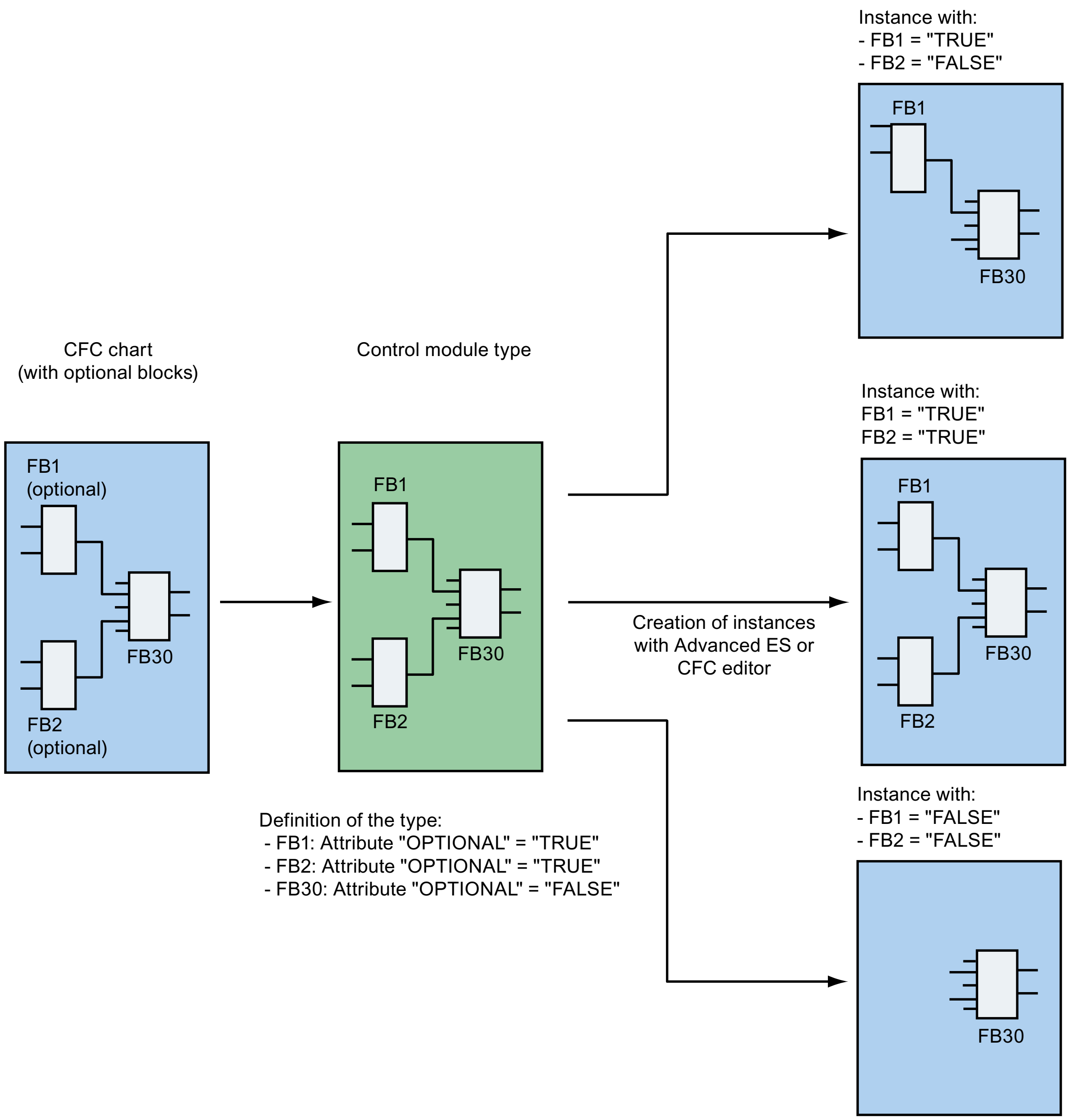
The following figure shows the creation of the type of process tag or control module, its handling and the creation of the instances.

It also shows the migration of a process tag type to a control module type.


Instances of the process tag type
Import/Export Assistant (only for process tag type)
Manually created instances of both types
CFC chart
Process tag type or Control module type
CFC Editor
Instances of both types
Migration
Existing process tag type
Control module type
Advanced ES

Optional blocks in a control module type

The following figure shows the creation of a control module type with optional blocks and the creation of possible instances.



Additional information

You can find a detailed description of the creation and handling of control modules and their types in the *Process Control System PCS 7; CFC for SIMATIC S7* manual.

9.15.7 Creating process tags from process tag types (multiproject)

Introduction

Use the wizard for process tag types to copy the process tag type from the master data library to the specified target projects. There it is inserted as a process tag. Then the associated data is imported from an import file.

Depending on the entries in the import file, you can create any number of process tags in one import action. As a result of the import, a process tag of this process tag type is created in the target project for every row of the import file according to the specified hierarchy path.

Sources for process tag types

The following process tag types can be stored in the master data library:

- Standardized process tag types from the control system library *PCS 7 Advanced Process Library*, for example, for motors, valves, PID controllers
- User-created process tag types from CFCs

Overview

Creating process tags from process tag types and subsequent editing of the tags involves the following topics:

- How to create a process tag type from a CFC (Page 475)
- How to change a process tag type (Page 476)
- How to insert a process tag into the project (Page 478)
- How to automatically generate multiple process tags (Page 479)
- How to edit a process tag (Page 480)
- How to adopt process tags (Page 481)
- How to synchronize process tags with the process tag type (Page 483)
- How to restore lost assignments to the process tag type (Page 485)

9.15.7.1 How to create a process tag type from a CFC

Options for creating a process tag type

The following options exist for creating process tag types:

- Creating a process tag type with a new or existing CFC
- Changing an existing process tag type: Adding or removing connections/messages
  These modifications may be necessary due to a change of CFC functionality (for example, interconnections or parameter assignment changed, blocks added or deleted). The starting point can be either the process tag type in the master data library or a process tag already contained in the project.
- Reestablishing a deleted process tag type from a process tag.

The new process tag type will be stored in the master data library.

Requirement

A CFC has been created in the project or in the master data library that contains the automation functions, parameters, and messages of the process tag to be implemented according to a specified process tag description.

Procedure

1. Select the intended CFC in the SIMATIC Manager (any view).
2. Select the menu command **Options > Process Tags > Create/Modify Process Tag Type...**.
   The wizard is started and displayed with the "Introduction" page. The current master data library is displayed.
3. Click "Continue".
   The wizard changes to the "Which I/Os do you want to assign to the process tag type?" page.
4. In the "I/Os in the chart of the process tag type" window on the left, select the I/O points for "Parameter" and "Signal". (By double-clicking or by selecting and clicking the "arrow" button.)
   The I/O point is activated and displayed in bold format.
5. Edit the selected I/O points in the right window, "I/O points for parameters/signals".
   You can edit the columns "Parameter/signal" (by means of a drop-down list), "Process tag I/O", and "Category" (by means of a drop-down list).
   To open the drop-down list, click in the corresponding input box.
6. In the "I/Os in the chart of the process tag type" window on the left, select the messages of the corresponding blocks.
   All the messages are displayed in the "I/O points for messages" window.
7. Verify your selection and click "Finish".

Result

The new process tag type is stored in the master data library. The CFC from which the process tag type originated is located in the S7 program. There it can be reused or deleted if no longer required.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.7.2 How to change a process tag type

Introduction

If you change a process tag type already used to create process tags, you may decide whether the changes should be applied to the process tags that were created prior to changing the process tag type.

Requirement

The CFC is stored in the master data library.

Procedure

1. Select the desired CFC in the SIMATIC Manager (Plant View).
2. Select the menu command **Options > Process Tags > Create/Modify Process Tag Type...**.
   The wizard is started and displayed with the "Introduction" page. The current master data library is displayed.
3. Click "Continue".
   The wizard changes to the "Which I/Os do you want to assign to the process tag type?" page.
4. In the "I/Os in the chart of the process tag type" window on the left, select the I/O points for "Parameter" and "Signal". (By double-clicking or by selecting and clicking the "arrow" button.)
   The I/O point is activated and displayed in bold format.
5. Edit the selected I/O points in the right window, "I/O points for parameters/signals".
   You can edit the columns "Parameter/signal" (by means of a drop-down list), "Process tag I/O", and "Category" (by means of a drop-down list).
   To open the drop-down list, click in the corresponding input box.
6. In the "I/Os in the chart of the process tag type" window on the left, select the messages of the corresponding blocks.
   All the messages are displayed in the "I/O points for messages" window.
7. If no process tags can be located in the project for the modified process tag type, click "Continue" and then "Finish".
   The wizard closes.
   Otherwise:

8. Click "Next".
   The wizard switches to the "Do you want to finish the process tag type and apply changes to the existing process tags?" page.
9. Click "Finish".
   The change log appears.
10. Click "Exit".

Result

Changes made to the process tag type and the process tags are completed. The wizard closes.

Changes in the CFC of the process tag type

Note

Any changes made directly in the CFC of the process tag type are not applied to existing process tags of this type with the "Create/Modify Process Tag Type" wizard!

This includes the following changes:

- Add/remove blocks
- Interconnection changes
- Parameter changes

In this case, you must delete the affected CFCs beforehand and then perform a new import for the changed process tag type using the Import/Export Assistant.

You can no longer change the names of the blocks for an existing process tag type or for process tags derived from it. Otherwise, import/export is no longer possible.

Ensure that all the projects are available in the multiproject for the synchronization of the process tags.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.7.3 How to insert a process tag into the project

Overview of inserting process tag types

The following options are available in the SIMATIC Manager for adding process tags to the project:

- Use the menu command **Insert > Process Tag (from library)...** to open the "Process Tag Types" catalog in the process object view.
  All the process tag types from the master data library are listed in this catalog.
  - You can drag the process tag type to a hierarchy folder in the process object view or in the plant view. This creates a process tag in this hierarchy folder.
  - Another option is to copy a process tag type in the catalog with the <Ctrl> + <C> keys and then paste it into one or more hierarchy folders in succession using <Ctrl> + <V>.
- Using the menu command **Options > Process tags > Import...** (if the process tag type is selected in the master data library), you can carry out an import and create any number of process tags from a process tag type. You can find additional information about this in the section "How to automatically generate multiple process tags (Page 479)".
- Drag-and-drop existing process tags to a hierarchy folder of another project (or use "Copy" and "Paste"). If you paste into the same project, you can be asked whether you want to overwrite or rename the existing object. Please remember that the chart name may only occur once.

Note

If you create process tags by copying and pasting, you still need to assign parameters and interconnect them.

If you work with the import file, the data relating to the parameter assignment and interconnection is taken from the import file.

9.15.7.4 How to create an import file or assign it to the process tag type

Introduction

An import file must be assigned to the desired process tag type in order to create process tags. The following steps can be carried out with the "Assign an import file to a process tag type" wizard:

- Assign an existing import file
- Open and check an import file that has already been assigned
- Create and assign a new import file

Procedure

1. Select the applicable process tag type in the master data library.
2. Select the menu command **Options > Process Tags > Assign/Create Import File...**.
   The wizard is started and displayed with the "Introduction" page. The current master data library is displayed.
3. Click "Continue".
   The wizard changes to the "Which import file do you want to assign to the process tag type?" page.
   The "Import file" drop-down list displays either a file or - if no assignment has been made - the "No import file assigned" text.
4. You have the following options:
   – To check an assigned import file to find out whether all the information is accurate, open the file by clicking "Open File" and edit the file with the IEA file editor if necessary.
   – To assign an import file that exists in the project, click "Other File..." and select the desired file in the dialog field.
   – To create a new import file, click "Create Template File..." and select the desired columns/column groups in the dialog field. Then edit the template with the IEA file editor that you open with "Open File".

   Note

   The "Column title" column can be edited if you select the "No import file assigned" text in the "Import file" drop-down list. You can change the titles and then generate the template file.

   In the "Importing" column, a check mark indicates which I/O points exist in the import file. If the check mark is not there, the I/O point exists in the process tag type but not in the currently assigned import file.
5. Click "Finish".

Result

The import file is assigned to the process tag type.

Additional information

- Section "Creating/editing import files with the IEA File Editor (Page 593)"
- Online help for *PH*, *IEA* and *PO*

9.15.7.5 How to automatically generate multiple process tags

Requirement

An import file must have been assigned to the process tag types.

Note to reader

You can find a detailed description of the creation of the import files in the section "Importing/Exporting Process Tags/Models". The following is a description of the basic procedure used when import files have already been assigned.

Procedure

1. Select the desired hierarchy folder, project node or process tag library (hierarchy folder in the master data library), or the process tag type.
2. Select the menu command **Options > Process Tags > Import...**.
   The "Import" dialog box opens.
   The wizard searches for the process tag types and corresponding import files (in all hierarchy subfolders as well) and lists them. The import is executed for all the import files listed.
3. If you do not want to import certain files, you can select them and remove them from the list with the "Remove" button.
   By clicking "Other File", you can search for a different import file and select it instead of the other file.
4. Click "Continue" and then "Finish".

Result

The actual import process starts.

Depending on the setting of the "Only show errors and warnings in log" check box, the complete list of activities with the individual steps or only the errors that occurred are displayed in the log window.

The log is saved in a log file. The name and path of the file are displayed below the log window. You can modify this setting with the "Other File" button.

Additional information

- Section "How to import process tag types and models (Page 587)".

9.15.7.6 How to edit a process tag

Introduction

In the process object view, you can edit individual process tags of the project, for example, change comments, values, and interconnections (as long as these are defined as "Parameter" or "Signal").

Procedure

1. Open the process object view with the menu command **View > Process Object View**.
2. Select the desired process tag in the tree (left window).
3. In the table on the right, select the required tab and make your modifications there (in the editable cells).

Example: You want to interconnect an I/O with another I/O.

Requirement: The I/O of the block is defined as a parameter.

1. Select the process tag.
2. Select the "Parameters" tab.
3. Select the cell for the required I/O in the "Interconnection" column.
4. Select the menu command **Insert Interconnection...** in the shortcut menu.
   The "Insert Interconnections" dialog box opens.
5. Select the process tag in the tree and the block containing the I/O you want to interconnect.
6. Click "Apply".
   As an alternative, you can double-click the I/O or drag the I/O to the selected cell in the process object.

Result

The interconnection is entered; the dialog box remains open. The next cell of the column is selected.

Renaming process tags

Note

After renaming process tags and subsequently compiling the OS, all interconnections in pictures and archives as well as tags in scripts are automatically adapted. However, the names of the archive tags are **not** adapted and retain their old process tag name. You can change the archive tag names accordingly. In this case, be sure that you also adapt the associated trend controls, for example.

The interconnections are only corrected for the local single control units of the OS. Any interconnections to single control units of another OS via server-server communication must be adapted manually.

9.15.7.7 How to adopt process tags

Introduction

You can reassign CFCs that have no assignment to the process tag type during the import if the conditions for this are met.

Requirements

The names of the CFC blocks and I/Os correspond with the names on the process tag type.

This applies to the following:

- I/Os that are identified as a parameter/signal.
- Blocks identified for messages.

Situation 1: identifying existing charts as process tags

You have created a CFC, for example, configured a motor control and have copied this chart several times manually. You have changed or adapted the copies to deal with different requirements.

In future, you want to use the functions of the assistant and create further process tags by importing. You want to continue using the previously created charts and want them to be identified as process tags.

Procedure - Scenario 1

1. Use one of the existing charts to create a process tag type with the menu command **Options > Process Tags > Create/Modify Process Tag Type....**
   You can find additional information about this in the section "How to create a process tag type from a CFC (Page 475)".
2. Assign a suitable import file to the process tag type with the menu command **Options > Process Tags > Assign/Create Import File....**
3. Start the import with the menu command **Options > Process Tags > Import..** and open the import file on page 2(3) using the "Open File" button.
4. Add each chart to be adopted to a row in the file. Continue until the import can be finalized.

   Note

   Please note the following:

   - Make sure that the charts you adopt are located in the folder entered in the "Hierarchy" column of the import file.
   - If you want to retain the values of the charts and you do not want them to be overwritten with the values of the process tag type, then delete the corresponding fields in the import file.

Result - Situation 1

If the conditions for adopting the process tags are fulfilled, the CFC becomes the process tag of the imported process tag type and the I/O name and category is applied from the process tag type. Any additional process tag identifiers (message block or block I/Os) are reset.

Additional blocks and I/Os that are not in the process tag type are tolerated and ignored.

If the adopted process tag is part of the replica of a model, the IEA flags remain unchanged. If, however, it is not part of a replica, then preset IEA flags are reset if necessary.

Situation 2: Chart has lost its assignment to the process tag type

For a CFC that was already a process tag, you have canceled the assignment to the process tag type via the object properties (with the menu command **Object Properties >** , "Process Tag Type" tab, chart selected, "Cancel" button).

In order to reassign the chart proceed as described under Items 3 and 4 of Situation 1.

Situation 3: Process tag type was copied manually

A process tag type was inserted by copying and pasting several times within the project or from the master data library. You now want to assign these copies to the process tag type and create or amend the IEA file.

Procedure - Situation 3

1. Select the process tag type in the PH.
2. Select the menu command **Options > Process Tags > Export...**.
   The "Import/Export Assistant: Export process tags" dialog box opens.
3. Click "Continue" and select the export file in the next dialog box ("Open File" or "Other File" buttons).
4. Click "Continue".
5. If necessary, select the path and the name of the log file and click "Finish".
   The export is executed and the export file is created. The actions are logged in the window and stored in the log file.
6. Click "Back" to check the export file and then open the export file you have just created.

Result - Situation 3

All copies of the process tag type are included in the export file.

You can now use these files for further work, by adding entries when needed, and then using them for the import process.

9.15.7.8 How to synchronize process tags with the process tag type

Introduction

When a process tag type is modified, the process tags existing in the multiproject are automatically synchronized. Synchronization can also be carried out directly if modifications result in inconsistencies between the process tag type and the process tags (for example: not all of the process tags of a project were accessible during the synchronization process).

Requirements

- Process tags are available in the multiproject.
- The modified process tag type is located in the master data library.

Procedure

1. Select the applicable process tag type (in the master data library) and then select the **Options > Process tags > Synchronize....** menu command.
   The "Synchronize process tags" wizard is launched and the current master data library is displayed.
2. Click "Continue".
   The wizard changes to the "Do you wish to compare the existing process tags with the process tag type?" page.
3. Click "Finish".

The synchronization process log appears.

Process tag type modifications

Note

Changes that you make in the chart of the process tag type are not taken into account when the process tags are synchronized. In this case, you must re-import the modified process tag type.

In the import file, add the keyword "Delete" for each process tag you want to delete in the "ImportMode" column of the "General column group". To create a new process tag, insert an additional line in which the field of the "Import mode" column remains empty.

Subsequent synchronization of process tags that were not accessed

Process tags cannot be synchronized according to the method described above if the following circumstances apply at the same time:

- If the name of the process tag type was changed
- If synchronization was carried out at a time when not all of the process tags of this type could be accessed (for example: after the project was distributed to the engineering work division)
- If these process tags were subsequently restored to the project.

Subsequent synchronization of process tags

You can later synchronize the process tags that could not be accessed using the following procedure:

1. Change the name of the relevant process tag type.
2. Select the menu command **Options > Process Tags > Synchronize....**
   All process tags are synchronized with the modified process tag type.
3. Rename the process tag type with its original name and repeat the synchronization.

All process tags are now adapted to the corresponding process tag type.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.7.9 How to restore lost assignments to the process tag type

Introduction

If process tags exist in a project but the corresponding process tag type is no longer in the master data library, it is not possible to import or export these process tags. The import/export file structure is always required for the import/export process. This, however, is located only on the process tag type.

Remedy

You can create a process tag type from an existing process tag in the project and reestablish the assignment.

Procedure

1. Select the applicable process tag in the project.
2. Select the menu command **Options > Process Tags > Create/Change Process Tag Type...**.
   The wizard is started and the current master data library is displayed.
3. Click "Continue".
   The assistant brings up an error message and queries whether you want to create the selected chart as a process tag type in the master data library.
4. Click "Yes".
   The assistant moves to the "Which I/Os do you want to assign to the process tag type?" page.
5. Click "Finish".

Result

The process tag type is created and stored in the master data library. The assignment of process tags to the process tag type is therefore reestablished.

You now still have to assign the import file or create a new one.

Rules

Note

It is possible to modify the process tag type if necessary during this procedure. Existing process tags are adapted automatically.

Note

If the process tag was adapted for a specific technological task for which the process tag type is not relevant or is not permitted to be present, then the corresponding changes (for example: interconnections, assignment of parameters) have to made in the CFC.

9.15.8 Creating sequential control systems (SFC)

SFCs and SFC editor

An SFC is a sequential control system in which up to 8 (SFC type: up to 32) separately startable sequences can be integrated, in the form of sequencers.

An SFC is assigned uniquely to a CPU and is also executed completely on this CPU.

The SFC editor is a tool for creating sequential control systems.

Additional information can be found in the SFC online help or in the manual *SFC for S7; Sequential Function Chart.*

Sequential control system

A sequential control system is a controller with step-by-step execution and where control passes from one state to the next state depending on conditions.

Sequential control systems can be used, for example, to describe the manufacture of products as event-controlled processes (recipes).

With a sequential control system, functions from basic automation (typically created with CFC) are controlled by operating and state changes and executed selectively.

Using Sequential Control Systems

The typical applications of sequential control systems involve processes and plants with discontinuous characteristics. Sequential control systems can, however, also be utilized in continuous working plants.

Examples:

- Approach and withdrawal movement
- Operating point change
- State change during interference

Sequential control systems can be used at the following levels within a plant:

- Plant level (synchronization of units and common resources, for example, routing)
- Unit level (tank, mixer, scales, reactor, etc.)

- Group control level (proportioning, stirring, heating, filling, etc.)
- Device control level (open valve, start motor, etc.)

How it works

Using the SFC editor, you create your sequential control system using graphic tools. The SFC elements of the chart are positioned in the sequencer according to fixed rules. You do not have to concern yourself with details such as algorithms or the assignment of machine resources. This allows you to concentrate on the technological aspects of the configuration.

After creating the chart topology, switch over to configuring the object properties. Here you will need to formulate the sequencer properties as well as the individual steps and transitions. In this way, you configure the actions and conditions.

After configuration, you compile the executable machine code with SFC, download it to the PLC and test it with the SFC test functions.

Additional information

- Online help on SFC
- Manual *SFC for S7; Sequential Function Chart*
- Manual *Process Control System PCS 7, Getting Started - Part 1*

9.15.8.1 Advantages and use cases of SFC type/SFC instance

The type/instance concept

The type/instance concept can be used to create sequential control systems that generate SFC instances when they are placed in a CFC.

The following is achieved with the type/instance concept:

- Centralized configuration
- Reusability
- Ability to download changes

SFC type

In addition to the "SFC" object type, the SFC also contains the "SFC type" object type.
The SFC type allows the definition of sequential control systems and of an expandable interface.

The sequential logic of the SFC type is based on the interface I/Os of the SFC type. By contrast to the SFC, the SFC type does not access random process signals.

The SFC type is not executable by itself. Like a function block type, an SFC type must be placed in a CFC to obtain a runtime-relevant object, in this case, an SFC instance. To run an

SFC instance, both the SFC type and the SFC instance are downloaded to the automation system.

Note

SFC types can also be located in libraries (for example, *SFC Library*).
For SFC types to be usable, they have to be located in the chart folder of the program. This can be realized as follows:

- When you place an SFC type from the library directly into a CFC, the SFC type is copied into the chart folder of the program. The SFC type is then visible in the CFC catalog in the "Blocks" tab and can be placed in the CFC from there.
- Copy the SFC types from the chart folder of the library into the chart folder of the program. The SFC types can then be used in the CFC catalog in the "Blocks" tab and can be placed in the chart from there.

SFC instance

An SFC instance is derived from an SFC type. To do this, the SFC type is installed in a CFC similar to a function block type in the CFC. SFC instances are always assigned to a CFC and addressed by this chart. Like CFC instances, SFC instances are represented as blocks: Their interface is visible in the CFC.

SFC instances are not displayed in the SIMATIC Manager because they can only be addressed through the CFC. With the assignment of the CFC to the plant hierarchy, the SFC instances contained are also indirectly assigned to the plant hierarchy.

Basic procedure

1. You create the SFC type in the SFC editor. At the same time you configure its sequencers and the SFC interface.
   You can find additional information about this in the section "How to create an SFC type (Page 506)".
2. You create the SFC instances in the CFC and set the parameters and interconnect them.
   You can find additional information about this in the section "How to create an SFC instance (Page 509)".

Pre-configured sequencer templates

Pre-configured sequencer templates are located in the *SFC Library*. You can copy these templates and modify them for your own use.

SFC visualization on the OS

Use the *SFC Visualization* add-on package to operate and monitor the SFCs on the OS. The required configuration work for the operation and monitoring of SFCs can also be carried out with *SFC Visualization*. Refer to the configuration manual *Process Control System PCS 7; Operator Station* for more information.

Additional information

- Online help for SFC
- Manual *SFC Visualization for S7*

9.15.8.2 Overview of the configuration steps

Introduction

The following is a series of steps that you must execute when configuring sequential control systems (SFCs) for your PLC: The same series of steps also applies to the configuration of SFC types, however in this case, the I/Os and characteristics must still be defined.

Requirement

A project structure is created in the SIMATIC Manager in which you can configure CFC/SFCs.

Overview of configuration tasks

Step	What?	Description
1	Specify the chart properties	When you specify the chart properties, you can change the chart name and add a comment.
2	Create the topology of the sequential control system	Sequential control systems are configured with SFCs. This is accomplished by inserting the steps and transitions for one or more sequencers and if necessary adding structure elements.
3	Configure the sequencer properties	For each sequencer, you configure the start condition, the action for preprocessing and for postprocessing.
4	Configure the steps (in the "Object Properties" dialog box)	Formulate the actions in the steps. The actions contain instructions for changing the values of block inputs and shared addresses or for activating and deactivating runtime groups or other SFCs.
5	Configure the transitions (in the "Object Properties" dialog box)	Formulate the step-enabling conditions in the transitions. The conditions read the values of block I/Os, of shared addresses, or the state (active/inactive) of runtime groups or other SFCs. If the conditions following the specified logic operations are true, the next step becomes active and its actions are executed.
6	Adapt the operating parameters and runtime properties	By setting the operating parameters, you specify the behavior of the sequential control system, such as the mode (manual, auto), step control mode (T, C, T and C...), SFC startup after CPU restart and other chart execution options (cyclic operation, time monitoring, autostart, etc.). The runtime properties of an SFC determine how the SFC is included in the execution of the entire structure on the PLC (in the window of the CFC runtime editor).
7	Compile the SFCs	During compilation, the CFC and SFCs of the active chart folder are converted to an executable user program (Compile: Entire program/ changes only).

Step	What?	Description
8	Download the SFC program	Following compilation, you can download the program to the target system (CPU) (Download: Entire program/changes only).
9	Introduction to testing the SFC program	After compiling and downloading, you can test the SFC program in process mode or in laboratory mode. Using the SFC test functions, you can run the sequential control system in various operating modes and step control modes and monitor and modify the values of addresses on the CPU. You can also influence the most important operating modes (STOP, clear/reset, RUN, etc.) of the CPU.

Note

When entering units, ensure that the following special characters are not used: ['] [$].

Additional information

- You can find information on versioning in the section "Versioning CFC and SFCs (Page 652)".
- You can find information on access protection in the section "How can the plant be protected from unauthorized access? (Page 36)".

9.15.8.3 How to create a new SFC

Introduction

You can create SFCs and SFC types in the SIMATIC Manager.

Requirements

- The required project structure already exists in the SIMATIC Manager.
- The hierarchy folder used for creating the chart must be assigned to a chart folder.

Procedure

1. Select the desired hierarchy folder in the plant view of the SIMATIC Manager.
2. Select the menu command **Insert > Technological Objects > SFC**.
   A SFC is inserted into the hierarchy folder. The SFC is automatically assigned to a chart folder.
   The chart receives a standard name from the system (for example, SFC(1)).
3. Change the name according to your requirements. The name must be unique in the CPU. This is checked by the system.
4. Double-click the new SFC in the right window (content of the hierarchy folder).

Result

The SFC editor starts (if it is not already started) and the SFC is displayed in its initial state in a window of the SFC editor.

Naming

Note

Note the following:

- The names of SFCs can contain a maximum of 22 characters.
- The names of SFC types can contain a maximum of 16 characters. Although you can enter 24 characters in the properties, only 16 characters are permitted when the instances are created.
- The following characters are not permitted in names: \, ., /, ", %

Additional information

- Online help for SFC

9.15.8.4 How to specify the sequencer properties

Introduction

The sequencer properties are used to determine how the sequencer starts or which sequential control system starts first. The sequencer of a newly created SFC (type) already has a start condition (RUN = 1). As a result, it is connected to the operating state logic (OSL). For each further sequencer you must specify the start conditions yourself. The start conditions and the priorities determine which sequencer starts.

Procedure

1. Select the menu command **Edit > Sequencer Properties...** in the SFC editor.
   The "Properties” dialog box opens.
2. Set the sequencer properties listed in the following table.

Selectable sequencer properties

Tab	Property	Meaning
General	Name	Name of the current sequencer You can type in a maximum of 16 characters.
	Comment	Comment on the sequencer You can type in a maximum of 80 characters.
	Priority	Priority of the sequencer from 1 to 32 The priority decides which sequencer of an SFC is started when the start conditions of several sequencers are met simultaneously. Note: Priority 32 is the highest priority, 1 is the lowest.
Start condition		Specifies the conditions that must be true to start the sequencer (for example, "SFC.RUN = Active" starts the sequencer when the SFC is in the "RUN" operating mode). To allow a three-stage transition logic, you can combine the conditions logically to create a Boolean expression.
OS Comment		Specifies the properties of the sequencers and the properties of the transitions You can enter an OS comment with a maximum length of 256 characters for every condition in the SFC / SFC type.
Preprocessing		Defining actions that are to be executed after the start of the sequencer in each cycle before the steps and transitions are executed
Postprocessing		Defining actions that are to be executed after the start of the sequencer in each cycle after the steps and transitions are executed

Additional information

- Online help for SFC

9.15.8.5 How to create the topology of the sequencer

Chart depiction in the SFC editor

The newly created SFC (SFC type) initially consists of one sequencer that can be expanded with up to 8 (SFC type: up to 32) sequencers. Each sequencer is created in a separate working window. You can switch between the separate sequencers using the tabs at the bottom of the window.

A **sequencer** in the initial state consists of the start step, a transition, and a final step.

The chart topology is formed by the sequences of steps and transitions.

If you decide to insert or delete **SFC elements** in the sequencer, then these elements are displayed automatically according to predefined rules. The following factors are, for example, dictated by the rules:

- The distances between the chart elements
- The extent of the steps and the transitions
- The configuration of alternative sequences

The display/layout rules can be modified at any time with the menu command **Options > Customize > Representation...**.

You can center the entire plant topology on the display area. In this way the elements are distributed evenly on the chart. The zoom functions can increase or reduce the size of the display as a percentage determined by the zoom factor.

Creating the sequencer

Use the menu command **Insert > Sequence > ...** in order to create a sequencer.

A new sequencer is inserted into a preselected position in the chart. The window is expanded by a tab at the bottom of the window. Each tab contains the name of one of the sequencers in the SFC (RUN, SEQ1, ...).

You can insert SFC elements into the sequencer with the menu command **Insert > ...**.

Syntax rules

The basic rule for chart topology is as follows: A step (S) is always followed by a transition (T) and vice versa (sequence: S-T-S or T-S-T). The editor automatically abides by the rules.

Example:
If you insert a simultaneous branch in a sequencer following a transition but prior to a step, a transition is created automatically before the step, since the syntax rules require a transition before and after a simultaneous branch.

Overview of the SFC elements

SFC element	Function
Sequencer	Status-dependent and event-controlled processing is possible in SFC with sequencers. A SFC contains sequencers that can be controlled through differently defined start conditions.
Sequencer elements	An SFC consists of 1 to 8 sequencers and an SFC type of 1 to 32 sequencers, each with one sequence consisting of the following sequencer elements (basic elements): • Step • Transition Outside a sequence, the following element also exists: • Text The remaining elements are structures that are made up of different basic elements: • Sequence • Simultaneous branch • Alternative branch • Loop • Jump
Step	In SFC, a step allows actions to be executed. The following step types exist: • Initial step • Normal step • Final step
Initial step	Each SFC has exactly one initial step. The following objects are automatically installed in the SFC when you create a new chart (initial state): • Initial step • A transition • A final step The initial step can be copied, cut or deleted. However, you can copy, cut or delete initial step actions. The initial start actions are configured precisely like the actions of any other step.
Final step	Each SFC has exactly one final step. When you first create a chart, an initial step, a transition and a final step are created (initial state). The final step can be copied, cut or deleted. However, you can copy, cut or delete final step actions. The final start actions are configured precisely like the actions of any other step.
Transition	The transition is a basic element of SFC and contains the conditions under which a sequential control system passes control from one step to the next.
Text	A text is an element that can be inserted in charts. You can enter comments in your charts using this element. Texts inserted in charts can be edited, moved, copied, cut, and deleted.
Sequence	Structure element in the SFC containing a sequence of steps and transitions. A simultaneous branch or an alternative branch consists of at least 2 sequences arranged side-by-side and containing at least 1 element.
Simultaneous branch	In SFC, a simultaneous branch allows several sequences to be run at the same time. The simultaneous branch is complete when all the sequencers have been completed (synchronization).

SFC element	Function
Alternative branch	A structural element in SFC, that consists of at least two sequencers. Only the sequencer whose transition condition is satisfied first is processed by the AS.
Loop	In SFC, a loop allows a jump back to a selected previous point. The return jump is executed when the SFC is at the start of the loop and the loop transition is fulfilled. In this case, the sequence in the loop is run through again.
Jump	The jump is a structure element of SFC, with which the execution of an SFC can be continued at a different step in the same chart depending on a transition condition.

Adding SFC elements

To add further chart elements to the SFC, select the icon of the required SFC element in the element bar.

The mouse pointer changes its appearance from an arrow to the selected icon with a positioning cross-hairs. To insert the chart element, position the cross-hairs at the required position on a link and click the left mouse button. The inserted chart elements are selected and displayed in color.

Data backup

Note

All changes made in the SFC editor are saved immediately - there is therefore no extra save option in SFC. Please remember that you **cannot** undo or cancel changes in the SFC editor after closing the editor without saving.

We recommend archiving the data contained in the entire multiproject or the relevant project using the menu command **File > Archive...**.

9.15.8.6 How to configure steps

Steps

Actions are defined in the steps. These contain statements with which values of block inputs can be modified, for example, or other SFCs can be activated or deactivated.

Properties of the steps

You can make the following settings in the "Properties" dialog box of the step:

Tab	Meaning
General	In this tab, you can edit the general properties of the selected step (for example, name, comment).
Initialization **Processing** **Termination**	The tabs for the processing phases (actions) "Initialization", "Processing" and "Termination" all have the same layout. Here, you configure the statements that will control the process. In these tabs, you can define the following actions for the steps: • Actions that should be carried out once upon activating the step (Initialization) • Actions that should be carried out in cycles when the step is processed (Processing) • Actions that should be carried out once upon exiting the step (Termination) Each step for which you have defined an action is displayed in dark gray. This means that you can see at a glance whether or not a step has already had parameters assigned.

Procedure

1. Select the step you want to edit in the SFC Editor.
2. Select the menu command **Edit > Object Properties...**.
   The "Properties" dialog box of the step opens.
3. Enter the desired properties in the "General" tab.

   Note

   All other tabs can theoretically be edited in the same manner.

4. Select the required tab (Initialization, Processing, Termination) and position the mouse pointer in the text box for the left address (the operator) of the required statement line.
5. Click "Browse".
   The "Browse" dialog box opens.
   In this dialog box, you can see the CFCs of the project with the PH assignment, the chart name, and the comment in the first three columns. In the next three columns, you can see all the blocks belonging to the chart selected in the first columns. As soon as you select a block, the last column displays all the relevant I/Os.
6. Select the required CFC.
   All blocks of the chart are displayed.
7. Select the required block.
   All I/Os of the block are displayed.
8. Select the required I/O and select the shortcut menu command **Apply I/O**.
   The selected block I/O is entered with the corresponding complete path. The mouse pointer is automatically positioned in the text box for the right address.
9. Depending on the left address, enter a setpoint for the right address such as TRUE or FALSE or an interconnection to an additional block I/O (menu command **Browse**).
   For additional information refer to the section "Syntax for the interconnection of block I/Os".

10. Click "Apply" to apply the settings.
11. Click "Close".
12. Follow the same procedure if you want to edit more steps.

Additional information

- Online help for SFC

9.15.8.7 How to configure transitions

Transitions

A transition contains the conditions under which a sequential control system passes control from one step to the next. Several conditions can be logically combined using Boolean operators. The result of the logic operation determines whether the next step is enabled. Transitions are theoretically configured in the same way as steps.

Properties of transitions

You can make the following settings in the "Properties" dialog box of the transition:

Tab	Meaning
General	In this tab, you can edit the general properties of the selected transition (for example, name, comment).
Condition	In this tab, you define the conditions for the SFC / SFC type that cause transitions to enable the next step in the sequencer. To allow a three-stage transition logic, you can combine the conditions logically to create a Boolean expression.
OS Comment	In this tab, you can enter an OS comment with a maximum length of 256 characters for every condition in the SFC / SFC type. Formulated conditions are entered as defaults in the "Conditions" or "Start Condition" tab.

Conditions

Conditions offer the following options in a transition:

- To read values from block I/Os or shared addresses
- To logically combine the read values with a constant or another read value using Boolean operators (=, >, <, ...)

The result of a condition is a Boolean variable that can be logically combined with the results of other conditions.

Procedure

1. Select the transition you want to edit in the SFC editor.
2. Select the menu command **Edit > Object Properties...**.
   The "Properties" dialog box for the transition opens.
3. Enter the desired properties in the "General" tab.
4. Select the "Condition" tab and position the mouse pointer in the text box for the left address (the operator) of the required statement line.
5. Click "Browse".
   The "Browse" dialog box opens.
   In this dialog box, you can see the CFCs of the project with the PH assignment, the chart name, and the comment in the first three columns. In the next three columns, you can see all the blocks belonging to the chart selected in the first columns. As soon as you select a block, the last column displays all the relevant I/Os.
6. Select the required CFC.
   All blocks of the chart are displayed.
7. Select the required block.
   All I/Os of the block are displayed.
8. Select the required I/O and select the shortcut menu command **Apply I/O**.
   The selected block I/O is entered with the corresponding complete path. The mouse pointer is automatically positioned in the text box for the right address.
9. Select the required operator with which the two addresses are to be logically combined.
10. Depending on the left address, enter a setpoint for the right address such as TRUE or FALSE or an interconnection to an additional block I/O (menu command **Browse**).
11. Specify the three-level transition logic. The Boolean operators are designed as buttons.
    Clicking on the operator switches it from "AND (&)" to "OR (≥1)". Changing "AND" to "NAND" and "OR" to "NOR" is carried out by clicking the address output.
    The negation is displayed by a bold dot on the output line.
12. Open the "OS Comment" tab.
    In this tab, you can enter an OS comment with a maximum length of 256 characters for every condition in the SFC / SFC type.
    Formulated conditions are entered as defaults in the "Conditions" or "Start Condition" tab. Opening the "OS Comment" tab the first time applies the formulated condition as an OS comment. This can be changed at any time.
    If the OS comment is the formulated condition, in other words the default, this is indicated at the start of the line by the "Link" symbol.
13. Click "Apply" to apply the settings.
14. Click "Close".

Syntax for the Interconnection of block I/Os

In SFC, the operator combines two addresses in one condition. Both addresses are compared to each other. The result is TRUE or FALSE.

The following addresses are possible:

- < (less than)
- <= (less than or equal to)
- = (equal to)
- >= (greater than or equal to)
- > (greater than)
- <> (not equal to)

Additional information

- Online help for SFC

9.15.8.8 How to adapt the operating parameters and runtime properties

Introduction

You can display and modify the operating parameters and runtime properties for the active SFC. The initial state of the SFC is specified with the operating parameters.

Adjustable operating parameters and runtime properties of the SFC

You can make the following settings in the "Properties" dialog box of the SFC:

Tab	Meaning
General	You can enter or change the following in this tab: • Name • Author • Comment • Write-protected
Operating parameters AS	In this tab, you can change the default settings for the operating parameters of the AS and the start options of the SFC. • Default settings for the initial state of the SFC: – "Step Control Mode" – "Operating Mode" – "Command Output" – "Cyclic operation" – "Time monitoring" • Options for the SFC startup after a CPU restart – "Initialize SFC" – "Retain SFC state" • Options for starting the SFC: – "Autostart" – "Use default operating parameters when SFC starts" The settings for this option determine the runtime characteristics of the sequential control system.
OS	In this tab, you can specify if the SFC should be included in the next compilation of the OS.
Version	In this tab, you can change the version number of the SFC.

Adjustable operating parameters and runtime properties of the SFC

You can make the following settings in the "Properties" dialog box of the SFC type:

Tab	Meaning
General	You can enter or change the following in this tab: • Name • Author • Comment • Write-protected
Operating parameters AS	In this tab, you can change the default settings for the operating parameters of the AS and the start options of the SFC type. • Default settings for the initial state of the SFC type: – "Step Control Mode" – "Operating Mode" – "Command Output" – "Cyclic operation" – "Time monitoring" • Options for the SFC startup after a CPU restart – "Initialize SFC" – "Retain SFC state" • Options for starting the SFC: – "Autostart" – "Use default operating parameters when SFC starts" The settings for this option determine the runtime characteristics of the sequential control system.
Options	In this tab you can set the options for SIMATIC BATCH for the SFC type. • Category: – None" – "EOP" – "EPH" • Allow operator instructions • SIMATIC IT – "MES-relevant" • Control strategy selection
Version	In this tab, you can change the version number of the SFC type.

Procedure

1. Select the menu command **SFC > Properties...**.
   The "SFC Chart Properties" dialog box opens.
2. Adapt the operating parameters and runtime properties.
3. Click "OK".

Operating mode

In this combo box select whether the execution is controlled by the operator or carried out automatically.

- **AUTO** (process mode):
  The execution is controlled automatically. The program defaults are used. These default settings are determined, for example, by the parameter assignment or interconnection of inputs in the SFC external view of the CFC. In the "Auto" mode, the step control modes "T" and "T/T and C" can be set.
- **MANUAL** (operator mode) (default):
  The execution is controlled manually by the operator (for example, in the SFC test mode or on the OS in the SFV). All step control modes are permitted.

Step control mode

In this combo box select the step control mode in which the SFC/SFC instance will run.

The different step control modes affect the behavior of prepared or true transitions.

It is possible to change the step control modes in all operating modes. The individual step control modes are mutually exclusive.

Step control mode	Meaning
T (default)	Control with transition The sequential control system runs controlled by the process (automatically). When a transition is fulfilled, control is passed by disabling the predecessor steps and enabling the successor steps.
C	Control with operator-confirmation The sequential control system runs exclusively with operator control. The transitions do not need to be fulfilled. For each successor transition of every active step, an operator prompt is set and control passes to the next step or steps only after the operator has confirmed the prompt.
T and C	Control with transition and operator confirmation The sequential control system runs controlled by the process and with operator control. If the successor transition of an active step is satisfied, an operator prompt is set and control passes to the next step or steps only after the operator has confirmed the prompt.

Step control mode	Meaning
T or C	Control with transition or operator confirmation The sequential control system runs controlled by the process or with operator control. For each successor transition of an active step, an operator prompt is set and control passes to the next step or steps when the operator prompt has been confirmed. If the transition is true before the operator prompt is acknowledged, control passes to the next step or steps without operator intervention (automatically).
T/T and C	Control with step-specific confirmation by operator. The sequential control system proceeds in the following manner: • **process-controlled** in steps without the "confirmation" identifier Each completed transition following a step without this identifier passes on control without operator intervention (corresponds to T). • **Operator-controlled** in steps with the "confirmation" identifier If the transition following an active step with this identifier is completed, an operator prompt is set and control passes to the next step or steps after the prompt has been confirmed (corresponds to T and C).

Execution and start options

Option	Meaning
Command output	Default: On During installation and commissioning, or if errors occur, blocking command output in conjunction with certain operating modes can bring the sequential control system to a defined state without influencing the process. The actions are processed by activated steps when the check box is selected; otherwise the actions are not processed.
Cyclic operation	Default: Off When the sequence is completed and the check box is selected, the SFC or the SFC instance that was created by this type switches over from "Completed" to "Starting" mode. The SFC or the SFC instance automatically begins with start processing.
Time monitoring	Default: Off When this check box is selected (check mark), the monitoring times (# 0 ms) set as parameters in the object properties of the steps are evaluated. A message is generated (step error) if this time is exceeded.
Autostart	Default: Off When this check box is selected, the SFC or SFC instance generated from this type is set to "Starting" mode after a complete restart of the CPU. The SFC or the SFC instance automatically begins with start processing. Otherwise the SFC or the SFC instance is in "Idle" mode waiting for the start command.
Use default operating parameters when SFC starts	Default: Off When this check box is selected, all operating parameters set in the "Defaults" group (and possibly changed in test mode) are reactivated when the SFC or SFC instance starts.

9.15.8.9 Handling of charts, types, and instances

Introduction

You can do the following with SFCs and SFC types:

- In the SIMATIC Manager and SFC Editor:
  - Create new
  - Open for editing
  - Change the properties
- In the SIMATIC Manager only:
  - Copy and delete
- Within a CFC:
  - Copying and deleting SFC instances

Opening SFCs, SFC types and SFC instances

The SFC editor without chart window is opened when you execute the "**SFC - Creating sequential control systems**" command using the search box in the start menu. No chart is opened.

What?	How ?
Open SFC in the SFC Editor	In the SFC editor, select the menu command **SFC > Open...** and then select the required chart.
Opening an SFC Type in the SFC Editor	Select the menu command **SFC > Open...** in the SFC editor. To open an SFC type, you must select the entry "SFC type" from the drop-down list in the "Open" dialog box field from the "Object type" field.
Open SFC in the SI-MATIC Manager	Select the required SFC in the component view or plant view with the menu command **Edit > Open Object**.
Open SFC type in the SIMATIC Manager	Select the required SFC type in the component view with the menu command **Edit > Open Object**.
Opening SFC instan-ces	Select the SFC instance in the CFC and in the shortcut menu the menu com-mand **Open**.

Copying, moving and deleting SFCs, SFC types and SFC instances

What?	How and Where?
Copying SFCs	Copying entire charts allows you to copy structures or substructures you have tested, even to other CPUs. You can copy not only individual charts but also an entire chart folder with all the charts it contains. Note that the name of the chart folder within the multiproject must be unique.
Moving SFCs	Moving entire charts allows you to move structures or substructures you have tested, even to other CPUs. You can move not only individual charts but also an entire chart folder with all the charts it contains.

What?	How and Where?
Copying SFC types	SFC types can be copied in the SIMATIC Manager (component view). The runtime objects belonging to the SFC type are also copied. If the generated version of the SFC type is not up-to-date (time stamp of the FB older than the time stamp of the SFC type), a message is displayed. If the SFC type already exists at the destination when you copy the SFC type (SFC type with the same name), this is overwritten after a prompt for confirmation and any differences from the existing type are transferred to the SFC instances.
Moving SFC types	SFC types can be moved in the SIMATIC Manager. SFC types can only be moved when no SFC instances of the SFC type exist in the source. The runtime objects belonging to the SFC type are also moved. If the SFC type already exists at the destination (SFC type with the same name), this is overwritten after a prompt for confirmation and any differences to the existing type are transferred to the SFC instances.
Copying SFC instances	If you copy an SFC instance within a CFC or between CFCs in the same chart folder, or copy a CFC within a chart folder, the SFC instance is copied. The runtime objects belonging to the SFC instance are also copied. When you copy an SFC instance between CFCs from different chart folders or copy a CFC to a different chart folder, the SFC type is also copied.
Moving SFC instances	Only the position of the SFC instance changes if you move an SFC instance within a CFC. If you move an SFC instance between CFCs of the same chart folder, the SFC instance is moved. The runtime objects belonging to the SFC instance are retained. When you move a CFC to another chart folder, the SFC type is also copied.
Deleting charts and SFC types	You only delete SFCs and SFC types in the SIMATIC Manager. You can delete SFCs in the same way as other objects (hierarchy folder, OS pictures, etc.); mark them and select the menu command **Edit > Delete**. You can only delete SFC types if there are no SFC instances for the SFC type. If there are instances for an SFC type, a message will appear indicating this. The runtime objects belonging to the SFC type are also deleted.
Deleting SFC instances	You delete SFC instances in the CFC or indirectly by deleting the CFC in the SIMATIC Manager. The runtime objects belonging to the SFC instance are also deleted.

Additional information

- Online help on SFC

9.15.8.10 How to configure messages in the SFC

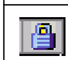
Introduction

You can configure specific message texts for each SFC/SFC type. You can change the message text in a dialog box.

Procedure

1. Select the menu command **SFC > Message...** in the SFC Editor.
   The "PCS 7 Message Configuration" dialog box opens.
2. Use the table below to configure the block-related message types and messages for display on the PCS 7 OS.

Settings for messages

Column	Meaning
Message name	This column displays the name of the block-related message within the message configuration.
Message class	Select the required message class in this field.
Priority	Select the priority level for acknowledging individual messages in this field. The higher the value, the higher the priority.
Event	Enter the message text in this field.
Single acknowledgment	Select the check box, if the message should be acknowledged as a single message.
Info text	Enter the info text in this field.
With acknowledgment	Select this check box if the messages generated should be acknowledged. Depending on whether this check box is selected or not, the "Message class" column will either display those classes that can be acknowledged or those that cannot be acknowledged.
	For SFC type only! Whether or not this column is displayed depends on whether you are editing message types or messages. By putting a check mark in this column, you can interlock the text you entered in the column before it.

Note

If you edit existing messages, the entries for Origin, OS area, and Batch ID are displayed in red and italics if they were edited during message configuration and the entries are not uniform. To make the entries uniform, overwrite the displayed text.

If you have not yet created a PCS 7 OS, a display device is created automatically and given an internal name.

9.15.8.11 How to create an SFC type

Introduction

The SFC type is managed in the SIMATIC Manager component view.

An SFC type does not have any runtime properties, since it is not relevant to execution of the program. An SFC type cannot be installed in the run sequence.

Creating an SFC type

There are two possible methods for creating and modifying a SFC type:

- Creation/modification in a library
  The advantage of this is that the master for the SFC type is always located in the library and that the test project always remains executable until a new version of the SFC type is adopted.
- Creation/modification in a project
  This is advantageous as each change to the SFC type can be checked immediately because you are working directly with the master.

Requirement

- A PCS 7 project is created.

Procedure

1. Select the menu command **Insert > S7 Software > SFC Type** in the component view of the SIMATIC Manager with a selected chart folder.
   The next free FB number is automatically reserved for the SFC type to be created and the type template with this number is copied to the block folder. The FB number can be changed later in the "Object properties" dialog box.
   When you first create an SFC type, the blocks required for compilation are copied to the current program and then managed in the ES. The blocks are contained in the supplied *SFC Library*.

   Note

   SFC types cannot be assigned to a hierarchy folder in the plant view since they themselves are not relevant to execution (from the perspective of the process to be automated).

   ---
2. Select the SFC type in the SIMATIC Manager and then the menu command **Edit > Object Properties...**.
   The "SFC Type Properties" dialog box opens.
3. Set the SFC type properties and the operating parameters.
   You can find additional information on this in the online help and in the section "How to adapt the operating parameters and runtime properties (Page 499)".
4. Select the SFC type in the SIMATIC Manager and then the menu command **Edit > Open Object...**.
   The SFC type opens.
5. Select the SFC Editor menu command **View > Characteristics** and add the control strategies, setpoints (note: do not forget the control strategy assignment), process values, block contacts, etc.
6. Add and then configure the sequencers. Edit the start conditions.
   You can find additional information on this in the section "How to specify the sequencer properties (Page 491)".

7. Configure the messages for the SFC type.
   You can configure a maximum of 7 messages that require acknowledgment and 5 that do not. The SFC type itself requires the remaining available messages (one per message type and 10 notify messages for SIMATIC BATCH).
   You can find additional information on this in the section "How to configure the messages in the SFC (Page 505)".
8. Configure a text box in the SFC editor via menu command **SFC > Text Boxes...**. You can configure a text box for an SFC type, as done with the SFC.

You can find additional configuration options in the online help on SFC and in the manual *SFC for S7; Sequential Function Chart*.

Templates for SFC Type

The following SFC types can be found as templates in the library *"SFC Library"* under "SFC Library > Blocks+Templates > Templates":

- "TypeStates"
  This SFC type already contains several sequencers for state-based processing of the sequential control system.
- "TypeCtrlStrategy"
  This SFC type contains control strategy-based processing of the sequential control system.

You can copy these templates and modify them for your own use.

Interface of the SFC type

The SFC type has an interface analogous to the SFC. The interface is created when the SFC type is generated. The interface already includes the SFC type standard interface, which was derived from the SFC type template. The standard interface is required to provide SFC system functionality (operating modes, operating states, step control modes) on the SFC type interface.

- The elements of the standard interface cannot be moved or deleted. The initial value, comment, and attributes can be modified.
- You can expand the interface by adding I/Os with the interface editor; characteristics can be added with the characteristics dialog box. The same applies for these elements as for the standard interface.
- Special feature of block contacts: the interface is extended by the predefined I/Os of a block type. This is made possible by the "S7_contact" attribute (predefined I/Os for interconnecting to the SFC type).
- If more connections of the interface are to be displayed than can be displayed on three chart partitions, some block I/Os can be set invisible.
- During configuration, only the interface I/Os can be used to formulate step assignments or transition and start conditions. As a consequence, addresses in assignments or conditions are always references to I/Os of the interface. Here, textual interconnections are also possible. As a result the SFC type is self-contained. There are no external accesses originating from SFC type which bypass the interface.

Additional information

- Online help on SFC
- Manual *SFC for S7; Sequential Function Chart*

9.15.8.12 How to create an SFC instance

SFC instance

An SFC instance is generated by dragging the SFC type from the CFC block catalog into the CFC.

The SFC types in the chart folder of the AS are displayed in the CFC block catalog (in "All blocks" and in the folder of the family if they are assigned to a family, otherwise in the "Other blocks" folder).

The SFC instance is displayed like a CFC instance block. If there is not enough free space to position the SFC instance and it overlaps one or more objects that have already been placed, it will be displayed as an overlapping block (light gray and without visible I/Os). After moving them to a free location in the chart, the overlapping blocks are displayed as normal blocks again.

You can assign parameters to the SFC instance in the CFC and interconnect it in test mode.

If you have defined block contacts, when you interconnect an I/O of this block, the other I/Os are automatically interconnected (predefined I/Os for interconnection with the SFC type ("S7_contact" attribute)). The most important I/Os are already predefined in the technological blocks of the *PCS 7 Advanced Process Library*.

Procedure

1. Open the CFC in which you want to interconnect an SFC instance with the blocks of basic control.
2. Select the SFC type in the "Other blocks" block catalog of the CFC and place it in the CFC. An instance of the SFC type is created in the CFC.
3. Specify the properties of the SFC instance. You can change the general properties (name, comment) in the object properties of the SFC instance in the CFC.

4. Adapt the operating parameters and options of the instance:
   Use the shortcut menu command **Open** to open the SFC instance in the CFC and adapt the operating parameters in the "Properties" dialog box. These parameters determine the runtime behavior in the AS.
   You can find additional information on this in the section "How to adapt the operating parameters and runtime properties (Page 499)".
   You can optionally select which control strategies specified by the SFC type are to be used for the SFC instance.
5. Configure and interconnect the interface of the SFC instance:
   Assign the parameters for the I/Os of the SFC instance in the CFC using the object properties or in the SFC using the "I/Os" interface editor.
   In the CFC, interconnect the I/Os of the SFC instance with the I/Os of the CFC blocks or with shared addresses or create textual interconnections.

Additional information

- Online help on SFC

9.15.8.13 How to change an SFC type centrally

Introduction

SFC types can also be kept in the master data library. To be able to use them, you need to copy the SFC types from the chart folder of the master data library into the chart folder of the S7 program in the AS. In the result, the SFC types are visible in the CFC catalog, "Blocks" tab (Other blocks) and can be placed in the CFC from there. You can find information about this in the section "How to create an SFC instance (Page 509)".

To run an SFC instance, both the SFC type and the SFC instance are downloaded to the automation system.

Rules for changing the configuration

- In general, changes made to the SFC type, which prevent or limit a download of changes in RUN, may only be carried out following operator confirmation.
- Modifications to the interfaces of the SFC type are transferred to the corresponding SFC instances immediately. This means that the SFC type and its instances can only be downloaded in AS RUN mode when all SFC instances of this SFC type are deactivated or are deactivated briefly during the download process.
  The instances are deactivated during the download following operator confirmation and restarted after the download, again following operator confirmation. The execution of the instance then depends on the process state and on the configuration of the instances (especially the start conditions).
- While changes are being downloaded, the system prevents the SFC instances from being processed in the AS and prevents access to the SFC instances through interconnections in the CFC.

- Changes to the topology (step/transition sequence, changed jump target) or step/transition configurations are made to the SFC type and become effective in the SFC instances only following compilation and downloading.
  Inactive sequencers can be downloaded at any time when changes are made to the topology during downloads, whereas the SFC instances must be deactivated before downloading active sequencers.
- Changes to the step and transition configuration can be downloaded at any time even if SFC instances of the SFC type are currently being processed in the AS.
- After configuration changes are made, you need to compile the OS to ensure that the current data is available there.

Procedure

1. Open the SFC type in the chart folder.
   The SFC type is opened in the SFC editor.
2. Make the required changes in the SFC editor.
   The changes are made to the SFC type and to each of the existing SFC instances.
3. Compile, download, and test the program.
4. Copy the SFC type to the master data library so that the modified version is available in the CFC block catalog.
5. If the modifications made are relevant for assigning parameters or interconnections, these modifications must be carried out in all the SFC instances.
   In order to do this, open the relevant CFCs and complete them.

Additional information

- Section "How to download SFCs (Page 514)"
- Manual *Process Control System PCS 7, Getting Started - Part 2*

9.15.8.14 How to compile charts and types

Compile

During compilation (scope: entire program) all charts (including SFC types) of the current chart folder are transferred block-by-block to the SCL Compiler and compiled. After changing the SFC (SFC type, SFC instance), you only need to compile the changes (scope: "changes").

Consistency is automatically checked during the compiling process. You can also start this check manually.

After compiling, download the user program to the CPU, test it and then put it into operation.

Settings for compiling

Use the menu command **Options > Customize > Compile/Download...** to open the dialog box containing the information about the resources used in conjunction with compiling charts. The following can be specified:

- The warning limits to be applied so that possible dangers are detected before downloading.
- The resources to remain unused during compilation of the charts of the current chart folder. This can, for example, be useful if you want to solve an automation task partly with charts and partly by programming (for example, STL, LAD or SCL programs) and when you have functions (FCs) or data blocks (DBs) from other sources in your user program.
- In addition, you can view the statistics which show many resources (DBs, FCs) are available in your CPU for compiling the charts and how many are already in use.

Note

If you only work with CFC and SFC in your program, you can leave the standard compilation settings unchanged.

You can find an overview of the blocks generated during compilation in the online help.

Consistency check

Prior to the actual compilation, the system automatically makes the following consistency checks:

- Whether the block types in the user program match the types imported into the CFC.
- Whether symbolic references to shared addresses are entered in the symbol table.
- Whether the data blocks (DB) to which there are interconnections actually exist in the user program.
- Whether in/out parameters or block outputs of the type "ANY", "STRING", "DATE_AND_TIME" or "POINTER" are supplied (interconnected).
- Whether all the blocks accessed by SFC conditions or statements still exist.

Note

You can also check the consistency without compiling. To do this, select the menu command **SFC > Check Consistency**.

Procedure

1. Select the menu command **SFC > Compile...**.
   The "Compile program" dialog box appears.
2. Select one of the following options in the "Scope" group to specify the scope of the compilation:
   - Entire program: All the charts are compiled.
   - Changes: Only the objects changed since the last compilation are compiled.

3. Select the "Generate SCL source" check box if required.
4. Click "OK".
   The compilation process begins.

Result

The charts of the current program (chart folder) are checked for consistency and then compiled.

Saving settings without compiling

You can save the settings with the "Apply" button in the "Compile Program" dialog box without starting the compiling process.

Display logs

The result of the consistency check and all messages occurring during compilation are displayed automatically following compilation.

You can also display the log later and print it out with the menu command **Options > Logs...**.

Additional information

- Online help on SFC

9.15.8.15 How to compare the SFCs before downloading

Introduction

During configuration, testing and commissioning, there is often the need to compare a new/changed SFC with the previously loaded version before downloading it.

Requirement

Before the initial download in the SFC editor, use the menu command Options > Settings > Compile/Download and activate the check box "Generate image of downloaded program for comparison" in the "Settings for Compiling/Laden" dialog box.

Procedure

1. Select the menu command **PLC > Download...** in the SFC Editor.
2. Click the "Show Changes" button.
   The Version Cross Manager opens and the image created by the previous download (see Requirements) is compared with the version to be downloaded and correspondingly displayed.

   Note

   The "Show Changes" button is only enabled when the "Version Cross Manager" add-on package is installed and an image has been generated for the loaded program.
3. Go back to the "Download" dialog box.
4. Click "OK" or "Cancel".

Additional information

- Online help on SFC

9.15.8.16 How to download SFCs to the CPU

Download

Before the graphic charts can be put into operation on a CPU, the charts must first be compiled and downloaded to the CPU. The charts are downloaded to the CPU to which the user program containing the current chart folder is assigned.

Requirements

- There must be a connection between the CPU and your programming device/PC.
- The edit mode is set (not the test mode).
- If you download the entire program, the CPU is in STOP mode.
  If you only download changes, the CPU may be in RUN-P mode.

Procedure

1. Select the menu command **CPU > Download...** in the SFC Editor.
   The "Download to CPU" dialog box opens.
2. Select one of the following options in the "Download mode" group to specify the scope of the compilation:
   – Entire program
     The entire content of the "Blocks" folder is downloaded.
   – Changes
     The CPU can be in the "RUN-P" mode. Only the changes made since the last compiling are downloaded.
   – Download to test CPU
     With this type of download, you can download a modified program to another CPU or to an S7 PLCSIM, without losing the delta download capability in the original CPU.
3. Click "OK".
   The compilation process will begin.

   Note

   With the programs created in SFC, you must download to the CPU from SFC (or CFC), since only this download function guarantees the consistency of the configuration data with the CPU data.

   The same download function is available in the SIMATIC Manager with the following menu commands:
   - Menu command **CPU > Compile and Download Objects...** and then activate the "Charts" object for compiling and downloading
   - In the component view: Mark the "Charts" folder and select the menu command **CPU > Download**

Result

The program (or only the changes) is downloaded to the CPU.

Note

If you have made download-relevant changes in the configuration and have not compiled since you made the changes, you will be prompted to compile before you download. The download is automatically carried out after error free compiling.

Complete download

If you select "Download: entire program", all the charts from the current chart folder are downloaded to the CPU in this download mode. After a prompt for confirmation the CPU is set to STOP and all of the blocks are deleted in the CPU.

Note

Compiling the entire program does not necessarily mean a complete download. If the program was already loaded in the CPU prior to compiling, then it is possible to download only changes.

If a full download is aborted, changes cannot be downloaded until the full download is completed. Reason: The blocks on the CPU were deleted prior to the download.

Downloading changes

If you select "Download: changes only" in the "RUN-P" CPU mode, you can download changes to your configuration to the AS without having to change the CPU to the STOP mode. With this type of download, you only download changes that have been made since the last download. Please comply with the following:

- If the chart topology has been changed in the SFCs (steps or transitions added, deleted, copied, moved, jump destination changed, ...), these charts must be deactivated when changes are downloaded.
- Modifications to the interface of the SFC type are transferred to the SFC instances immediately. The SFC instances must therefore be deactivated during downloads and execution stopped on the CPU.
- If SFCs have been modified (chart properties, object properties are the steps/transitions) without changing their structure, you can download the charts after they have been compiled while the CPU is in RUN without needing to deactivate the modified SFC.
- If you have not changed the chart itself, but only the objects that are accessed (for example, a symbol in the symbol table, runtime groups, block I/O), you do not need to deactivate the chart before it is downloaded.
- After you download changes, a stopped SFC with the property "Autostart: on" is not started automatically, it must be restarted by the operator.

Note

Please take note that there is no absolute guarantee that the CPU will not switch into the STOP mode when changes are downloaded.

See also

How to load individual changed charts into the CPU (Page 453)

9.15.8.17 How to test SFCs

Test mode

The SFC editor provides test functions that support the commissioning process. These are used to monitor the sequential control system in the AS, to influence it and to change setpoints, if necessary. For this purpose switch the SFC editor into a test mode.

Operating modes of the test mode

The test mode refers to the CPU which involves the active chart. As an alternative you can test in two operating modes:

Operating mode	Description
Process mode	In process mode, the communication for online dynamic display of the SFCs and SFC instances is restricted and causes only minor additional load on the CP and bus. If an overload occurs in process mode, a message is displayed indicating that the limit of the bus load has been reached. In this case, you should stop the test mode for the SFCs that are not absolutely necessary for the test. When test mode is activated, all blocks have the status "Watch Off".
Laboratory mode	Laboratory mode allows for convenient and efficient testing and commissioning. In contrast to process mode, communication for online dynamic display of SFCs is unrestricted in laboratory mode. When test mode is activated, all blocks have the status "Watch On".

Requirements

- There must be a connection between the CPU and your programming device/PC.
- The program has been downloaded.

Activate/deactivate test mode

1. Select the required operating mode with the menu commands in the **Test** menu:
   – **Test > Process Mode**
   – **Test > Laboratory Mode**

   Keep in mind that it is not possible to switch the type of test used while in test mode.
2. Select the SFC menu command **Test > Test Mode**.
   Test mode is activated.
3. Select the menu command **Test > Test Mode** once again in the CFC to stop test mode.

Testing

Once you have started the test mode, you can test the functionality of your SFC.

The SFC can be started in "manual" mode. You can also influence the operating parameters used for executing the SFC (for example, cyclic operation).

If the SFC is in the "RUN" operating mode, the following is displayed:

- Which step is currently active
- Which actions are executed in this step
- Which transitions are active and the conditions that must be satisfied for this transition

Note

Any operator input that you made or parameters you assigned in test mode are then performed simultaneously in the CPU and in the data of the SFC.

If you switch an S7 CPU off and on again without battery backup, these parameter changes are lost in the CPU. To restore the parameter settings in these cases, you must recompile the chart folder and download it to the CPU again from your PC/programming device.

Additional information

- Online help for SFC
- Manual *Process Control System PCS 7, Getting Started - Part 1*
- Manual *SFC for S7; Sequential Function Chart*

9.15.9 Creating models (multiproject)

9.15.9.1 How to create and edit a model

Introduction

Generally a plant is structured by dividing it into smaller functional units that can be classified, for example, as fixed setpoint controls or motor controllers.

Instead of planning these functional units each time it is possible to create a supply of prefabricated functional units known as models in the engineering system. Then you only have to copy and modify them according to the requirements of the new solution.

To ensure that a model is used in only one version throughout a project, all models should be stored centrally in the master data library and all adaptations should be made prior to generating the replicas.

Model

Note

You can only create or modify models in a multiproject.

A model consists of hierarchy folders that contain the following elements:

- CFC/SFCs
- OS pictures
- OS reports
- Additional documents

A model also contains a link to an import/export file (IEA file).

Using the import/export assistant (IEA), you link block/chart I/Os and messages of blocks to the columns of an import file.

Replicas

The model can be imported with the Import/Export Assistant after it is prepared in this way and linked it to an import file. The generated replicas are assigned the parameters, interconnections, and messages of the model. Each line in an import file creates a replica in the destination project.

Requirement

The functional unit from which you want to create a model has been tested on the automation system and on the operator station.

Creating a model

1. Select the hierarchy folder containing the CFC (or CFCs, SFCs, etc.) required for the model in the master data library (or a hierarchy folder containing a nested hierarchy folder with a CFC).
2. Start the wizard with the menu command **Options > Models > Create/Modify Model...** and select the following in the next steps:
   – Which I/Os do you want to import as parameters or signals?
   – For which blocks do you want to import message texts?
   – Which import data do you want to assign to specific model data?

In the step "Which import data do you want to assign to specific models?", the text "No import file assigned" is initially entered in the "Import file:" text box. By clicking "Other File..,", you can browse and enter an import file.

Creating an import file

In case the import file does not yet exist or no suitable import file exists, you can create an import file with the "Create Template File..." button from the previously selected model data.

For this purpose there are two methods of procedure:

- You create the import file and at the same time edit the required column titles.
  - In the "Import file" list, select the entry "No import file assigned".
    The editing mode is now active in the "Column Title" column of the "Model Data" list.
  - Edit the required column titles.
  - Continue as described for the second procedure.
- You generate the import file with "artificial" column titles since you do not yet want to finalize the texts:
  - Click "Create file template..." and specify the file name.
  - Select the optional column types in the next dialog box or deselect the columns that are not of interest (for example, LID, FID).

In the structure of the file, the attributes of the I/O flags are evaluated and the entries for Text 0, Text 1, unit, value, and identifier are entered automatically if they exist; interconnections, chart name and hierarchy are entered automatically. Afterwards, only the hierarchy and the chart name must be adapted.

If you select the second method, you can edit the assigned file with the IEA file editor by opening it with the "Open File" button. You can perform the following here:

- Change the column titles
- Remove individual columns that are not required
- Add lines
- Edit descriptions

After saving the file, the Import/Export Assistant displays the new column titles that you must subsequently assign.

Finishing the model

1. Once you have assigned the import data to the model data, click "Finish".

Result

You then have a model available with an assignment to a column of the import file for each selected I/O and each selected message; as a result every column of the import file has been used (1:1 assignment).

When working with messages the following applies: not all lines of the model data must be supplied with data from the import file. The number of messages in the import file can, therefore, be less than the number of messages in the model (in this case the 1:1 assignment does not apply).

The hierarchy folder is displayed as a model in the SIMATIC Manager.

Modifying a model

Models that do not have replicas can be modified at any time.

1. Select the menu command **Options > Models > Create/Modify Model...**.

If you modify models that already have replicas, a message is displayed since the import data no longer match the model data.

If you modify the I/O points (IEA flags) of a model that already has replicas, a message is displayed and the dialog box is expanded by an additional step. All the modifications that have been made are logged in this additional dialog box. The following modifications are then made to all replicas:

- If IEA flags are missing in the replicas, they are set.
- If there are more IEA flags set in the replicas than in the model, these are removed from the replicas.

Note

The block names may no longer be modified in an existing model or in replicas of a model. Otherwise, import/export is no longer possible.

With the IEA, you can assign parameters to block I/Os and chart I/Os and interconnect them; you can also rename chart I/Os.

Note

Please remember that it may be necessary to adapt the IEA file as well.

Additional information

- Section "How to work with models in the SIMATIC Manager (Page 524)"
- Online help for *PH*, *IEA* and *PO*

9.15.9.2 Textual interconnections and models

Introduction

Using a textual interconnection, you interconnect the inputs and outputs of blocks or nested charts for the import. This can be done both within a chart and across charts.

Requirements

- The interconnection partners are in the same chart folder.

Syntax

The interconnection has the following syntax:

cfc\baustein.anschluss

or

cfc\chart.io

or

sfc.I/O

If folders of the PH are included in the name, the path of the plant hierarchy can also precede the name (ph\ph\cfc\chart.block] but this is ignored.

Textual interconnections

Textual interconnections are possible only for I/Os defined as parameters.

Textual interconnections can start both at outputs and imports if these are defined as parameters. Multiple interconnections are possible only at the outputs of the CFCs. Only single interconnections are possible at the inputs.

When creating the IEA file, the textual interconnection check box must be activated on the "Parameters" tab of the "Create File Template" dialog box.

Multiple interconnections

Multiple interconnections are interconnections that lead from one output to several inputs.

- Multiple interconnections can be entered in the import file for parameter and signal outputs. The I/O names are separated in the column by quotation marks (").
- If you want to retain an existing single interconnection and add a new interconnection, enter the separator character " (quotation mark) after the text for the interconnection. Without this separator character, the old interconnection would be replaced by the new one.
- If a multiple interconnection already exists, the interconnection is always created during import in addition to the existing and connections. This happens regardless of whether or not there is a separator character.
- The keyword "---" deletes all interconnections at the output.

During export, the existing multiple interconnections are also indicated by the " separator character.

Rules

The following rules apply when working with textual interconnections in models:

- When you create a model/process tag, the "Create Template File" function enters the interconnection partner according to the interconnection in the model for the textual interconnection in the "TextRef" column. This would lead to an interconnection in the model and thereby change the model during the import process.
  This column must, therefore, be corrected. To prevent accidental changes to the model, the interconnection partner is prefixed by a question mark ("?") in the "TextRef" column, which would lead to an error during import.
- As part of the correction process, you can search for "?" with the IEA file editor and modify these cells accordingly.
  Textual interconnections should, whenever possible, only originate at inputs. For this reason, no "TextRef" columns are created for outputs when the file template is generated, even if the "Textual Interconnection" option has been activated in the selection dialog. If required, you must create these extra with the "Expand Column Group" function of the IEA editor.
- Textual interconnections are set up at parameter I/O points, interconnections to shared addresses at signal I/O points.

9.15.9.3 How to create replicas of models

Introduction

Using the Assistant for models, you import the data of the model.

The model is copied from the master data library to the specified target projects as a replica. Thereafter the data is imported. According to the entry in the import file, you can create any number of replicas.

When you import, you can decide whether or not the imported signals will be entered in the symbol table (option: "Also enter signals in the symbol table"). With PCS 7, we recommend that you do not use the option because these entries are made when you configure the hardware with HW Config.

Requirement

The corresponding import file is available.

Note to reader

You can find a detailed description of the creation of the import files in the section "Importing/Exporting Process Tags/Models". The following is a description of the basic procedure used when import files have already been assigned.

Procedure

1. Select the required model in the master data library.
2. Select the menu command **Options > Models > Import...**
   The wizard searches for the single control unit types and corresponding import files (in all hierarchy subfolders as well) and lists them. The import is executed for all the import files listed.
3. If you do not want to import certain files, you can select them and remove them from the list with the "Remove" button.
   By clicking "Other File", you can search for a different import file and select it instead of the other file.
4. Click "Continue" and then "Finish".
   The actual import process starts.

Result

Depending on the setting of the "Only show errors and warnings in log" check box, the complete list of activities with the individual steps or only the errors that occurred are displayed in the log window.

The log is saved to a log file. The name and path of the file are displayed below the log window. You can modify this setting with the "Other File" button.

Additional information

- Section "How to import process tag types and models (Page 587)"
- Online help for *PH*, *IEA* and *PO*

9.15.9.4 How to work with models in SIMATIC Manager

Copying models

Note

In a multiproject, a model must not exist more than once and must be located in the master data library.

The following applies when copying models in the SIMATIC Manager:

- When you copy a model **within the same multiproject or from the multiproject into a different multiproject**, a replica of this copy is created with identical content.
- When you copy a model from the master data library **into a project**, a replica is created.
- When you copy a model from the master data library **into a different master data library** (different multiproject), it remains a model.
- When you copy a model from the master data library **into a different library**, it remains a model.
  This way you can create a backup of the model. During import, the backup is ignored.

Copying replicas of the model

When you copy a replica of a model in the SIMATIC Manager **within the same multiproject**, this new hierarchy folder is also assigned to the original model. Similar to all other replicas generated with the IEA, this copy is not assigned to the import file. It reacts in the same manner as a replica generated per import with the IEA.

When you copy a replica **to a different multiproject**, it has no assignment there as long as there is no copy of the corresponding model in the master data library. The replica receives its assignment again when it is copied back into the original project (for example, when branching and merging project data).

Removing models

If you no longer want a model to be available for import/export, or if you want the model to become a normal hierarchy folder again, follow these steps:

1. Select the hierarchy folder
2. Select the menu command **Edit > Object Properties...**.
3. Open the "Models" tab.
4. Click "Clear".

The saved assignment to the import file is deleted. This also means that all existing replicas of the model are converted into normal hierarchy folders.

Removing replicas

Model replicas can be removed in the same manner as models. Follow these steps to change replicas back into "normal" hierarchy folders.

1. Select one of the replicas.
2. Select the menu command **Edit > Object Properties...**.
3. Open the "Models" tab.
4. Select the replica and click "Clear".

Deleting models with replicas

When you delete a model of which a replica already exists, all the replicas are retained unchanged but they lose their assignment to the model.

When you then replace the deleted model with a model of the same type (for example, by branching and merging projects), the assignment of the replicas is established again.

If you do not want to retain them as replicas, but want to convert them back into normal hierarchy folders, then proceed in the manner described above (section "Removing replicas").

9.15.9.5 How to assign replicas to a model later on

Use cases

By using the IEA, you can convert replicas or neutral hierarchy folders with CFCs that do not belong to a model into replicas of an existing model if the structure of the replica corresponds completely to the structure of the model.

The following applications are conceivable:

- You imported into a project and then adapted the replicas locally. Due to a handling error (for example, the model was forgotten after branching and merging in distributed engineering), the replicas exist but the associated model is missing.
- You want to continue working with the IEA in a project after several charts have already been created and adapted locally. You want to assign the hierarchy folders with these charts to a model as replica.

The procedure for the situations outlined above is described below.

Procedure

If replicas no longer have a corresponding model, then a suitable model can be created for them in the following manner:

1. Select the replica.
2. Select the menu command **Options > Models > Create/Modify Model...**.
3. Select the previous import file in subsequent dialog steps and assign this import data to the model data.
   You can find further information about this in the section "How to create a model (Page 518)".
4. Start the export using the **Options > Models > Export...** menu command.
   You can receive an IEA file that includes the current data of all existing replicas.

9.15.10 Editing mass data

Introduction

In the process object view (Page 218), all project-wide data of the basic automation can be displayed and edited in a view based on process control. Project-wide means that the data from all the projects is contained in a multiproject.

Working with the process object view

You can create, copy, move, and delete objects in the tree view. The properties of the hierarchy folders for batch and continuous plants can also be edited here.

All essential aspects of the objects can be documented and edited directly in the table (content window), without the need to access the configuration tools for editing the objects.

Not all the attributes can be edited directly. This information is then grayed. There are however shortcuts to the necessary configuration tools.

Shortcuts in the Process Object View

You can edit aspects of an object (process tag, CFC, SFC, picture) in the supporting configuration tool if they cannot be edited in the process object view.

There are shortcuts to the selected object in the process object view that you can call with the menu command **Edit > Open Object**. This applies regardless of the selected tab.

The following table provides an example of this for the "General" tab:

Object	Establishes ...	Opens ...
Picture	The connection between a process tag, a CFC or an SFC and their picture interconnections.	The WinCC Graphics Designer with the picture defined by the currently selected cell/row.
Archive	The connection between a process tag, a CFC or an SFC and their archive tags.	WinCC Tag logging with the archive defined by the currently selected cell/row.
Chart	The connection to the CFC/SFC.	The CFC/SFC Editor with the relevant chart defined by the currently selected cell/row.
Module	The connection between a process tag or a CFC and the corresponding modules.	HW Config with the object properties of the module.
Message	The connection to the block message.	The dialog box for configuring messages with block messages defined by the currently selected cell/row.
Symbol table	The connection to the symbol table.	The symbol table of the S7 program defined by the currently selected cell/row.

Overview

Editing mass data in the process object view involves the following topics:

- How to edit general data (Page 530)
- How to edit blocks (Page 533)
- How to edit parameters (Page 535)
- How to edit signals (Page 538)
- How to edit messages (Page 541)
- How to edit picture objects (Page 543)
- How to edit archive tags (Page 545)
- How to edit hierarchy folders (Page 547)
- How to edit equipment properties (Page 548)
- How to edit shared declarations (Page 549)
- How to test in the process object view (Page 550)

Additional information

Section "Configuring logical operations (Page 449)"

9.15.10.1 Working in the process object view

Filtering

In the process object view, you can limit the number of objects selected for display by using a filter. The default setting is: <No filter>.

In the "Filter by column:" combo box, select the column in which you determine the objects to be displayed in the table with the filter text ("Display:" text box).

Examples:

- You want to display all CFCs in the table.
  Select the type in "Filter by column:" and enter "cf" in the "Display:" text box.
  All object types that start with the letters "cf" are displayed (e.g. all CFCs).
- You want to display all objects from a certain range in the table:
  Select the path in "Filter by column:" and enter "*Boiler" in the "Display:" text box.
  All objects whose paths contain the "Boiler" character string are displayed.

Special filter entries apply to the "Simulate outputs" column.

Note

The filter settings that you make in the "General" tab apply to all other tabs. The filter settings in these tabs specify the selection you make.

Sorting

You can sort the data displayed in the process object view in ascending and descending alphanumeric order. To do this, click the heading of the column whose data is to be sorted. A small arrow will indicate whether the data has been sorted in ascending or descending order.

Setting the column width

You can set the width of the columns directly in the table (in the same way as with Excel). When you close the process object view or SIMATIC Manager and reopen it, these settings will remain.

Dividing a table

You can divide the window into two halves (left and right), so that each has an individual scroll bar. This is a function which you may recognize from Excel, for instance.

Displaying/hiding columns

You can use the menu command **Options > Settings...** to hide columns, show columns that were previously hidden, and change the order of the columns in the "Columns" tab.

Defining your own columns

You can also use the menu command **View > Define Columns...** to add or remove your own columns. You can enter project-specific data in these columns, for example, specific information about maintenance intervals. This information is saved at the relevant process object and is copied along with the object.

Note

Within a project, on the "Blocks" tab you can assign the **OS-relevant** attribute to a newly defined column or remove an attribute that has already been assigned, using the corresponding shortcut menu command.

Importing and exporting

You can also use import and export functions to exchange this data with other tools.
You can find additional information about this in the section "Data exchange with plant engineering (Page 575)".

Restrictions for copying, moving, and deleting

It is possible to copy, move, and delete objects in the process object view in exactly the same way as in the plant view. However, the following restrictions apply:

- Copying and moving from the content window (right window) into the tree view (left window) or into another view, is only possible in the "General" tab.
- Copying and moving from the tree view or from another view into the content window is not possible.
- Deleting objects is only possible in the tree view or in the "General" tab of the content window.

Carrying out procedures for individual blocks

You can select and copy information in the table for individual blocks, and paste it at a different location. This function is not only available within the table itself, but also between the table and Office applications, for example, such as Excel and Access.

This allows you to copy data from specified lists to PCS 7 quickly and easily. If an error occurs during this process, you can correct it using the "Undo" function (via the shortcut menu in the table).

Find and replace

You can find and replace text in the tabs of the process object view (with the shortcut menu in the table).

The Find operation starts from the cell that has been selected or in which the cursor is positioned. Depending on the search range selected, the table is searched as follows:

- The entire table
- Row by row, from left to right
- Column by column, from top to bottom

The Find operation is performed cyclically: Once the end of the row or column has been reached, it starts again from the beginning until it reaches the initial cell.

The search stops when the first text is found. When you click "Find", the search continues without the text being replaced. When you click "Replace", only the text in this cell is replaced. When you click "Replace all", the search continues and all the text found is replaced.

Note

Note the following:

- You do not have to enter the complete text you are searching for; entering only a part of it is sufficient if this guarantees that the text being sought can be identified uniquely.
- When you click "Replace"/"Replace all" without having entered text in the "Replace by:" field, the found text is deleted.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.10.2 How to edit general data

"General" tab

In this tab, all the underlying ES objects (objects of the PH) for the part of the plant selected in the hierarchy window are displayed along with their general information. If the selection is changed, the relevant objects are read in again.

Columns in the table

If you have selected the icon for a multiproject in the hierarchy window, only the columns relevant to the objects of the multiproject are displayed.

Note

If the block is a component of a fail-safe program, at the beginning of the line the field with the line number has a yellow background.

Column	Meaning
Hierarchy	Displays the technological path of the object (or the storage location of the projects/libraries).
Name of	Displays the icon of the object and the object name. You can change the object name.
Comment	Input field for the comment on the object. You can change the comment. **Note:** The comment field does not accept an empty value.
Type	Displays the object type, for example Process tag, CFC, SFC, OS picture, OS report, or additional document.
Process tag type	Displays the name of the process tag type from which the process tag was derived.
FID	Input field for the function identifier. If you modify the text here, it is also entered in the CFC/SFC, "Part 3" tab, "Descriptions:" text box.
LID	Input field for the location identifier. If you modify the text here, it is also entered in the CFC/SFC, "Part 3" tab, "Code field according to location:" text box.
Status	This column is visible only in the online view. A status message is displayed here if the check box is selected in the "Watch" column. The status display displays texts and colors the same as in CFC.
Monitoring	This column is visible only in the online view. Here, you can register or deregister the process tag or chart for test mode. If the watch function is switched on, the columns "Activated," "Simulate inputs," and "Simulate outputs" are displayed dynamically. They are then displayed with a yellow background.
Sampling time	Shows the current execution cycle for the charts for which a runtime group with the same name has been created. You can change the execution cycle. The drop-down list shows the cycles determined from the specified OB cycle and any reduction ratios for the runtime group.
Selected	With this option, you can activate or deactivate charts in the run sequence. The check box can be set offline and online.
Simulate inputs	With this option, the processed input signals from the sensor are converted into the simulation values of the channel blocks. The check box can be set offline and online. Exception: If all SIM_ON I/Os are interconnected, the check box is disabled. If only some of the SIM_ON I/Os are interconnected, the check box is enabled, the setting however, applies only to the SIM_ON I/Os that are not interconnected.
Simulate outputs	With this option, the output of signals to the actuators in the automation system is changed from the calculated value to the simulation value of the channel blocks. The check box can be set offline and online. Exception: If all SIM_ON I/Os are interconnected, the check box is disabled. If only some of the SIM_ON I/Os are interconnected, the check box is enabled, the setting however, applies only to the SIM_ON I/Os that are not interconnected.
AS	Displays the component path to the S7 program that contains the process tag or the CFC or SFC. By clicking in the box, you can display a drop down list. If the project contains several S7 programs, these are displayed in the drop-down list. By selecting a different S7 program, you move the associated chart.

Column	Meaning
OS	Displays the component path for the OS containing the OS picture or the OS report. By clicking in the box, you can display a drop down list. If the project contains several operator stations, these are displayed in the drop down list. By selecting a different OS, you move the associated object.
Block icons	In this column you can see the pictures for which block icons will be automatically generated (in the PH or when the OS is compiled). You can set or reset the attribute "Derive block icons from the plant hierarchy" for each of the collected pictures without needing to open the object properties of each picture.
OCM possible	You use this column to determine if the SFC from the AS-OS engineering should be transferred to the OS for visualization.
Author	Input field for the name of the author. If SIMATIC Logon Service was activated when a shared declaration was created, the user logged on at the time is entered here. You can change the names for charts and additional documents.
Version	Displays the version number of the CFC and SFCs that you can change here.
Size	Shows the size of the object in bytes as far as is practically possible.
Last modified	Displays the date of the last modification to the object.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.10.3 How to edit charts

"Charts" tab

In this tab, all charts contained in the multiproject, including charts without PH assignment and beyond project boundaries are shown. The list contains SFC charts and SFC types in addition to CFC charts. No PH assignment is shown for SFC types in the table. This tab can be selected when the multiproject, project or a PH folder is selected.

Columns in the table

Column	Meaning
Subproject	This column displays the assignment to a subproject.
AS hierarchy	This column displays the assignment to an AS.
Plant hierarchy	This column shows the technological path of the object (hierarchy). This path is empty for objects without technological assignment, for example, SFC types.
Name	This column shows the object icon and name. The object name can be changed here.
Comment	This column shows the object comment. You can change the comment.
Type	This column displays the object type, for example, SFC type.

Column	Meaning
Process tag type	This column shows the name of the process tag type from which the process tag is derived.
FID	Input field for the function identifier. If you modify the text here, it is entered in the CFC/SFC chart footer, "Part 3" tab under "Description:".
LID	Input field for the location identifier. If you modify the text here, it is entered in the CFC/SFC chart footer, "Part 3" tab under "Code field according to location:".
Sampling time	This column shows the current sampling time of charts for which a runtime group of the same name has been created. You can change the sampling time. In the drop-down list, the times are displayed that have been determined from the set OB cycle and the possible scan rates of the runtime group.
Activated	With this option, you can activate or deactivate charts in the run sequence. With CFC charts, the setting affects the runtime group of the same name. With SFC charts, the setting affects the chart EN I/O. The check box can be selected both offline and online, apart from if there is no runtime group with the same name as a CFC chart. In this case, the check box cannot be selected.
OCM possible	You use this column to determine if the SFC chart from the AS-OS engineering should be transferred to the OS for visualization.
Author	Input field for the name of the author. If the SIMATIC Logon Service was activated while creating a new object, the logged-on user is entered here. You can change the names for charts and additional documents.
Version	This column shows the version number of the CFC and SFC charts, which you can change here.
Last modified	This column shows the date of the last change to the object.

9.15.10.4 How to edit blocks

"Blocks" Tab

In this tab, the block properties of all blocks in the CFCs are displayed for the object currently selected in the hierarchy window. SFC instances are also identified as blocks here.

Columns in the table

Note

If the block is a component of a fail-safe program, at the beginning of the line the field with the line number has a yellow background.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed).
Chart	Shows the name of the process tag or CFC (cannot be changed).
Chart comment	Shows the comment on the chart (cannot be changed).
Block	Shows the block name. You can change the name. You can enter a maximum of 16 characters for block names.

Column	Meaning
Block comment	Displays the block comment. You can change the comment.
Create block icon	You can use this check box to specify if a block icon should be generated for this block. Select the "Operator C and M possible" check box to enable this option. You can then edit the cell in the "Block icon" column.
Block icon	This shows the name of the icon with which the block is displayed in the OS picture. The cell can only be edited if the check box in the "Create block icon" column is activated. You enter a name for this block instance here if there is more than one variant of block icons for this block type. If no name is entered, the default block icon is used.
OCM possible	This check box determines if the block can be operated and monitored (system attribute "S7_m_c").
MES-relevant	Check box which determines whether the information of this I/O can be transferred to the management levels MIS/MES in response to a request. The option can only be set when the "Operator C and M possible" check box is selected. Note: The column is hidden by default, as this information is not normally used in PCS 7. To display the column in the process object view, use the menu command **Options > Settings...**, and select the "Columns" tab.
Readback enabled	Indicates whether or not the block is marked as readback enabled (block with system attribute "S7_read_back"). You can modify the option.
Block group	Indicates blocks that belong to a specific message group, intended automatic alarm suppression based on the operating state. You can change the name of the group or enter it if the block has not yet been assigned to a group. You can enter exiting group names from a drop-down list. The name can have a maximum of 24 characters.
With interrupt	Indicates blocks that have message response (cannot be changed).
Instance DB	Shows the object names of the corresponding instance data blocks (for example, DB86) (cannot be changed).
Family	Shows the name of the block family to which the block belongs (for example, CONTROL) (cannot be changed).
Author	Shows the name of the author or the membership in a specific library for PCS 7 blocks (for example, DRIVER70) (cannot be changed).
Block type	Shows the name of the block type from which the block originates (cannot be changed).
Internal ID	Shows the name of the internal ID (for example, FC 262) (cannot be changed).
Process tag type	Shows the name of the process tag type from which the process tag (chart) containing this block was created (cannot be changed).

Additional information

- Online help for PH, IEA, and PO

9.15.10.5 How to edit parameters

"Parameters" Tab

This tab displays the I/O points for all the process tags and CFCs displayed in the "General" tab that were specifically selected for parameter assignment or interconnections between the process tags or CFCs.

I/Os for the "Parameters" tab can be selected at the following locations:

- In SIMATIC Manager with the menu command **Options > Process Objects > Select I/Os...**. (display of objects selected in the tree view)
- In the CFC in the "Properties – I/O" dialog (of a block)
- On block type: System attribute S7_edit = para

Editing

The following parameter values can be entered for those I/Os visible in the "Parameter" tab.

- The value
- The unit
- The identifier
- Operator text for binary states and commentary.

As an alternative to the value, you can also insert block interconnections.

You can open the corresponding CFC in the shortcut menu. The relevant I/O of the block is selected.

You can limit the number of objects selected for display by using a filter. For more information, refer to the "Working in the Process Object View (Page 528)" section.

Each cell displayed in the table with a white background can be edited directly in the process object view.

Columns in the table

Note

If the connection is a structured connection from a fail-safe program, the field with the line number is displayed yellow at the beginning of the relevant line.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed).
Chart	Shows the name of the process tag or CFC (cannot be changed).
Chart comment	Shows the comment that has been entered in the chart properties (cannot be changed).

Column	Meaning
Block	Displays the block name (cannot be edited).
Block comment	Displays the block comment. You can change the comment.
I/O	Displays the name of the block I/O (cannot be changed).
I/O comment	Input field for the block I/O comment. You can change the comment.
Process tag I/O	Shows the name of the I/O point as specified for the process tag type (cannot be changed).
Category	Shows the category of the I/O point as specified for the process tag type (cannot be changed).
Status	This column is visible only in the online view. The status message is displayed here if the check box is selected in the "Watch" column. In terms of color and text, the column is analogous to CFC.
Monitoring	This column is visible only in the online view. You can register or unregister the I/O for test mode in this view. If "Watch" is switched on, the columns "Status" and "Value" are displayed dynamically. They are then displayed with a yellow background.
Value	Input field for the value of the I/O according to the data type and permitted range of values. You cannot edit the value if it involves an interconnected I/O type IN or IN_OUT. If the I/O is a STRUCT data type, the value of the first structure element is displayed with an elementary data type. You can only change the value if the structure can be configured. If this is the value of an enumeration, you can select the text for the enumeration value from a drop-down list if there is text in the enumeration of the shared declaration. The enumerations and their values are declared and managed on the ES. The column is displayed dynamically (on a yellow background) when "Monitor" is enabled in the test mode. A value of interconnected I/Os that is to be monitored and cannot be edited is visualized on a gray-yellow background. A red background indicates a problem in transmission (value failed).
Unit	Input field for the unit of the value. In addition to entering texts, you can select standard units (kg, m, s, min, etc.) from a drop-down list (I/O with system attribute "S7_unit"). Note: The list of units is generated from the basic CFC set. This basic set can be managed and changed in the ES.
Interconnection	Input field for interconnecting the I/O. In addition to entering text, you can also open the interconnection dialog box with the shortcut menu command **Insert interconnection...**. Interconnections written as text are displayed with a yellow background. Note: When you select the shortcut menu command **Go to Interconnection Partner**, you switch to the line of the interconnection partner if the interconnection partner is identified in the process object view as a parameter.
Add forcing	Check box that indicates whether forcing has been added for the I/O. If this check box is selected, the two columns that follow - "Forcing active" and "Forcing value" - will be enabled for editing. If this option cannot be used, the I/O is not enabled for forcing.
Forcing active	Check box that indicates whether forcing is active for this I/O. "Add forcing" must be activated in order to use this option.

Column	Meaning
Force value	Input field for the forcing value. This value is dependent on the data type of the I/O. To enter a value, "Add forcing" must be activated.
OCM possible	Check box with which you can display whether the I/O can be controlled and monitored by the operator (I/O with system attribute "S7_m_c"; the attribute cannot be changed).
Identifier	Input field for the shortcut of the I/O (I/O with system attribute "S7_shortcut").
Text 0	Input field for a text describing the state "0". The text is only displayed and can only be edited when the I/O is of the data type "BOOL" and has the system attribute "S7_string_0". Exception: If the I/O also has the "S7_enum" system attribute, only the input field is active in the "Enumeration" column.
Text 1	Input field for a text describing the state "1". The text is only displayed and can only be edited when the I/O is of the data type "BOOL" and has the system attribute "S7_string_1". Exception: If the I/O also has the "S7_enum" system attribute, only the input field is active in the "Enumeration" column.
Watched	Check box that decides whether the I/O is registered in test mode (I/O with system attribute "S7_dynamic"). You can modify the option.
Archiving	Indicates whether or not the block I/Os that can be controlled and monitored by the operator are intended for archiving (I/O with system attribute "S7_archive"). You can change this entry. By clicking in the box, you can display a drop down list. The following types of archiving can be selected: • No archiving • Archiving • Long-term archiving
Readback enabled	Indicates whether or not the I/O is marked as being capable of being read back (I/O with system attribute "S7_read_back"). You cannot modify the option.
MES-relevant	Check box which determines whether the information of this I/O can be transferred to the management levels MIS/MES in response to a request. The option can only be set when the "Operator C and M possible" check box is selected. Note: The column is hidden by default, as this information is not normally used in PCS 7. To display the column in the process object view, use the menu command **Options > Settings...**, and select the "Columns" tab.
Enumeration	For I/Os with the system attribute "S7_enum", the object name of the enumeration assigned to the I/O is listed here. You can change the name. If you click in the text box, a drop-down list opens from which you can select the desired name for the enumeration. The enumerations and their values are declared and managed on the ES.
Operating rights level	Input field for the operating rights level (value between 1 and 99). This field is only enabled if the "Op_Level" attribute is available for the block type. Operator control in the views of the APL faceplates is dependent on certain APL operator authorizations. For more information on this topic, refer to the section "Overview of User Permissions" in the *Process Control System PCS 7; Operator Station* manual and to the *Process Control System PCS 7; Advanced Process Library* manual.

Column	Meaning
OS additional text	Input field for the label text of a button in the faceplate. You can use this button to jump to the faceplate of the interconnected block. The text can be edited. The input field is only active if the block has screen jump functionality in WinCC.
Data type	Shows the data type of the I/O (cannot be changed).
I/O	Shows the I/O type (IN = input, OUT = output, IN_OUT = in/out parameter) and cannot be changed.
Block type	Shows the name of the block type from which the block originates (cannot be changed).
Chart type	Here, you can see whether the flagged I/O belongs to a CFC or SFC.
Process tag type	Shows the name of the process tag type from which the process tag (chart) containing this block was created (cannot be changed).

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.10.6 How to edit signals

"Signals" Tab

This tab displays the I/O points for all the process tags and CFCs displayed in the "General" tab that were selected explicitly for signal interconnections.

I/Os for the "Signals" tab can be selected at the following locations:

- In the SIMATIC Manager with the menu command **Options > Process Objects > Select I/Os....**
- In CFC in the "Properties – I/O" dialog box
- On block type: System attribute S7_edit = signal

Editing

You can enter symbol names for the interconnections with I/O devices as well as text attributes and commentary for the I/Os displayed in the "Signal" tab.

As an alternative to entering interconnection symbols as text, signals can also be selected in a dialog box if they have already been specified by the hardware configuration.

In the shortcut menu, you can open either the relevant CFC or the hardware configuration (HW Config) or the symbol table.

You can limit the number of objects selected for display by using a filter. You can find additional information about this in the section "Working in the process object view (Page 528)".

Each cell displayed in the table with a white background can be edited directly in the process object view.

Columns in the table

Note

If the connection is a structured connection from a fail-safe program, the field with the line number is displayed yellow at the beginning of the relevant line.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed).
Chart	Shows the name of the process tag or CFC (cannot be changed).
Chart comment	Displays the object comment (cannot be edited).
Block	Displays the block name (cannot be edited).
Block comment	Displays the block comment. You can change the comment.
I/O	Displays the name of the block I/O (cannot be changed).
I/O comment	Input field for the block I/O comment. You can change the comment.
Process tag I/O	Shows the name of the I/O point as specified for the process tag type (cannot be changed).
Category	Shows the category of the I/O point as specified for the process tag type (cannot be changed).
Status	This column is visible only in the online view. A status message is displayed here if the option is set in the "Watch" column. In terms of color and text, the status display is analogous to CFC.
Monitoring	This column is visible only in the online view. You can register or unregister the I/O for test mode in this view. The columns "Status" and "Value" are displayed dynamically if "Monitor" is switched on during test mode.
Value	Input field for the value of the I/O according to the data type and permitted range of values. You cannot edit the value if it involves an interconnected I/O type IN or IN_OUT. If this is the value of an enumeration, you can select the text for the enumeration value from a drop-down list if it is present. The enumerations and their values are declared and managed in the ES. The column is displayed dynamically (on a yellow background) when "Monitor" is enabled in the test mode. A value of interconnected I/Os that is to be monitored and cannot be edited is visualized on a gray-yellow background. A red background indicates a problem in transmission (value failed).
Unit *)	Input field for the unit of the value. In addition to entering texts, you can select standard units (kg, m, s, min, etc.) from a drop-down list (I/O with system attribute "S7_unit"). Note: The list of units is generated from the basic set of the CFC. This basic set can be managed and changed in the ES.
Signal	Input field for the name of the interconnected signal. You can also directly enter an absolute address. If a symbol exists for the absolute address you enter, it will be displayed. Otherwise, the absolute address will be displayed with '%' preceding it. In addition to entering text, you can also open the interconnection dialog box with the shortcut menu command **Insert signal...**.
Signal comment	Input field for the signal comment read from the symbol table (cannot be changed).
Add forcing	Check box that indicates whether forcing has been added for the I/O. If this check box is selected, the successive "Forcing active" and "Forcing value" columns will be enabled for editing. If this option cannot be used, the I/O is not enabled for forcing.

Column	Meaning
Forcing active	Check box that indicates whether forcing is active for this I/O. "Add forcing" must be activated in order to use this option.
Force value	Input field for the forcing value. This value is dependent on the data type of the I/O. To enter a value, "Add forcing" must be activated.
Absolute address	Absolute address of the signal (for example, QW 12 or I3.1) read from the symbol table or originating from the "Signal" input field if the absolute address was entered there (cannot be modified).
Hardware address	Hardware address of the signal. Read from HW Config (cannot be changed).
Measurement type	Measuring type of the signal for input modules; output type of the signal for output modules. Read from HW Config (cannot be changed).
Measuring range	Measuring range of the signal for input modules; output range of the signal for output modules. Read from HW Config (cannot be changed).
AS	Displays the component path to the S7 program containing the process tag or the CFC (cannot be modified).
OCM possible	Check box with which you can display whether the I/O can be controlled and monitored by the operator (I/O with system attribute "S7_m_c"; the attribute cannot be changed).
Identifier *)	Input field for the shortcut of the I/O (I/O with system attribute "S7_shortcut").
Text 0 *)	Input field for a text describing the state "0". The text is only displayed and can only be edited when the I/O is of the data type "BOOL" and has the system attribute "S7_string_0".
Text 1 *)	Input field for a text describing the state "1". The text is only displayed and can only be edited when the I/O is of the data type "BOOL" and has the system attribute "S7_string_1".
Watched	Check box that decides whether the I/O is registered in test mode (I/O with system attribute "S7_dynamic"). You can modify the option.
Archiving	Indicates which block I/Os that support OCM are intended for archiving. You can change this entry. Clicking in the edit box displays a drop-down list. You can select the following types of archiving: • No archiving • Archiving • Long-term archiving Note: If you identify an I/O for archiving, it will only be displayed on the "Archive tags" tab once you have performed compilation on the OS.
Readback enabled	Indicates whether or not the I/O is marked as being capable of being read back (I/O with system attribute "S7_read_back"). You cannot modify the option.
MES-relevant *)	Check box which determines whether the information of this I/O can be transferred to the management levels MIS/MES in response to a request. The option can only be set when the "Operator C and M possible" check box is selected.
Enumeration *)	For I/Os with the system attribute "S7_enum", the object name of the enumeration assigned to the I/O is listed here. You can change the name. If you click in the text box, a drop-down list opens from which you can select the desired name for the enumeration. The enumerations and their values are declared and managed on the ES. You can also enter a name in the input field for which no enumeration has yet been defined.
Data type	Shows the data type of the I/O (cannot be changed).
I/O	Shows the I/O type (IN = input, OUT = output, IN_OUT = in/out parameter) and cannot be changed.
Block type	Shows the name of the block type from which the block originates (cannot be changed).

Column	Meaning
Chart type	Here, you can see whether the flagged I/O belongs to a CFC or SFC.
Process tag type	Shows the name of the process tag type from which the process tag is derived (cannot be changed).

*) Note: The column is hidden in the default setting, since this information is not normally used in PCS 7. To display the column in the process object view, select the menu command **Options > Settings...**, followed by the "Columns" tab, "Object types" group, and "Process object view" folder. Here, select the desired entry and activate the required check box in the "Visible columns" group.

Additional information

- Online help for *PH*, *IEA*, and *PO*

9.15.10.7 How to edit messages

"Messages" Tab

When using the "User-configurable message classes" function, refer to the information in the section "User-configurable message classes".

This displays the message texts of the signaling blocks belonging to the process tags and CFC/SFCs displayed in the "General" tab.

Editing

You can open the corresponding chart in the shortcut menu.

You can limit the number of objects selected for display by using a filter. For more information, refer to the "Working in the Process Object View (Page 528)" section.

Each cell displayed in the table with a white background can be edited directly in the process object view.

Columns in the table

Note

If the message about a block is from a fail-safe program, the field with the line number is displayed yellow at the beginning of the relevant line.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed).
Chart	Shows the name of the process tag or CFC (cannot be changed).
Chart comment	Displays the object comment (cannot be edited).
Block	Displays the block name (cannot be edited).

Column	Meaning
Block comment	Displays the block comment. You can change the comment.
I/O	Displays the name of the block I/O (cannot be changed).
I/O comment	Input field for the block I/O comment. You can change the comment.
Sub number	Sub number of the message (cannot be changed).
Class	Message class as specified for the block type. You can make your selection using a drop-down list. You cannot change the message class if it is locked in the block type message.
Priority	Message priority. You can make your selection using a drop-down list. You can not be able to change the priority under the following conditions: • If it is locked in the block type message • If the message was configured according to the old message concept ("message numbers assigned uniquely throughout the project")
Trigger action	Initiates the "GMsgFunction" standard function (can be changed using "Global Script" PCS 7 Editor)
Origin	Origin of the block. In PCS 7 the keyword $$HID$$ is used. You cannot change the text if it is locked in the block type message.
OS area	OS area text according to which the message list can be filtered online. In PCS 7, the keyword $$AREA$$ is used. You cannot change the text if it is locked in the block type message.
Event	Input field for the event text (for example, "$$BlockComment$$ too high). You cannot change the text if it is locked in the block type message.
Single acknowledg-ment	Select the check box, if the message should be acknowledged as a single mes-sage.
Batch ID	BATCH message text. You cannot change the text if it is locked in the block type message.
Info text (Operator control/ Free text 1-5)	You cannot change the text if it is locked in the block type message. Note: In addition to the "Info text" column, the tab also contains the columns "Free Text 1" .... "Free Text 5" and "Operator Control." The columns are hidden in the default setting, since these texts are not normally used in PCS 7 *).
Reaction time	Reaction time taken for a particular message.
Description	Provides the details of the message selected.
Cause	Provides the cause for the message which is generated.
Operator action	Provides the action that needs to be taken by the operator.
Consequence	Provides the consequence that you might face if appropriate action is not taken by the operator.
Status 1-10 (32) *)	In the status columns you specify in which operating states (Status 1 to Status 32) the message is to be hidden in the process mode of the OS. In the default setting, Columns 11 to 32 are not displayed. The status columns can be modified under the following prerequisites: • The block belonging to the message is contained in a block group. • The CPU-wide message concept is set in the current project. The default column headings are replaced by concrete operating states, if the current selection only contains messages from block groups at whose SR blocks (Status Representation blocks) the same listing type is configured. The listing types contains the possible operating states in a list form.

Column	Meaning
Block group	Shows the name of the block group whose blocks belong to a specific message group and for which operating-state-specific automatic hiding of messages is specified (cannot be changed).
Block type	Shows the name of the block type from which the block originates (cannot be changed).
Chart type	Here, you can see whether the flagged I/O belongs to a CFC or SFC.
Process tag type	Shows the name of the process tag type from which the process tag is derived (cannot be changed).

*) Note: The column is hidden by default, as this information is not normally used in PCS 7. To display the column in the process object view, select **Options > Settings...** > "Columns" tab > "Object types" group > "Process object view" folder. Here, select the desired entry and activate the required check box in the "Visible columns" group.

Additional information

- Online help for *PH*, *IEA*, and *PO*

9.15.10.8 How to edit picture objects

"Picture Objects" Tab

This displays the OCM-capable blocks of the CFCs for all of the process tags and CFCs displayed in the "General" tab, along with their picture interconnections and picture assignments. All the SFCs and their picture interconnections and picture assignments are also displayed.

For each block, you can see the location where it is used (for each OS, for each OS picture, and for each picture object to which it is interconnected). With block icons, you can select the appearance of the icon. If a row next to the block is empty, this means that the block is not operated or monitored by any project OS.

Editing

The displayed interconnections and assignments cannot be edited. The tab essentially has a cross-reference function, and is used to provide a fast overview of the existing or missing picture interconnections and assignments of one or more process tags.

If you would like to modify the content of a picture, use the shortcut menu to also open the WinCC Graphics of the selected OS picture (the shortcut menu can also be used to open the CFC).

You can limit the number of objects selected for display by using a filter. For more information, refer to the "Working in the Process Object View (Page 528)" section.

Each cell that is displayed in the table on a white background can be edited directly in the Process Object View.

Columns in the table

Note

If the operable block is a fail-safe block or if the operable connection is a structured connection from a fail-safe program, the field with the line number is highlighted in yellow at the beginning of the corresponding line.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed).
Chart	Shows the name of the process tag or CFC (cannot be changed).
Chart comment	Displays the object comment (cannot be edited).
Block	Displays the block name (cannot be edited).
Block comment	Displays the block comment. You can change the comment.
I/O	Shows the name of the block I/O or SFC I/O (cannot be changed). This cell is empty if a picture object is assigned to the block as a whole.
I/O comment	Input field for the I/O comment. You can change the comment. This cell is empty if a picture object is assigned to the block as a whole.
Process tag I/O	Shows the name of the I/O point as specified for the process tag type (cannot be changed). This cell is empty if a picture object is assigned to the block as a whole.
OS	Displays the component path of the OS where the OS picture is located. In a multiproject, the project name is also displayed in the path of an OS from a different project (cannot be modified).
Picture	Name of the OS picture (cannot be modified).
Picture object	Name of the picture object, for example, faceplate, user object (cannot be modified).
Property	Name of the interconnected or assigned property of the picture object (cannot be modified).
Block type	Shows the name of the block type from which the block originates (cannot be changed).
Chart type	Here, you can see whether the OS picture is assigned to a CFC or SFC.
Process tag type	Shows the name of the process tag type from which the process tag is derived (cannot be changed).

Additional information

- Online help for *PH*, *IEA*, and *PO*
- Configuration manual *Process Control System PCS 7; Operator Station*

9.15.10.9 How to edit archive tags

"Archive Tags" Tab

Here, all the process tags, CFCs and SFCs shown in the "General" tab and the interconnected WinCC archive tags are displayed, along with their attributes.

Each archive tag is displayed in a row. Not all the attributes defined in WinCC Tag logging are displayed, but only the subset relevant to PCS 7.

Editing

The archive tags must first be created in WinCC Tag logging. The attributes of the archive tags can then be edited directly in the table (without opening WinCC Tag logging).

When necessary, you can open WinCC Tag logging from the shortcut menu.

You can limit the number of objects selected for display by using a filter. You can find additional information about this in the section "Working in the process object view (Page 528)".

Each cell that is displayed in the table on a white background can be edited directly in the Process Object View.

Columns in the table

Note

If the connection is a structured connection from a fail-safe program, the field with the line number is displayed yellow at the beginning of the relevant line.

Column	Meaning
Hierarchy	Shows the technological path of the process tag or CFC (cannot be changed)
Chart	Shows the name of the process tag or CFC (cannot be changed)
Chart comment	Shows the comment on the object (cannot be changed)
Block	Displays the block name (cannot be edited).
Block comment	Displays the block comment. You can change the comment.
I/O	Shows the name of the block I/O or SFC I/O (cannot be changed). This cell is empty if a picture object is assigned to the block as a whole.
I/O comment	Input field for the I/O comment. You can change the comment.
Process tag I/O	Shows the name of the I/O point as specified for the process tag type (cannot be changed).
OS	Displays the component path for the OS containing the OS picture or the OS report. In a multiproject, the project name is also displayed in the path of an OS from a different project (cannot be modified).
Archive name	Name of the measured value archive (cannot be modified).
Tag name	Input field for the name of the archive tag.

Column	Meaning
Tag comment	Input field for the comment of the archive tag.
Long-term archiving	Indicates whether the archive tag is intended for long-term or short-term archiving. Modifications made in this column have a direct effect on the WinCC measured value archive without recompiling the OS. The changes also affect the "Parameters" tab and the relevant block I/Os in the CFC.
Tag supply	Type of tag supply. You make the selection from a drop-down list (system, manual input).
Archiving	Specifies whether the archiving should begin immediately at system start-up. You make the selection from a drop-down list (enabled, blocked).
Acquisition cycle	Cycle for acquiring data. You can make your selection using a drop-down list.
Factor for archiving cycle	Here, you can specify the factor for the archiving cycle. The factor cannot be modified if the acquisition type is acyclic.
Archiving/display cycle	Here, you can enter the cycle used for archiving and for displaying the data. You can make your selection using a drop-down list. The cycle cannot be modified if the acquisition type is acyclic.
Save on fault/error	Here, you enter the type of correction if faults or errors occur. You make the selection from a drop-down list (last value, substitute value).
Archive if	Here, you specify the state change of the logical signal, the type of change, and the time at which the change is archived. You can make your selection using a drop-down list. The entry is possible only for binary tags.
Unit	Unit from the ES data management. This is only displayed here and can be modified in the "Parameters" tab.
Data type	Displays the data type of the I/O.
I/O	Displays the I/O type (IN = input, OUT = output, IN_OUT = in/out parameter).
Block type	Displays the name of the block type from which the block originates.
Chart type	Here, you can see whether the archive tag belongs to a CFC or SFC.
Process tag type	Displays the name of the process tag type from which the process tag was derived.
Compression	Specifies whether the archive tag should be compressed (check mark in the box) or not (check box cleared). Compression is only possible with analog values. The following columns are only relevant if you set the check box.
Tmin, ms	Here, you specify the minimum time between 2 saves for the archive tags.
Tmax, ms	Here, you specify the maximum time between 2 saves for the archive tags.
Deviation	Here, you specify a value for the maximum deviation.
abs/rel	Specifies whether the maximum deviation is measured as a percentage or in absolute values.
Low limit	Specifies the low limit for the parameter to be archived.
High limit	Specifies the high limit for the parameter to be archived.

Additional information

- Online help for *PH*, *IEA* and *PO*
- Configuration manual *Process Control System PCS 7; Operator Station*

9.15.10.10 How to edit hierarchy folders

"Hierarchy Folder" Tab

In this tab, the hierarchy folders of the PH are displayed for the object currently selected in the hierarchy window. A row is displayed for each existing hierarchy folder.

Columns in the table

Column	Meaning
Hierarchy	Shows the technological path of the hierarchy folder (cannot be changed).
Name	Shows the name of the hierarchy folder. You can rename the object. For the current project, the maximum number of characters per hierarchy level is specified in the "Plant Hierarchy – Settings " dialog box (menu command **Options > Plant Hierarchy > Settings...**). The name cannot be changed for hierarchy folders that are listed as logic operations and system-generated diagnostic folders.
Comment	You can change the comment. The comment cannot be changed for hierarchy folders that are listed as logic operations.
ISA-88 type	The column is hidden by default. It displays the default ISA-88 type that can be changed. All possible ISA-88 types and <neutral> are offered in a drop-down list for the respective hierarchy level. The ISA-88 type cannot be changed for hierarchy folders that are labeled as logic operation or for system-generated diagnostic folders.
AS	Displays the component path to the S7 program containing the hierarchy folder. Clicking in the text box opens a drop-down list. If the project contains several S7 programs, these are displayed in the drop-down list. By selecting another S7 program, you can move the hierarchy folder with all subordinate levels to this program or remove the assignment to the AS with <no assignment>.
OS	Shows the component path of the OS containing the hierarchy folder. Clicking in the text box opens a drop-down list. If the project contains more than one OS, they are displayed in the drop-down list. Select a different OS to move the object in question with all lower levels to this OS, or to reset the assignment to the OS with <no assignment>. When compiling specific areas, you can only change the OS assignment at the hierarchy folder of the OS area level.
OS area identifier	In this column, you can change the name of the hierarchy folder of the OS area level.
Picture name for OS	In this column, you can change the name of hierarchy folders below the OS area level.
Picture order	In this column, you can change the picture order for the picture selection on the OS. The numbers in the drop-down list indicate the arrangement of the pictures in descending order from left to right.
Author	Text box for the name of the author. If the SIMATIC Logon Service was activated when creating the hierarchy folder, the logged-on user is entered here.
Revision date	You can see the date of the last change in this column (cannot be changed).

Additional information

- Online help for *PH*, *IEA* and *PO*
- Configuration manual *Process Control System PCS 7; Operator Station*

9.15.10.11 How to edit equipment properties

"Equipment properties" tab

The equipment properties contained in the selected project are displayed in this tab. These equipment properties are instances created by equipment property types configured in the shared declarations. A row is displayed for each existing equipment property. If changes are made to a type, the attributes that cannot be edited here are transferred to the instance.

Columns in the table

Column	Meaning
Hierarchy	Shows the path of the equipment property in the hierarchy tree (cannot be changed).
Name	In this column, you can select the required name of the equipment property type for one of the listed instances in a drop-down list. After updating the data with <F5>, the configured attributes of the type are applied.
Display name	The display name is multilingual and is transferred to WinCC during OS compilation (cannot be changed). You can only change the display name at the type ("Shared Declarations" tab).
Comment	After the instance has been created, the type comment is displayed in this column. You can change the comment.
Value	In this column you can assign a value to the equipment property. The syntax is checked according to the data type. If an enumeration has been configured for the type, you can select one of the configured values in a drop-down list.
Unit	Shows the configured unit (cannot be changed). You can only change the unit at the type ("Shared Declarations" tab).
Data type	This column shows the configured data type (cannot be changed). You can only change the unit at the type ("Shared Declarations" tab).
Enumeration	If an enumeration has been configured at the equipment property type, it is displayed here (cannot be changed). You can only change the enumeration at the type ("Shared Declarations" tab).
Author	Text box for the name of the author. If the SIMATIC Logon Service was activated when creating the equipment property, the logged-on user is entered here.

Additional information

- Online help for *PH*, *IEA* and *PO*
- Manual *Process Control System PCS 7; SIMATIC BATCH*

9.15.10.12 How to edit shared declarations

"Shared Declarations" tab

In this tab, you can edit the attributes of the enumeration, unit and equipment-property types in the project.

Columns in the table

Column	Meaning
Hierarchy	Shows the path of the object in the hierarchy tree (cannot be changed)
Name	Shows the names of the objects in the Shared Declarations folders.
Display name	The display name is multilingual and is transferred to WinCC during OS compilation. The display name can only be changed for enumerations and equipment property types.
Comment	Shows the object comment. You can change the comment.
Type	Shows the type name of the object. Type names are: Enumeration, value, unit, equipment property (cannot be changed).
Value	Shows the configured values of the enumerations. You can change the value. The fields are empty for units and equipment properties.
Unit	This column shows the configured unit for the equipment property. You can change the unit by selecting from a drop-down list. The fields are empty for enumerations and units.
Data type	Shows the configured data type for the equipment property. You can change the data type by selecting from a drop-down list. The fields are empty for enumerations and units.
Enumeration	Shows the configured enumeration for the equipment property. For the data types INT, DINT, SOURCE, DEST and VIA, you can change the enumeration by selecting from a drop-down list. The fields are empty for enumerations and units.
Control strategy	Shows whether the enumeration is a control strategy (box checked). The attribute can be changed.
Author	Text box for the name of the author. If SIMATIC Logon Service was activated when a shared declaration was created, the logged-on user is entered here. The check boxes are empty for units and equipment properties.
Version	Shows the current version of the configured types: Enumerations, Units and Equipment properties. The version can be changed.

Additional information

- Online help for *PH*, *IEA* and *PO*

9.15.10.13 How to test in the process object view

Test mode in the process object view

The process object view provides a test mode in which you can test and commission process tags and CFCs online on the CPU.

In test mode, the following columns are displayed dynamically in the process object view:

Tab	Dynamic column	Additional column in test mode
General	Status Selected Simulate inputs Simulate outputs	Monitoring
Parameter	Status Value	Monitoring
Signals	Status Value	Monitoring

You register a process tag or chart for testing (Page 627) by placing a check mark in the "Watch" column.

The tabs not listed in the table (messages, picture objects etc.) cannot be selected in test mode.

Setting test mode

Analogous to CFC, the test mode can be run-off in process or laboratory mode. You can set this in offline mode with the menu commands **Options > Process Objects (Online) > Process Mode** or **> Laboratory Mode**.

Use the menu command **Options > Process Objects (Online) > Test Settings...** to open a dialog box for setting the monitoring cycle. The watching cycle has global effects on all process tags and CFCs of the current window in the process object view (not CPU-specific as in CFC and SFC).

These setting are made independently of the settings in CFC/SFC.

Activating/Deactivating Test Mode

You set test mode in the SIMATIC Manager. When it is activated/deactivated, the active window of the process object view is affected.

- **Activating/deactivating test mode**
  Use the menu command **View > Online** to activate test mode.
  Use the menu command **View > Offline** to deactivate test mode.

When it is activated, the system switches to the existing window rather than opening a new one.

During the changeover process into the test mode a test is carried out to make sure that the online data and the offline date correspond with each other. This procedure is carried out in the same way as the test mode in CFC and SFC. If there are deviations, a message to this effect is displayed.

Explanations of the tabs

The test mode has the following effect on the tabs:

Tab	Description
General	In this tab, it is not possible to delete, move, or copy objects. Apart from the "AS" column, all the columns remain editable if they can be modified in offline mode. When test mode is activated, changes in the "Activated", "Simulate inputs" and "Simulate outputs" columns are saved in the engineering station and downloaded to the AS. This also applies if the process tag or chart is not registered for the test.
"Parameters" and "Signals"	In these tabs, the columns "Watch", "Value" and "Watched" can be edited. When test mode is activated, changes in the "Value" and "Watches" columns are saved in the engineering station and downloaded to the AS. This also applies when the I/O is not registered for the test. A faulty or undefined value is indicated with "####". Dynamic values are shown on a different background according to their status as follows: • Yellow (dynamic, can be changed) • Gray-yellow (dynamic, cannot be changed) • Red (failed) The color of the field changes from yellow to white when it is clicked on to edit the value. The offline value is then shown.

Logging the Changes in the ES log

In test mode, all the actions that cause a change (value change) in the CPU are logged in the ES log.

Requirements:

- The SIMATIC Logon Service is installed.
- The ES log is activated for the currently selected chart folder.

If there is a change, the ES log is opened and the reason for the change is entered. If the user is not yet logged into the SIMATIC manager then the SIMATIC Logon Service dialog will open prior to opening the change log.

The logged changes can be found via the menu command **Options > Charts > logs...**, in the "ES log" tab.

Printing tab displays

Just as in offline mode, you can print out the values displayed in the current tab using the shortcut menu **Print > Current Tab**.

You can only print the current tab with the menu command **File > Print > Object List...** in contrast to offline mode. This is already selected in the "Settings for printing the process object view" and cannot be modified.

Additional information

- Online help for *PH*, *IEA*, and *PO*

9.16 Downloading the configuration to the CPU

9.16.1 How to download the configuration in CPU-STOP

Introduction

Hardware configuration of the SIMATIC stations is completed.

First save and compile the hardware configuration you have created and then pass on the information to the CPU.

Rules

Note

In some situations it is possible to download the hardware configuration during operation (CPU in RUN). You can find a list of the configuration changes (CiR) you are allowed to make in RUN in the section titled "Overview of the permitted configuration changes (Page 374)".

Other configuration changes mean that the hardware configuration can only be downloaded when the CPU is in STOP!

Requirements

- The data link from the engineering station to the automation system must be working.
- The hardware configuration of the automation systems to be loaded opens.
- The SIMATIC station is in the STOP operating state.

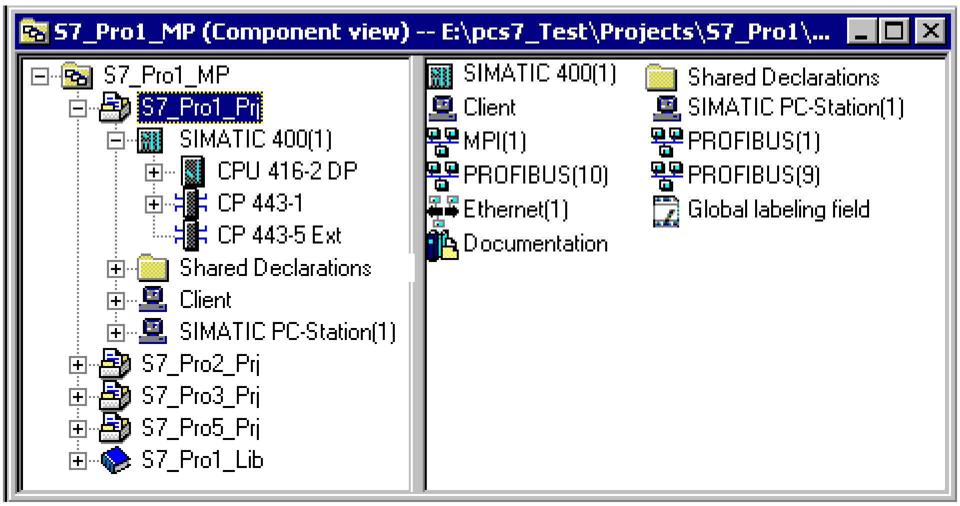
Procedure

1. Select the menu command **Station > Save and Compile** in HW Config.
   Existing consistency errors are signaled to you. Click "Details" for detailed information about the errors that have occurred.
2. Select the menu command **CPU > Download to Module**.
   The "Select Target Modules" dialog box opens.
3. Select the target module and click "OK".
   The "Select node address" dialog box opens.
4. Click the "Refresh" button.
   All the nodes that can be reached are listed in the "Accessible Nodes" group.
5. Select the required node and click "OK".
   The configuration is loaded into the PLC.
   If the change log is activated, it opens. Enter a comment here in the "Reason" group and click "OK".

6. On completion of the download, restart the CPU.
7. Select the menu command **Station > Exit** to close the hardware configuration.

Result

Your project is created, for example, with the following structure in the component view.



Source files and blocks

- The source texts of the user blocks and the SCL source files generated by CFC/SFC are stored in the "Sources" folder.
- Standard and user blocks and blocks generated by CFC/SFC (e.g. instances) are stored in the "Blocks" folder.
- The "Charts" folder contains CFCs, nested charts (chart in chart) and SFCs.
- Enumerations, units and equipment properties are saved in the "Shared Declarations" folder.

Plant changes in runtime on an H System

For more detailed information about making "Plant changes in RUN" in H systems, refer to the manual *S7-400H Programmable Controller, High Availability Systems*

9.16.2 How to Download Configuration Changes in CPU RUN (CiR)

Requirements

- The changed hardware configuration must be complete.
- The changed hardware configuration must have been saved and compiled.

Procedure

1. Check that the current configuration can be downloaded with the menu command **Station > Check CiR Capability**.
2. Select the menu command **Station > Save and Compile** in HW Config.
3. Download the configuration to the CPU with the menu command **PLC > Download to Module...**.

Note

Please note the following:

- If the configuration changes cannot be downloaded, close HW Config **without** saving. This avoids inconsistencies between the configuration in the CPU and on the ES.
- When you download the configuration to the CPU, the INTF LED lights up and then goes off again, the EXTF LED is lit permanently. You cannot start to add the real stations or modules until the INTF LED goes out again. The EXTF LED then also goes off again.

Recommendation

Back up your current configuration whenever you download the station configuration from HW Config, regardless of the operating state of the CPU. This is the only way to make sure that you can continue working and not lose CiR capability if an error occurs (loss of data).

Additional information

- Online help for HW Config

9.16.3 Reaction of the CPU after downloading configuration changes in CPU RUN (CiR)

CPU response after the configuration is downloaded in RUN mode

After downloading a modified configuration, the CPU initially checks whether the modifications are permitted. If they are, it analyzes the affected system data.

This analysis affects important operating system functions, such as updating of the process image and editing of the user program. These effects are explained in detail below.

The time taken for the CPU to interpret the system data (known as the CiR synchronization time) depends on the number of input and output bytes in the affected DP master system. The default synchronization time is up to 1 second. This value cannot be changed.

At the start of the system data evaluation, the CPU enters event W#16#4318 in the diagnostic buffer and on completion of the evaluation it enters the event W#16#4319.

Note

If a "Power Off" occurs while the system data is being analyzed or the CPU switches to STOP mode, the only practical course is to run a warm restart.

Once the system data has been analyzed, the CPU starts OB 80 with event W#16#350A and enters the duration of the analysis in its start information. This allows you, for example, to consider this time in your cyclic interrupt OBs for control algorithms.

Note

Make sure that OB80 is always loaded on your CPU. Otherwise the CPU switches to STOP when an OB 80 start event occurs.

Validation of the Required Configuration Change by the CPU

The CPU first calculates the number of DP and PA master systems on which you are adding or removing slaves or modules or wish to change the existing process image partition assignments. At a maximum of 4 affected master systems, the CPU continues the check, at more than 4, it rejects the modified configuration.

In the next step, the CPU calculates the CiR synchronization time as follows:

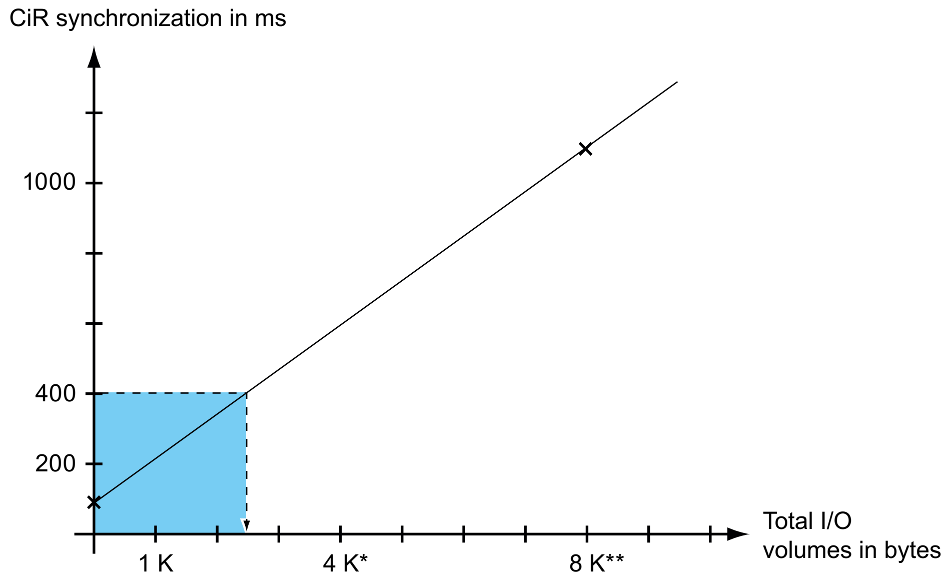
- If you are only changing parameter settings for existing modules, the following applies regardless of the CPU type:
  CiR synchronization time of the CPU = 100 ms
- In all other situations, the following applies:
  The CiR synchronization time of the CPU is the sum of the CiR synchronization times of the relevant master systems. The relevant master systems are those in which you add or remove slaves or modules, or change the existing partial process image assignment.
  CiR synchronization times of the relevant master system =
  Basic load of the master system + total I/O volume of the master system in bytes * time per byte.
  The total I/O volume of the master system is the sum of the existing real input and output bytes of the CiR elements in this master system. To calculate the basic load of a master system and the time per byte for a specific CPU type, refer to the technical specifications of your CPU.

  Note

  CiR synchronization time:

  - The CiR synchronization time calculated in this way is based on a worst-case scenario. This means that during CiR, the actual CiR synchronization time is always less than or equal to the calculated time.
  - The CiR synchronization time of a master system is displayed in the properties window of the CiR object in HW Config.

The following figure shows the relationship between the CiR synchronization time of a master system and its entire I/O volume based on the example of a CPU 417-4.



* corresponds to the maximum address area of the MPI interface, for example (2 K inputs + 2 K outputs)

** corresponds to the maximum address area of an external DP interface module, for example (4 K inputs + 4 K outputs)

Based on this diagram, you can easily obtain the maximum size of the master system based on the maximum CiR synchronization time if you only make changes to one DP master system. This is explained with reference to an example in the "Example for defining the size of a DP master system" section.

The CPU now compares the calculated CiR synchronization time with the current high limit for the CiR synchronization time. The fixed upper limit set in PCS 7 for the CiR synchronization time is 1 s.

If the calculated value is less than or equal to the current upper limit, the CPU assumes the changed configuration, otherwise it rejects it.

Modifying the CiR synchronization time

From the formula above, it is clear that the CiR synchronization time can be modified as follows:

The CiR synchronization time is reduced:

- The fewer input and output bytes are selected for a master system
- The fewer guaranteed slaves are selected for the master systems to be changed (the number of guaranteed slaves thus directly affects the number of input and output bytes)
- The fewer master systems to be changed in one CiR action

This is of particular significance for F systems. Here, the F monitoring time must include the CiR synchronization time. The highest value of all the DP master systems with a CiR object must be used (if only one DP master system is modified per CiR action) or the sum of the master systems to be modified at the same time.

Example calculation

The following table is an example of a CPU 417-4 with 6 DP master systems.

The maximum permitted CiR synchronization time is 550 ms. This allows changes to be made to several DP master systems, provided that the sum of the CiR synchronization times of these master systems does not exceed 550 ms. From the last column, you can see which DP master systems can be modified in one CiR action.

DP master system	Total I/O vol. in bytes	CiR synchronization time of the master system	Distribution of Changes to DP Master Systems
1	1500	100 ms + 1500 bytes * 0.12 ms/byte = 280 ms	Either 1 (280 ms) or (1 and 2) (500 ms)
2	1000	100 ms + 1000 bytes * 0.12 ms/byte = 220 ms	Either 2 (220 ms) or (2 and 1) (500 ms) or (2 and 3) (500 ms)
3	1500	100 ms + 1500 bytes * 0.12 ms/byte = 280 ms	Either 3 (280 ms) or (3 and 2) (500 ms)
4	2500	100 ms + 2500 bytes * 0.12 ms/byte = 400 ms	4 (400 ms)
5	3000	100 ms + 3000 bytes * 0.12 ms/byte = 460 ms	5 (460 ms)
6	7000	100 ms + 7000 bytes * 0.12 ms/byte = 940 ms	Cannot be modified!

Example for defining the size of a DP master system

This assumes a maximum CiR synchronization time of 400 ms. The diagram thus gives a maximum total configuration of 2500 I/O bytes for the DP master system (dashed line). If you intend to have 250 input and 250 output bytes in the CiR object for future use, you therefore have 2000 bytes available for the initial configuration of the DP master system.

Two constellations are considered by way of example:

- If ET 200M stations are used with a full configuration (128 bytes for inputs, 128 bytes for outputs, some of which may be in CiR modules), you can operate 2000/(128 + 128), i.e. approximately 8 ET 200M stations.
- If you typically require 48 bytes per ET 200M station (e.g. 6 analog modules each with four channels of 2 bytes or a smaller configuration with a CiR module), you can therefore operate 2000/48, i.e. approximately 42 ET 200M stations.

If such a configuration is insufficient, you can improve the situation as follows:

- Use a more powerful CPU (CPU with a smaller time per byte - you can find more information on this topic in the technical specifications for the CPU).
- Select several smaller master systems rather than one large master system.
- Select one or more master system is with a very large configuration and a CiR object with no guaranteed slaves. In such master systems, only changes to parameter settings for existing modules are possible within the framework of CiR. Select additional small master systems in which you add or remove slaves or modules, or change the existing process image partition assignment.

Error displays

From the beginning of the validation until completion of the SDB evaluation, the INTF LED is lit. It is also lit when the parameters of modules are reassigned.

On completion of the CiR action, there is a difference between the expected and actual configuration (the expected configuration has changed because you downloaded a configuration change to the CPU); as a result, the EXTF LED lights up. If slaves are added when the configuration is changed, the BUS1F or BUS2F LEDs also flash. Once you have performed the relevant hardware changes, the EXTF, BUS1F and BUS2F LEDs go out again.

Effects on the operating system functions during the CiR synchronization time

During the CiR synchronization time, the operating system functions respond as follows:

Operating system function	Effects
Process image updating	Updating of process images is disabled. The process input and output images are kept at their current values.
User program execution	All priority classes are locked; in other words, no OBs are processed. All outputs are maintained at their current value. Existing interrupt requests are retained. Any interrupts occurring are accepted by the CPU only after completion of the SDB evaluation.
Target system	Timers continue to run. The clocks for time of day, cyclic, and delayed interrupts continue to run, the interrupts themselves are, however, locked. There are accepted only on completion of the SDB evaluation. As a result, a maximum of one interrupt can be added per cyclic interrupt OB.
Programming device operation	Only the STOP command is available on the programming device. Data record jobs are not possible.
External SSL information, via MPI, for example.	Information functions are processed with a delay.

9.17 Configuring OS functions

9.17.1 Overview of configuration steps

Introduction

The PCS 7 operator station (OS) is configured in various substeps. The configuration is carried out using several PCS 7 tools:

- In the SIMATIC Manager
- In the WinCC Explorer

The entire configuration of the OS is carried out in the engineering system so that all the configuration data can be managed centrally.

Depending on the requirements of your project, some of the steps in configuration are mandatory and others optional.

For a complete description of the configuration of OS functions, refer to the *Process Control System PCS 7; Operator Station* manual.

When using the "User-configurable message classes" function, refer to the information in the section "User-configurable message classes".

The following table provides a preliminary overview of the various configuration tasks that you have to complete. The sequence listed in the table corresponds with the recommended sequence.

SIMATIC Manager

Configuration tasks	Mandatory	Optional
Inserting and configuring a PCS 7 station		X ; When additional operator stations are required. The PCS 7 wizard automatically creates a PCS 7 OS
Configuring network connections for a PCS 7 OS	X	
Access protection for projects		X
Inserting pictures in the plant hierarchy	X	
AS-OS assignment	X	
Creating block icons	X	
Changing unit and operator texts		X
Defining archive tags	X	
Enable the "Transfer to external archive server" option on the OS servers from which data is to be exported to the Process Historian [1)]		X ; If you use an Process Historian.
Configuring messages		X ; If you want to define messages that differ from the standard
Specifying the message number range	X	
Defining the message priorities		X ; Important for messages in the message line in the overview area

Configuration tasks	Mandatory	Optional
Specifying hidden messages by means of "Alarm Hiding"		X ; If you want to hide individual messages at a certain point in time
Defining the plant designation	X	
Defining the OS area ID	X[2)]	X ; OCM attributes
Defining picture names and picture hierarchy		X ; If you want to define picture names that differ from the standard
Setting the update routines: • Updating the AS-OS connections • Updating the OS area identifier		X
Specifying the compilation mode	X	
Compiling the OS	X	

1) Also assign the archive server to an OS single station system.

2) Plant hierarchy.

Compiling the OS

You must run the "Compile OS" function once you have completed ES configuration of all data in the SIMATIC Manager, and before you start to configure the OS data in the WinCC Explorer. You must also compile the OS if you subsequently changed the ES configuration.

All the data from the SIMATIC Manager, such as variables, messages, texts, and the hardware and connection configuration is "made known" to the OS for further configuration.

After completing all configuration tasks

Step	Mandatory	Optional
Downloading the OS [3)]	X	

3) This function does not apply to an OS single station system.

WinCC Explorer

Configuration tasks	Mandatory	Optional
Setting the object properties		X
Setting the computer properties		X
Setting the parameters in the OS Project Editor		X If you want to define settings that differ from the defaults
Setting up user permissions	X	
Visualization of a plant – basics: • Inserting dynamic objects • Using a status display • Using an extended status display • Inserting an I/O field • Configuring a group display	X Using the required objects	

Configuration tasks	Mandatory	Optional
Visualization of a plant – basics: • Using faceplates and block icons that are not created automatically by PCS 7. • Creating user objects • Creating user object templates • Inserting picture windows • Using the process object view and cross-reference lists		X These options support you effectively when making settings for process pictures
Calculating the group display hierarchy	X	
Setting the message system parameters: • Definitions in the project editor • Settings in alarm logging • Configuring the message lists • Configuring the acoustic signal generator		X
Configuring archives and logs	X	
Setting the • Time synchronization • Lifebeat monitoring	X	X
Setting up the PCS 7 maintenance station		X
Activate OS process mode on the engineering station ("Allow activation on ES" option)		X The activation of local activation of process mode on the ES cannot be withdrawn once an unlocked project is activated.
Directly on the OS servers/OS clients after downloading the project: • Activating the project	X	

Additional information

- Configuration Manual *Process Control System PCS 7; Operator Station*.

9.17.2 Setting the AS/OS lifebeat monitoring

Introduction

The OS function "Lifebeat Monitoring" enables you to monitor the AS and OS connected to the plant bus for their correct function in PCS 7. This means that you always have an up-to-date overview of the state of your plant.

The monitoring function is executed from the operator station declared as the lifebeat monitor.

Lifebeat monitor

The lifebeat monitor monitors all OS servers, OS clients and all automation systems.

Requirement:

All the components to be monitored are connected to an integrated network and assigned to the lifebeat monitor. Monitoring is performed in a cycle that you can specify when configuring lifebeat monitoring.

Lifebeat monitoring is configured in the WinCC "Lifebeat Monitoring" editor.

Monitoring an automation system

In an automation system, a process control message is generated in two situations:

- Lifebeat monitoring reads the current operating state from the ASs. When a state change is detected, for example, from RUN to STOP, a control system message is generated by the lifebeat monitor.
- Lifebeat monitoring sends monitoring requests to an AS. Whenever the power supply is interrupted, the device fails, or a connection breaks down, the AS can no longer respond to this monitoring request and a process control message is generated.

Display of lifebeat monitoring in process mode

Lifebeat monitoring is automatically activated for the OS. Lifebeat monitoring takes place for the OS in 5 second to 1 minute cycles.

An error message is displayed as follows:

- As soon as lifebeat monitoring recognizes that a component has failed, a process control message is generated automatically.
- The state of all monitored components is also displayed in a separate picture that the operator can display using a button in the button set. In this picture, the failed component is indicated by being "crossed out". In addition, a supplementary note in text form appears in this picture, for example:
  - "Failed"
  - "Server failed"
  - "Server configured"

The elimination of a problem is also indicated by a process control message.

Additional information

You can find step-by step instructions on configuring the AS/OS lifebeat monitoring in the configuration manual *Process Control System PCS 7; Operator Station*.

9.18 Configuring BATCH functions

Introduction

SIMATIC BATCH is a PCS 7 software package that enables discontinuous processes, known as batch processes, to be planned, controlled and logged.

Simple batch processes with configurable sequential control systems are automated with the CFC and SFC tools included in the PCS 7 Engineering System. In more demanding systems with recipe procedures, SIMATIC BATCH is used.

With SIMATIC BATCH, recipe structures are designed, modified, and started graphically on an operator station or on a separate PC.

The configuration tasks involve the following:

- Engineering
- Permission management
- Recipe creation (offline)
- Process mode

Engineering

Configuration of the batch process cell takes place along with the basic engineering of the S7-400 on the engineering station in the SIMATIC Manager (for example, phase and operation types, equipment properties, user data types, units of measure).

Configuration tasks	Obligatory	Optional
Batch plant configuration in the engineering system (ES)	X	
Compiling Batch process cell data	X	
Downloading the Batch process cell data to target systems (BATCH servers, BATCH clients)	X	
Reading in Batch process cell data on the BATCH clients	X	

Permission management

SIMATIC BATCH uses the PCS 7 central user management.

Configuration tasks	Obligatory	Optional
Specifying the user permissions for SIMATIC BATCH	X	

Recipe creation (offline)

Reading in the Batch process cell data (engineering data) on any BATCH client with BatchCC allows the creation of offline data. You create the materials, formula categories, and formulas with BatchCC. You create libraries and master recipes with the BATCH Recipe Editor. Releasing master recipes, library elements and formulas allows their subsequent use in process mode.

Configuration tasks	Obligatory	Optional
Editing materials	X	
Creating and editing master recipes	X	
Creating and editing library operations		X when working with libraries
Validating recipes	X	
Approving recipes for production	X	
Creating a new formula category (only with external formula)		X
Creating formulas (only with external formula)		X
Interconnecting parameters between master recipe and formula (only with external formula)		X

Process mode

The first phase of process mode is batch planning. The production orders are created here. These are divided into batch orders that can then be approved and started. The actual Batch processing programs (equipment phases) run on the automation system and are coordinated by the batch control.

The batch data management makes use of individual WinCC components. The values for the required measured value sequences for a batch report are obtained from the measured value archive and all Batch-relevant messages are filtered from the message archive and displayed within BatchCC.

Configuration tasks	Obligatory	Optional
Creating the production orders	X	
Creating and editing batches	X	
Approving the batch	X	
Starting production of a batch	X	
Operator control while editing a batch	X	
Batch reports	X	
Archiving the batch	X	

Additional information

- Online help for SIMATIC BATCH
- Manual *Process Control System PCS 7; SIMATIC BATCH*

9.19 Configuring the Route Control functions

Introduction

SIMATIC Route Control is a software package from PCS 7 for automating the transport of materials in plants.

SIMATIC Route Control searches for a route through the sections of the available route network and controls the material transport, for example, by opening valves and activating pumps.

SIMATIC Route Control includes both the configuration and the runtime system and offers numerous interfaces to the PCS 7 base system and to the user programs.

Depending on the plant design, both straightforward transport processes and complex route combinations are possible.

The configuration tasks involve the following:

- Engineering
- Permission management

Engineering

The PCS 7 project is the central configuration environment including the data storage.

You configure the following here:

Configuration tasks	Obligatory	Optional
Plant hierarchy (plants, units)	X	
Node points	X	
Automation systems	X	
Cross-project AS-AS connections (engineering tool: Route Control Wizard)	X	
PC stations	X	
CFCs	X	
SFCs	X	

Start the following SIMATIC Route Control tools in the SIMATIC Manager:

- Route Control Wizard
- Route Control Engineering (configuration interface)

Route Control Engineering encompasses the following steps:

Configuration tasks	Obligatory	Optional
Transfer of elements, routes, node points and automation systems from the PCS 7 project	X	
Configuration of the function catalog and function IDs	X	
Configuration of the sections in the route network	X	
Interconnection of element to sections and specification of the function levels	X	
Configuration of materials, material groups and permitted sequential relationships between materials and material groups	X	

Permission management

The central user management from PCS 7 is used for SIMATIC Route Control.

Configuration tasks	Obligatory	Optional
Defining user rights for SIMATIC Route Control (Windows user management)	X	

After SIMATIC Route Control has been installed, five user groups are created. The user who carried out the installation is entered automatically. If you require further users, you have to assign them to the user groups.

Additional information

- Online help for SIMATIC Route Control
- Manual *Process Control System PCS 7; SIMATIC Route Control*

9.20 Configuring the connection to the plant management level (OpenPCS 7)

9.20.1 How to configure OpenPCS 7 station for accessing PCS 7 data

Introduction

To enable access to the PCS 7 data, assign the OS server data to the OpenPCS 7 station and download the configuration data.

Requirements

- The OpenPCS 7 station has been created.
- The target path of the OpenPCS 7 station has been entered.

Procedure

1. Open the project in the SIMATIC Manager and activate the component view.
2. Select the OpenPCS 7 station in the tree view:
   SIMATIC PC-Station > SPOSA application > Open_PCS7_Station
3. Select the menu command **Options > OS > Assign OS Server...**.
   The "Assignment of OS Server for <name of OpenPCS 7 station>" dialog box opens.
4. Select the check box of the OS server whose server data you want to assign to the OpenPCS 7 station selected above.
5. Click "OK".
6. Select the menu command **PLC > Download**.

The OpenPCS 7 station is configured and loaded.

Configuring data communication

Configure the data exchange with your OPC client application by using the following functions:

- Data exchange via OPC - standard functions of the OPC server.
- Data exchange via OLE DB - standard functions of the WinCC-OLE DB provider.

You can find additional information on this with the following links:

Service & support (http://support.industry.siemens.com/cs)

OPC Foundation (http://www.opcfoundation.org)

Note

Ensure appropriate access protection for your OPC client application.

Additional information

- Section "How to insert an OpenPCS 7 station (Page 256)"
- Section "Connecting to the IT world via OpenPCS 7 (Page 97)"
- Section "Configuration of the OpenPCS 7 station (Page 147)"
- Manual *SIMATIC NET; Industrial Communication with PG/PC*
- System manual *SIMATIC HMI; OPC - OLE for Process Control*
- Manual *Process Control System PCS 7; PCS 7 - PC Configuration*

9.21 Merging projects after distributed editing (multiproject engineering)

Overview

Merging projects of a multiproject following distributed editing involves the following topics:

- How to move projects edited on distributed stations to the central engineering station (Page 570)
- How to merge subnets from different projects into a multiproject (Page 571)
- How to merge cross-project connections (Page 572)
- How to configure new cross-project connections between AS and OS (Page 573)

Rules for multiproject engineering with SIMATIC BATCH

NOTICE
Rules for distributed engineering on distributed engineering stations For multiproject engineering with SIMATIC BATCH, distributed engineering on distributed engineering stations including testing is only possible when certain conditions are met and the additional steps are taken. You can find additional information on this topic on the Internet (https://support.industry.siemens.com/cs/ww/en/view/23785345).

Rules for the external archive server in multiproject

Note

Only one external archive server (Process Historian) can be configured in a multiproject.

After the distributed projects of a multiproject have been merged, no more than one external Archive Server may be present in the multiproject.

When using a redundant Archive Server, there may only be one PC station for the Archive Server itself in the multiproject and one more for the redundant PC station of the Archive Server.

9.21.1 How to move projects edited on distributed stations to the central engineering station

Requirements

- The project is physically located on a distributed engineering station and is included in the multiproject.
- The distributed engineering station can be reached over the network.

Procedure

1. If necessary, delete the existing project of the same name (version prior to moving to distributed engineering station) on the central engineering station (backup copy).
2. Use the menu command **File > Open...** in the SIMATIC Manager to open the project from the central engineering station on the distributed engineering station
3. Click the "Browse" button.
4. Go to the "Browse" menu and enter the path of the project being moved in UNC notation in the "Search in directory" field.
5. Click "Start search".
   The project is displayed in the "User projects" tab.
6. Select the required project in this tab and click "OK".
   The project opens.
7. When SIMATIC PDM is installed on the engineering station:
   Stop the PdmAssetService in the task bar in the information area of the operating system.
8. Select the menu command **File > Save as ...**.
9. Make the following settings:
   – Clear the "With Reorganization (slow)" check box.
   – Select the "Add to multiproject" check box.
   – Select the "Current multiproject" entry in the corresponding drop-down list.
   – Select the "Replace current project" check box.
10. Click "OK".

Result

An identical copy of the distributed engineering station project is created on the central engineering station in the multiproject. The original is retained on the distributed engineering station and can remain there as a backup or be deleted.

SIMATIC PDM applied in the project

When SIMATIC PDM is installed on the engineering station:
You can start the PdmAssetService again.
Recommendation: Start the SIMATIC PDM asset service with the option "Allow automatic start/stop".

Rules

Note

Before the copied project can be copied back to its old location (same directory name), the backup has to be deleted or renamed on the central engineering station. For additional information on this, refer to the section: "How to move projects to distributed engineering stations (Page 312)"

Note

You can also move a project back to the central engineering station if it was moved out with the "Remove to edit..." function and provided that it can be accessed via the same path that was used during its removal:

1. Select the project labeled "project removed for editing" on the central engineering station (grayed out).
2. Select the menu command **File > Multiproject > Reapply after Editing...**.
   The project is moved from the distributed engineering station back into the multiproject on the central engineering station.

Additional information

- Section "How to move projects edited on distributed stations to the central engineering station (Page 312)"

9.21.2 How to merge subnets from different projects into a multiproject

Introduction

If you use cross-project networks in the multiproject, the networks in the projects must be merged back into the multiproject.

Requirement

Write access to the participating projects and their subnets is possible.

Procedure

1. Select the required multiproject in the SIMATIC Manager.
2. Select the menu command **File > Multiproject > Synchronize Projects...**.
   The "Synchronize Projects in Multiproject <xxx>" dialog box opens.
3. Go to the left window and select the Ethernet networks you want to connect and click "Execute".
   The dialog box for merging/separating the subnets opens.
4. In the left field, select the subnet and click "->".
   The selected subnet is merged in the selected overall network.
5. Change the default name of the cross-project network according to the requirements of your project (click the name twice).
6. Follow the same procedure for all the subnets you want to merge.
7. Click "Apply" and then "Close" in order to close the dialog box.

In the same dialog box you can also separate those networks that have already been merged.

In this dialog box, you can also create new cross-project subnets ("New" button).

Check consistency

After merging the subnets and prior to downloading to NetPro use the menu command **Network > Check Cross-project Consistency** to check whether there is consistency throughout the multiproject.

9.21.3 How to merge cross-project connections

Procedure

Cross-project connections can be merged as follows:

- During synchronization of projects in a multiproject in the SIMATIC Manager, using the menu command **File > Multiproject > Synchronize Projects...**.
- In NetPro with the menu command **Edit > Merge Connections...**.

Execution

The following variations occur in the execution:

SIMATIC Manager	NetPro
• In the SIMATIC Manager, the only connections that are merged are those in the projects that were configured as "Connection partner in other project" with identical connection names (reference).	• In NetPro, you can also assign connections that have similar or different connection names.
• When merging in the SIMATIC Manager, it is not possible to foresee which connection partner retains the connection properties and which connection partner adapts its connection properties (for example, active connection establishment).	• When you merge in NetPro, the partner always adapts its connection properties to those of the local module. Apart from this, it is also possible to change the properties of connections in the dialog box for merging connections in NetPro.
• In the SIMATIC Manager, S7 connections to an unspecified partner are ignored.	• S7 connections to an unspecified partner can be merged to a cross-project S7 connection in NetPro.

Additional information

- Online help for STEP 7
- Section "How to merge cross-project connections (Page 425)".

9.21.4 How to configure new cross-project connections between AS and OS

Introduction

Cross-project connections between AS and OS components are configured in the same way as cross-project connections between AS components.

Requirements

- The networks involved are merged on the multiproject level.
  You can find information about this in the section "How to merge subnets from different projects into a multiproject (Page 571)".
- The AS/OS assignment is specified.
  You can find additional information on this topic in the section "How to specify the AS/OS assignment (Page 270)".

Procedure

When creating cross-project connections between AS and OS components, in contrast to the procedure described in the section "Cross-project connections in a multiproject (Page 423)", you select a connection partner in a different project.

10 Data exchange with plant engineering

10.1 Overview of data exchange

Data exchange between PCS 7 and COMOS

With the aid of a data exchange interface (automation interface), you can convert automation-relevant data for plant planning from COMOS into PCS 7 data. The PCS 7 hardware configuration is derived from circuit diagrams contained in the electrical sample plan (EMSR). Based on the data contained in the function chart, the PCS 7 process tags are derived, assigned parameters and interconnected with the signals.
At the same time, the plant hierarchy, the process tag instances and the hardware configuration, including the symbol table, are synchronized.

Data exchange with PCS 7 permits the planning status in COMOS to be synchronized with the current project status in PCS 7, thus ensuring consistent plant documentation in COMOS.

Additional information can be found in the COMOS planning tools manuals.

Data exchange between PCS 7 and AdvES

The Advanced Engineering System (AdvES) prepares data from signal lists or process tag lists for use in the PCS 7 engineering system (ES). The prepared data be transferred directly to PCS 7. In addition, AdvES provides the ability to process engineering data in bulk in table views.

The plant hierarchy, process tags with signal and parameter settings, and the hardware configuration are generated in PCS 7.

With bulk data processing, for example, multiple instances, the control modules, are created from a configured control module type. You can find additional information on this topic in the section "Overview of the control module and its type (Page 471)".

You can find additional information on this in the manual *Process Control System PCS 7; Advanced Engineering System*

Data exchange between PCS 7 and Excel

In all the editors in PCS 7 and the process object view, you can select areas and transfer them to Excel by copying and pasting, edit them and then return them in the same way.

You can also exchange data with Access in the same way.

Import/export functions

All the essential applications of the PCS 7 engineering system have import/export interfaces. The use of these import/export interfaces has the following advantages:

- Plant-planning data can be synchronized with control-system engineering data. This is how control system engineering and plant engineering can be independently edited at the same time.
- Data from the engineering system can be exported as a template, be effectively duplicated and adapted in an external program (such as MS Excel) and then be imported back into the engineering system. This allows the configuration of repeated or similar plant information to the optimized.

Additional information

You can find information on the import/export functions and data formats in sections:

- Import and reuse of plant data (Page 191)
- Importable data and data formats (Page 129).
- Working with process tags and models (Page 579)
- Importing/exporting the hardware configuration (Page 599)

10.2 Identifying repeated functions

Introduction

The starting point for mass data processing is to identify repeated functions.

Functional units of a plant

Generally a plant is structured by dividing it into smaller functional units that can be classified, for example, as fixed setpoint controls or motor controllers.

Instead of implementing new functional units each time they are required, you can create a pool of ready-made functional units that you then only need to copy and modify for the new situation.

Configure in ES - consistent with the functional units of the plant - the process tag type or model objects you are familiar with to create any number of process tags or replicas using import/export.

Specifying process tag types and models

Define the process tag types and models of your plant.

Refer to the *PCS 7 Advanced Process Library* to determine which pre-compiled process tag types you can use in your project. Or create your own process tag types and models with CFCs.

Additional information

- Section "How to create a process tag type from a CFC (Page 475)"
- Section "How to create and edit a model (Page 518)"

10.3 Working with the Import/Export Assistant (IEA)

Note

The Import/Export Assistant (IEA) is a separate add-on package in PCS 7 which requires a separate license key.

The IEA is supplied together with the PH and the process object view on the *Process Control System; SIMATIC PCS 7* DVD and is installed together with these.

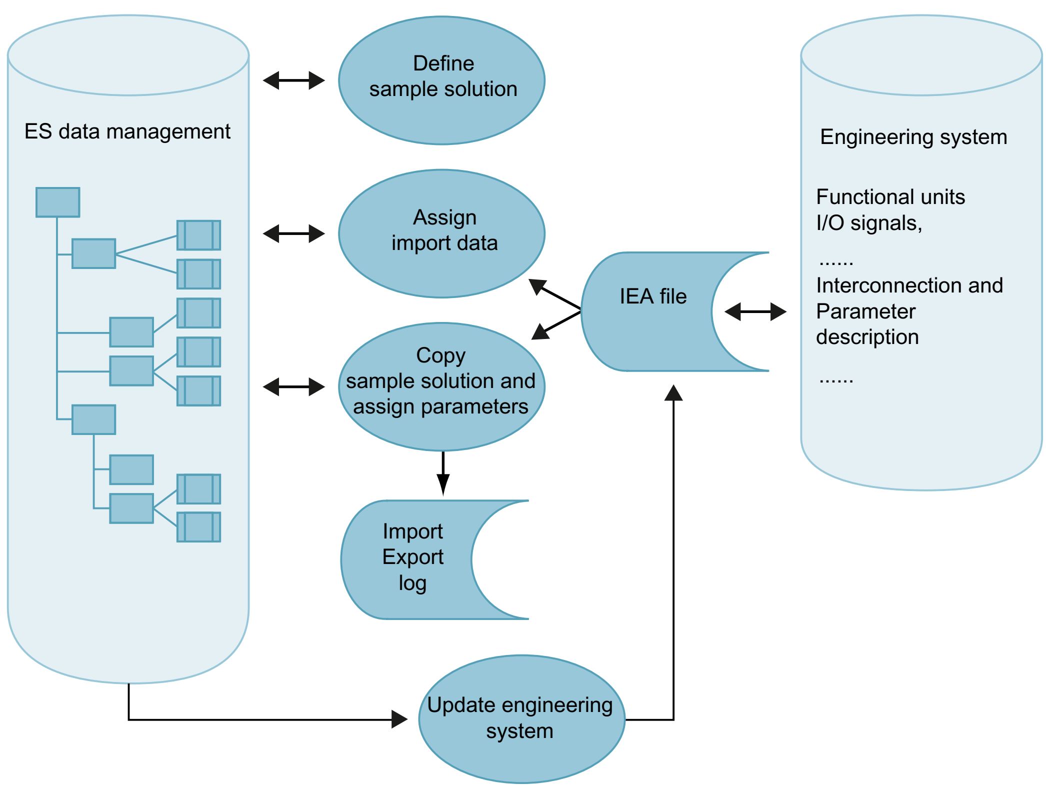
When do I work with the IEA?

During the planning of a plant, a wide variety of data is created, often at a time where no definite control system is planned. By using the import function, this data can be made available to the control system engineering.

You use the IEA when you frequently use multiple models or process tag types in one project (processing bulk data) and you want to conveniently modify the parameter descriptions of the blocks.

Using the IEA

The following figure shows the function of the IEA using a model as an example.



10.4 Working with process tags and models

Overview

Working with process tag types and models in the import/export wizard includes the following subjects:

- Requirements and steps in configuration (Page 579)
- Functions for working with process tags and models (Page 582)
- How to create an import file or assign it to the process tag type (Page 478)
- What happens during import? (Page 585)
- How to import process tag types and models (Page 587)
- What happens during export? (Page 589)
- How to export process tag types and models (Page 590)
- Restrictions in connection with the IEA (Page 591)

10.4.1 Requirements and steps in configuration

Requirement

The process tag types and/or models have been created in the master data library.

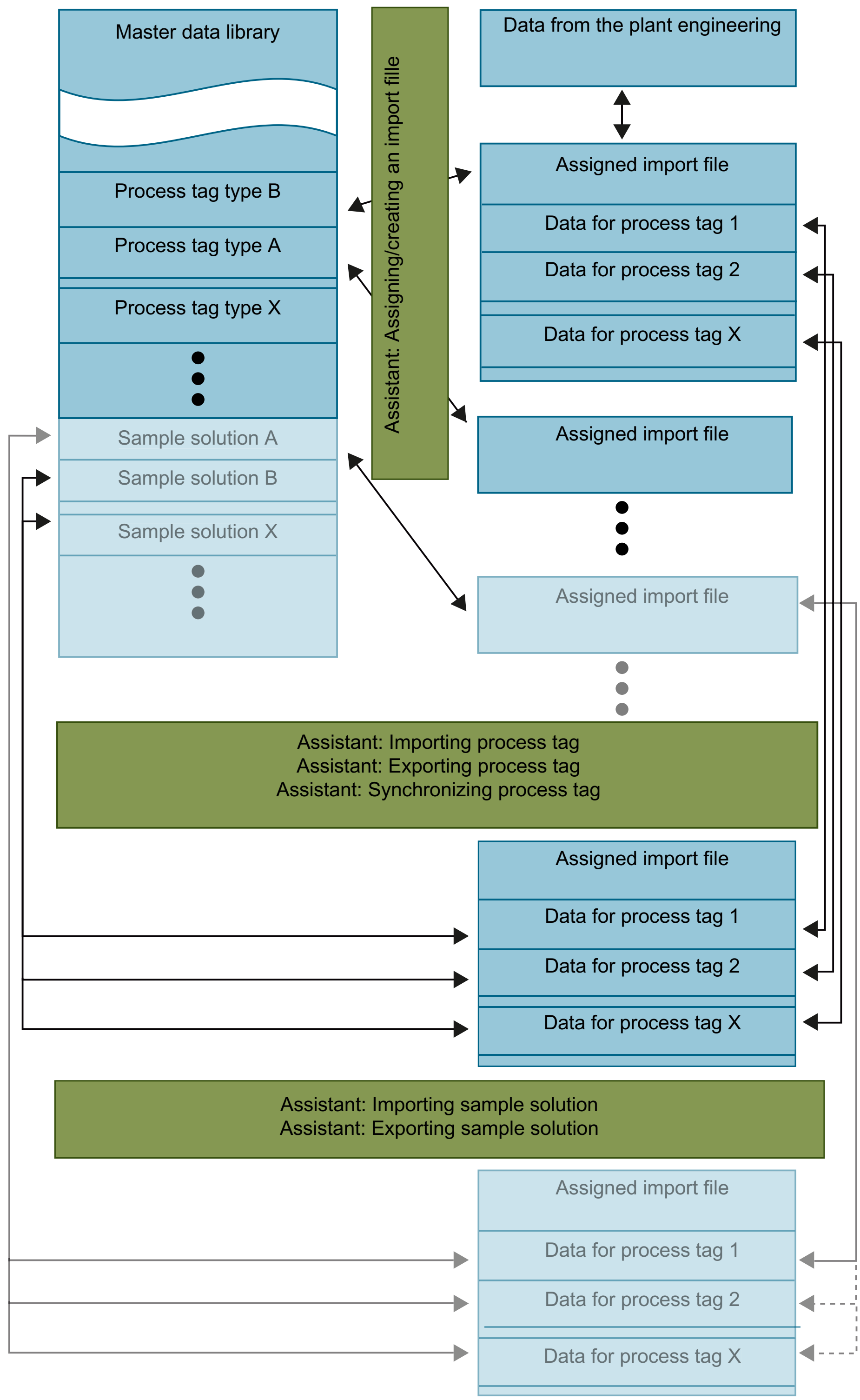
Overview of configuration tasks

Step	What?	Described in section
1	Creating process tag types/models	How to create a process tag type from a CFC (Page 475) How to create and edit a model (Page 518)
2	Assigning the import file to the process tag type/model - Creating the import file	How to create an import file or assign it to the process tag type (Page 478) How to create and edit a model (Page 518)
3	Editing the import file with the IEA File Editor	Creating/editing import files with the IEA file editor (Page 593)
4	Importing process tag type/models	How to import process tag types and models (Page 587)
5	Optional: Transfer of actual parameters to the process tags and replicas (only if the data was not already supplemented using the IEA file editor.)	

How the IEA works

The following figure illustrates the functions of the assistant based on the example of a "process tag type".

The model sequences are indicated likewise in gray.


Master data library
Process tag type B
Process tag type A
Process tag type X
Sample solution A
Sample solution B
Sample solution X
Assistant: Assigning/creating an import file
Data from the plant engineering
Assigned import file
Data for process tag 1
Data for process tag 2
Data for process tag X
Assigned import file
Assigned import file
Assistant: Importing process tag
Assistant: Exporting process tag
Assistant: Synchronizing process tag
Assigned import file
Data for process tag 1
Data for process tag 2
Data for process tag X
Assistant: Importing sample solution
Assistant: Exporting sample solution
Assigned import file
Data for process tag 1
Data for process tag 2
Data for process tag X

Start IEA

You start the Import/Export Assistant in the SIMATIC Manager either in the plant view or in the process object view after selecting a hierarchy folder. (An individual process tag can also be selected in process tag types.)

In the **Options** menu, select the command **Process tags** or **Models** and then the function you need in the next submenu.

Additional information

- Online help for *PH*, *IEA*, and *PO*

10.4.2 Functions for working with process tags and models

Introduction

With the Import/Export Assistant (IEA), you can work with process tag types and their process tags or models and all their instances. The IEA provides functions for reusing and adapting the process tag types/models.

Functions used when creating

Assistant	Functions of the wizard
Creating/changing a process tag type	Use the assistant to carry out the following: • Create a process tag type from existing CFCs and store it in the master data library. • Add/remove I/Os/messages to or from an existing process tag type. • Check if the existing process tags deviate from the process tag type and if so, synchronize them.
Creating/modifying models	Use the assistant to carry out the following: • Create a model for storage in the master data library using PH objects previously created with CFC/SFCs, OS pictures, OS reports, etc. • Add/remove I/Os/messages to or from an existing model. • Create and assign an import file. • Check the consistency of the model with the assigned import file. • Check replicas for changed IEA flags. The selected I/Os and messages are all assigned to a column of the import file. The import can be started after all the data is entered in the import file.

Importing data from plant planning

Each functional unit in the plant corresponds to a line in the import file. The IEA copies the appropriate model (creates replica) or process tag type (creates process tags) for each functional unit. It changes their interconnection/parameter descriptions and message texts depending on the content of the corresponding line in the import file.

When you import, you can decide whether or not the imported signals will be entered in the symbol table (option: "Also enter signals in the symbol table"). With PCS 7, we recommend that you do not use the option because these entries are made when you configure the hardware with HW Config.

Assistant	Functions of the wizard
Importing process tags	With the assistant, you can create process tags from process tag types and import the data from the import files to the process tags. The process tag type is copied from the master data library to the relevant target projects. Thereafter the data is imported. The result is a process tag as a copy of the process tag type for each row of the import file. The import file data is written to the corresponding I/Os or process tag blocks.
Importing models	With the Assistant, you can create replicas of models and import the data from the import file to the replicas. In a multiproject, the model is copied from the master data library to the specified target projects as a replica. Thereafter the data is imported. The result is a replica of the model for every row of the import file. The import file data is written to the corresponding I/Os or replica blocks.
Process tags: assigning/creating an import file	Use the assistant to carry out the following: • Assign an import file to a process tag type • Check the assignment of the import file to the process tag type • Create a template for the import file for the process tag

Export data for plant planning

The replicas of the models or the process tags of process tag types are modified, for example, during testing and commissioning of the control system. This also involves data that was configured with other tools during plant planning and imported for the control system engineering.

The following application options exist for the export of this data:

- If you want to synchronize the plant documentation with the current configured status, export the current data of the models previously created during the import process in the same form as when they were imported.
- You can export the data of the plant that is configured using model replicas or process tags. Using the IEA file editor, or a different tool (e.g. MS Excel, or Access), you can then edit and the re-import this data. You can make modifications to the project simply and quickly.

Assistant	Functions of the wizard
Exporting process tags	You can export the data of the process tags with the assistant. In the multiproject, all available projects are included. This results in an export file for each process tag type which contains one line for each process tag of the process tag type. A valid import file must be assigned. The individual column groups are structured with the same number of column titles and names as in the import file.
Exporting models	With the assistant, you can export the data of the replicas of models. In the multiproject, all available projects are included. This results in a model export file that contains a line for each replica of the model. A valid import file must be assigned. The individual column groups are structured with the same number of column titles and names as in the import file.

Rules

- When working with the "import/export" functions of the Import/Export Assistant, further hierarchy folders may be contained in the model.
- Only one OS picture per hierarchy folder may exist if the picture hierarchy is derived from the PH.
- If the model includes nested hierarchical folders, they may not be renamed.

Additional information

Assistant	Functions of the wizard
Process tags: Synchronize	The assistant enables you to perform a synchronization between the process tag type and the process tags. When a process tag type is modified, the process tags in the project are automatically changed accordingly. If not all process tags in the project can be accessed during the automatic synchronization, inconsistencies form between process tag type and the process tags. You should remove them with an explicit synchronization.

Tip

Note

In order to increase the clarity of the charts switch the model block I/Os that you do not require to **invisible**.

If you edit later in the IEA, you can see the selections set in the CFC in the process object view and can correct them there if necessary. The same applies to selections in models.

See also

How to create a process tag type from a CFC (Page 475)

How to create and edit a model (Page 518)

10.4.3 What happens during import?

Explanation of the import procedure - using the example "Model"

Process tags and models are imported in the same way.

You can start the import procedure after you have configured a model and have assigned an import file to it. The following steps are executed automatically:

1. The hierarchy path is read from the "Hierarchy" column in the first data line of the import file. The availability of the path is checked. Additional actions depend on the test results:
   - If the hierarchy folder already exists as a replica of the model, the parameter settings from the import file are applied to it.
   - If the hierarchy folder already exists and is suitable for becoming a replica, it along with its CFC are made into a replica of the model and assigned parameters according to the import file.
   - A hierarchy folder is created if it does not exist. Thereafter a replica of the model is created and assigned parameters accordingly.
2. If columns are available the following elements are entered into the chart text fields:
   - Function identifier (FID)
   - Location identifier (LID)
   - CFC name
   - Chart comment
3. Texts and values of the parameter descriptions and the interconnection descriptions (signals) are written to the corresponding block or chart I/Os of the replicas.

   Note

   An interconnection is deleted when the signal name (symbol or textual interconnection) consists of the code word "---" (three dashes).

   An interconnection remains unchanged, if no interconnection name (symbol or textual interconnection) is specified.

4. The I/O data types for signals are determined and assigned to the interconnections.

   Note

   The rule for interconnections with shared addresses is as follows: if the "Include signal in the symbol table" option is set, the names can be found in the model resource symbol table.

   With PCS 7, we recommend that you do not use the option because these entries are made when you configure the hardware with HW Config.

   Note the following rules:

   – **The symbol name is present in the symbol table**
   The data type must be the same; the symbol name may only exist once. The data type is assigned parameters according to block/chart I/O. The absolute address is overwritten and a symbol comment is entered for the symbol (if available in the import file). Only the information that has changed will be overwritten, existing attributes are retained.

   – **The symbol name is not yet available in the symbol table**
   The interconnection is created and the data type is assigned parameters according to I/O. The absolute address and the symbol comment are entered for the symbol (if available in the import file).

5. The message text is imported for each message.
6. Steps 1 through 5 are repeated for each line in the import file.

The input files appear together with the models in the list if you have selected a hierarchy folder that contains **several** models. If required, you can still edit the list. Following this, the import starts for all models in the list as described above.

Error messages in the import log

Error messages will be generated in the import log under the following circumstances:

- The hierarchy path contains a replica that does not belong to the model, in other words, there are too many or too few I/O points and/or the block is not or is incorrectly identified as a signaling block.
- If a model is located in the hierarchy path
- If the settings in the plant hierarchy do not match the imported hierarchy path
- If signals in the symbol table are not unique or will be written with incorrect data types

10.4.4 How to import process tag types and models

Sequence

Use the assistant for process tags or models to import the following data:

- **Process tag type**data
  The process tag type is copied from the master data library to the specified target projects as a process tag and the data is then imported. Any number of process tags can be created, depending on the entries in the import file.
  As a result of the import, a process tag of this process tag type is created in the target project for every row of the import file according to the specified hierarchy path.
- **Model**data
  The model is copied from the master data library to the specified target project as a replica and the data are then imported. You can create any number of replicas according to the entries made in the import file.

Note

When you import a process tag or model, you can decide whether or not the imported signals will be entered in the symbol table (option: "Also enter signals in the symbol table").

With PCS 7, we recommend that you do not use the option because these entries are made when you configure the hardware with HW Config.

Note

Before importing, check the language set for display. If you created the model in German and if the current setting of the SIMATIC Manager is "English", the German message texts will be written into the English text file.

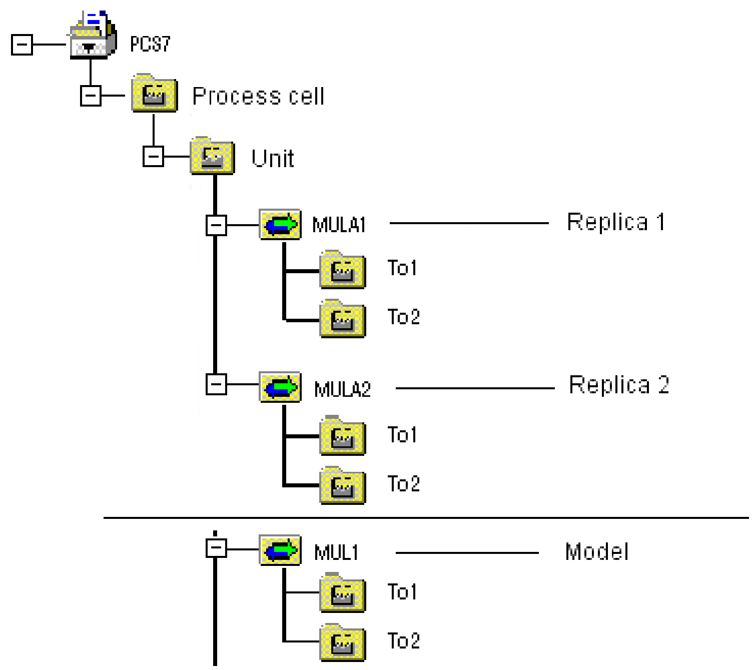
Procedure

1. Select the desired hierarchy folder, project node or process tag library (hierarchy folder in the master data library), or the process tag type.
2. Select the menu command **Options > Models > Import...**
   or **Options > Process Tags > Import....**
   The wizard searches for the models/process tag types and corresponding import files (in all hierarchy subfolders as well), and lists them. The import function will include all listed import files.
3. If you do not want to import certain files, you can select them and remove them from the list with the "Remove" button.
   By clicking "Other File...", you can search for a different import file and select it instead of the other file.
4. Click "Continue" and then "Finish".

Result

The actual import process starts. Depending on the setting of the "Only show errors and warnings in log" check box, the complete list of import activities or only the errors that occurred are displayed in the log window.
The log is saved in a log file. The name and path of the file are displayed below the log window. You can modify this setting with the "Other File" button.

In the following figure, both models and their replicas are shown as they appear in the SIMATIC Manager.



Import variants of process tag types/models

- **Importing process tag types/models for the first time**
  When you import a process tag type or a model for the first time, the process tags/replicas are created in the PH according to the entries in the import file and assigned parameters.
- **Importing additional process tag types/models**
  If you import a process tag type or model again, the I/Os copied during the first import are overwritten by the parameters, signals and messages specified in the IEA file (import changes), and those that do not yet exist are created.

- **Deleting replicas/process tags during import**
  You can decide whether existing replicas of a model or process tags of process tag type are deleted or overwritten during import. Using the import mode "delete" (in the "ImportMode" column of the import file), you can delete the replica/process tag. Thereafter a message indicates whether the deletion was successful.

  Note

  When you import, all the rows with the "delete" keyword are processed first and the subjects deleted. Only then are new objects created.

  If you have already created interconnections to the replicas, these will be lost.

- **Re-importing a process tag type/model**
  If you perform an import without modifying the model or the process tag type, the I/Os copied during the previous import are overwritten by the parameters, signals, and messages specified in the IEA file (import changes).

Reassigning CFCs to the process tag type (adopting)

If you have CFCs in your projects that are no longer or not yet process tags (for example, because the assignment to the process tag type was canceled) but have the conditions for process tags, you can assign these charts to the process tag type as process tags.

You can find information about this in the section "How to adopt process tags (Page 481)".

The same principles apply to adopting models.

10.4.5 What happens during export?

Explanation of the export procedure - using the example "Model"

Process tags and models are exported in the same way.

Once you have created replicas of the models by importing or copying in the SIMATIC Manager and, for example, have edited various values of the parameters and signals during test and startup, you can export the current data in the same form as they were imported. If you start the export function for a model or a replica directly, the following steps are executed automatically:

1. Identifying all the replicas of this model
   A data row is created in the export file for each replica found.
2. The identifiers LID, FID and the chart names are entered in the export file.
3. The parameter descriptions and interconnection descriptions (for each model found) are written to the corresponding cells of the file.
   In the case of interconnections with shared addresses, interconnection descriptions are identified and written in the corresponding cells of the file on the basis of the interconnection names (symbol names) in the symbol tables.
4. The blocks messages are identified and written in the corresponding cells of the file.

The export files appear together with the located models in the list if you have selected a hierarchy folder that contains **several** models. If required, you can still edit the list. Finally, the export starts (as described above) for all models in the list.

Error messages in the export log

You can see error messages in the export log if I/O points are missing or if there are too many in the replica.

10.4.6 How to export process tag types and models

Options

You export data for models or process tags using the assistant. The following options are available:

- Individually select a model/process tag type to export it by itself.
- You can select an upper level hierarchy folder or the project node in order to export all lower level models (replicas) or process tags.

This results in an export file that contains a line for each located replica of a model or for each process tag of a process tag type.

The structure of the export file corresponds to that of the import file.

Procedure

1. Select the desired hierarchy folder, project node and/or process tag library (hierarchy folder in the master data library), or the process tag type.

   Note

   After selecting a replica you are forwarded to the corresponding model in the master data library after the prompt.

2. Select the menu command **Options > Models > Export...** or
   Options > Process Tags > Export....
   he wizard searches for the models/process tags and lists them.
3. In the next step assign the export files to the displayed models/process tags or modify an existing assignment.
   The names of the assigned files can be changed by clicking "Other file..." to select another file or to enter a new file name.
4. In the final step of the dialog box you can select the log file or activate/deactivate the filter in order to log only error messages and the finished message.
5. Click "Finish".

Result

The export procedure starts. Any existing export files are overwritten during the export procedure.

Repeated exports

By exporting the model(s)/process tags more than once, you can create several export files (copies). During the export procedure you must modify the file name of the assigned export file. If you do not change the file names the export file with the same name is overwritten.

10.4.7 Restrictions in connection with the IEA

Restrictions placed on modifications

The following modifications may not be made to charts/chart I/Os with IEA attributes in CFC since these would prevent import or export.

- Renaming nested charts (charts with chart I/Os included in the chart of a model).
- Deleting nested charts.
- Changing the data type of a chart I/O
- Modifying the relative order of chart I/Os with IEA flags (or I/O points of a process tag), for example, by inserting or deleting chart I/Os (without IEA flag).
- If the model contains nested hierarchy folders, the names of the nested folders must not be modified.

Carrying out these modifications will generate an error in the error log.

10.5 Creating/editing import files with the IEA file editor

10.5.1 Data of the IEA file in the ES

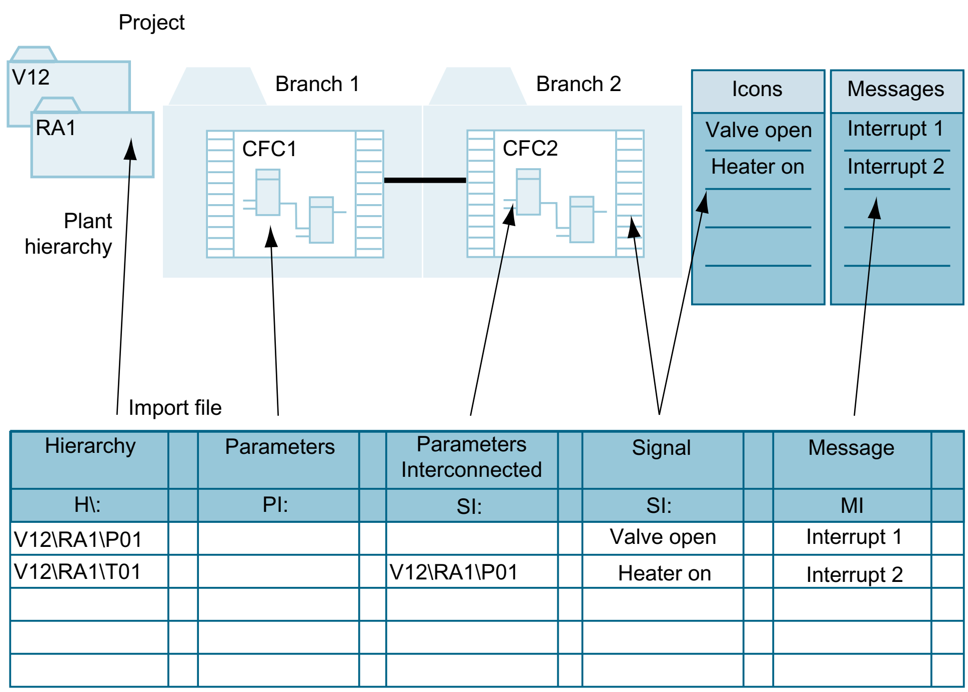
Introduction

The following sections explain how to create and edit the Import/Export files (IEA data) with the IEA file editor. The description includes the following topics:

- Creating/editing import files with the IEA file editor (Page 593)
- Data exchange with MS Excel/Access (Page 595)
- Structure of the IEA file (Page 596)

IEA file in the engineering system

The figure below shows the relationships between the project objects and the data of the import file.

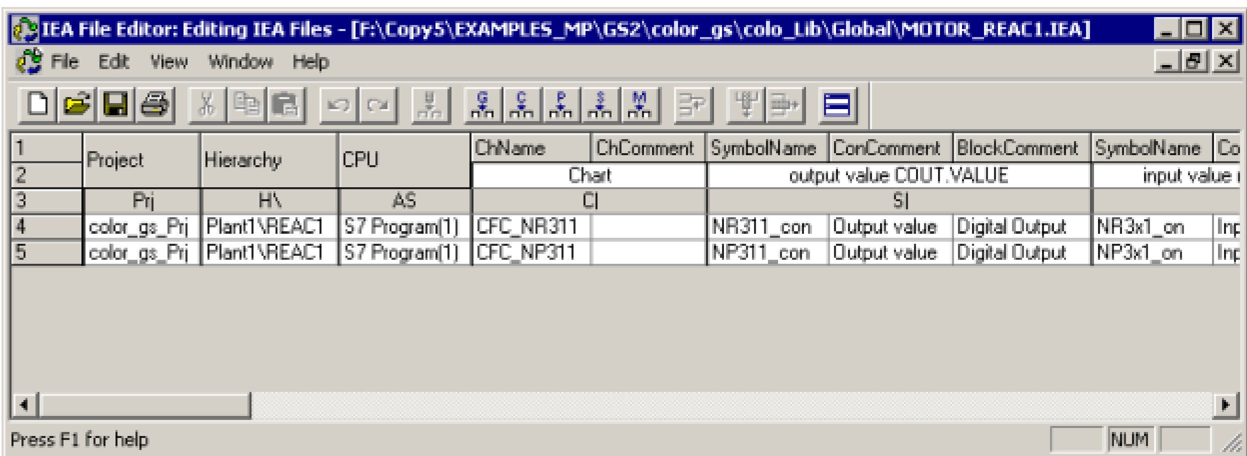


10.5.2 Creating/editing import files with the IEA file editor

IEA File Editor

The Import/Export Assistant (IEA) works with import/export files in a fixed format. A plant planning tool such as SIGRAPH EMR supports this format. The Import/Export Assistant installs an IEA file editor to allow for you to create and edit import files without difficulty and without the help of a plant planning tool. Using the IEA file editor to edit export and import files will ensure that you follow the rules for configuring export and import files.

The IEA Editor "s7jieaEx.exe" is a standalone application that can also be utilized outside of the PCS 7 installation. It can be copied and made available to plant planners.



Editor application scenarios - using the example "Process tag"/"Model"

The IEA File Editor is intended for the following situations:

- You have created a process tag type/model and created the import file with the IEA. You want to use this import file to create replicas of the model or process tags. The number of rows in the import file must be increased according to the number of replicas/process tags (for example, by copying and editing).
- You have created a process tag type/model and created the import file with the IEA. You want to change this model, for example, by including further I/Os and need to extend the import file by adding these columns.
- You do not have a tool for creating an import file and want to use the IEA File Editor as a planning tool to structure the columns, column groups and rows of the import file and the corresponding values.
- You want to compare an import file with an export file (or vice versa). By opening two windows and arranging them in the IEA File Editor window, you will have no difficulty in making the required comparison.

Appearance of the IEA File Editor

The IEA Editor is displayed as a table with columns and column titles. Certain columns are combined to form column groups, for example, column group for the chart with the words of the columns: "ChName" and "ChComment".

The name of the column groups can be changed as it coincides with the column title of the import file. Columns within a column group can be deleted if you only want to use a limited number of the import options. If you remove all the columns of a column group, this I/O point is lost; in other words, the IEA file will no longer match the model.

The row headers contain the number of the row. Marking a row header will select the entire row (for example, for copying).

The IEA File Editor also provides all the standard editor functions (copy, paste, save etc.).

To allow you to insert column groups, all the column group types (general, chart, parameter, signal, message) are defined in a submenu and are also available as buttons in the toolbar.

You can also add new columns to the column groups "General", "Chart", "Parameter", "Signal" and "Messages". Only those column titles that have not been used in this column group are offered in the extension dialog box.

You can select all the possible functions with the menu commands in the menu bar or the buttons in the toolbar.

Otherwise, the structure of the editor corresponds to the structure of the import/export file (IEA file).

Starting the IEA file editor

1. Start the IEA file editor
   The IEA editor opens
2. Open an IEA file.

Working in the editor table

With the IEA file editor, you work in the same way as with other Windows applications (for example, MS Excel).

The following functions are available:

- Use the arrow keys and the <Tab> key to navigate within the file.
- Use the <Return> key to complete the entry and move to the next row.
- You can select entire columns and rows.
- You can change or optimize the width of the column.
- The cut, copy, and paste functions can be used to insert cell contents from the table via the clipboard into selected cells one or more times.
- You can use the Find/Replace functions.

Additional information

- Online help for the *PH*, *IEA*, *PO* and *IEA file editor*

10.5.3 How to exchange data with MS Excel/Access

Introduction

The import/export data (IEA file) is available as a text file in CSV format. The CSV format is supported by many applications (MS Excel, MS Access, etc.) and is therefore suitable as a general data interface between any engineering tool and the ES. In IEA these files are expected to have the *.iea extension. You may have to change the extension.

CSV (Comma Separated Value) is an ASCII text format used for storing data configured in the form of a table. The character separating the cells depends on the regional and language options in the operating system (German: semicolon); a new row is created by pressing Enter.

You can create and edit a CSV file with spread sheet programs (for example, MS Excel) or as an export file from a database (dBase, Access, etc.). You can also conveniently edit the file (with the extension *.iea) using the IEA file editor.

Editing files with MS Excel

1. Change the extension of the file from *.iea to *.csv.
2. Start MS Excel.
3. Select the **File > Open...** menu command and open the CSV file.
   The file opens; the content of the file is shown precisely as it appears in the IEA file editor.

   Note

   When you open a CSV file by double-clicking it, the content of the file is not shown in table form in Excel.

   All cells should be formatted as "Text", otherwise the displayed information may be incorrect. Example: The numeric string "1.23" can be displayed as "23 Jan.".

   ---

4. Edit the file and save it.
5. Change the extension of the file from *.csv to *.iea.
6. If necessary, carry out any additional changes in the IEA file editor and/or import the file with the IEA.

Exchanging data with MS Excel

You can edit the file (with the extension *.iea) conveniently using the IEA file editor. The editor also offers the cut, copy, and paste functions as well as find and replace. Use Excel if you require more advanced functions.

Follow these steps:

1. Start the IEA file editor and open the required file.
2. Start Excel and create a new file.
3. Select the desired area of the table in the IEA file editor and copy it.
4. Paste the copied area into the empty MS Excel file.
5. Edit the data in MS Excel.
6. Select and copy the data in MS Excel.
7. Paste the copied data in the IEA file editor to the IEA file.

10.5.4 Structure of the IEA file

Import/export file (IEA file)

You can edit the import file (with the extension *.iea) conveniently using the IEA File Editor. The import file is a CSV file that you can create and edit with spreadsheet programs (MS Excel) or as an export file from a database (dBase, Access, etc.).

To edit with a table or database program, you must be familiar with the file structure described below.

File structure

There must be a column group for each I/O and message.

Row	Meaning
0	There can be a comment line before the first header (starting with "#" or "//") containing both the version number and the date created.
1	The first header row contains the titles of the column groups.
2	The second header line contains the column identifiers. This information tells the Import/Export Assistant how to interpret the columns. These identifiers are the same in all language versions.
3	The third header row contains the keywords for the relevant flagged I/O. This decides which data will be imported for this I/O. Not every keyword must be entered; only the first one is mandatory.
4-x	The next rows contain the data. There is one row per replica or process tag. During import, each row generates a replica of the model in the specified hierarchy folder. Process tags are created in the hierarchy folder.

Example: Measured value acquisitions

In the following example, the IEA file is shown as a table to make it easier to read and the text in the three header rows is shown in "bold" print. The quotation marks are also missing at the start and end of each column entry.

You can only edit the area with the data and not the header lines.

Since this is clean ASCII text, you may not format an original file (for example, insert spaces or tabs or use bold print).

The IEA file can be displayed and edited as a table formatted with the IEA File Editor.

Project;	Hierarchy;	FID;	LID;	Chart;	High limit;	Measured value	Alarm high
Prj;	H\;	F;	O.;	C|;	P|;	S|;	M|
;	;	;	;	ChName| ChComment;	Value| ConComment| S7_shortcut| S7_unit;	SymbolName| SymbolComment| ConComment| S7_shortcut| S7_unit;	Event|
Pro_A	V12\RA1\P01;	;	;	P01|Internal pressure;	90|Com.|OG|mbar;	Tpress|ComS.| ComA.|PK|mbar;	Int. pressure too high
Pro_A	V12\RA1\P02;	;	;	P02|External pressure;	8.5|Com.|OG|bar;	Apress|ComS.|ComA.|PK|bar;	Ext. pressure too high
Pro_A	V12\RA2\T01;	;	;	T01|Temp contr	80|com.|OG|degC;	Mtemp.|ComS.|ComA.|MT|degC;	Temperature exceeded
Pro_B	V12\RA2\T02;	Delete					

Explanation of the column groups

- **Project**
  The "Project" column group contains the names of the target project in the multiproject where the replicas or process tags are stored.
- **Hierarchy**
  The "Hierarchy" column group contains the complete hierarchy path even if individual hierarchy folders do not contribute to the name.
  During import, the hierarchy folders (replicas of the models or process tags) are created from this and the content of the model/process tag (charts etc.) is copied into this new hierarchy folder if it does not yet exist. During export, all existing replicas of the model are entered.
  With process tags, the process tags are generated from the process tag type and created in the hierarchy folder. A hierarchy folder may contain multiple process tags.
  The hierarchy levels are separated by a "\", and the IEA is informed of this in the second row. Here, "\" must be used as the separator.
- **FID and LID**
  The "FID" and "LID" column groups belong to the "general column groups" and are optional. FID and LID are entered in the text boxes of all top charts of the replicas.
  The "FID" column group contains the function identifier.
  The "LID" column group contains the location identifier.
  The data of the FID and LID is missing in the example. The ";" must nevertheless be included so that the number of column groups remains the same. The text is entered in the "Part 3" tab, in the "Descriptions:" or "Code field according to location:" text box.
- **Chart**
  The "Chart" column group is optional for models, but if used it always follows the "Hierarchy" column group, or, if they exist, after the general column groups. Any name can be used for the title. The column group contains the name and comment of the CFC/SFC. The name of the chart in the replica of the model is changed with the keyword "ChName". The chart comment is changed with the keyword "ChComment".

- **Further column groups**
  The following column groups identify the I/Os to be imported. Each of these connections is described by a text string (in quotation marks) that is separated from the next connection using a separator (list separator specified by the Windows regional settings) . The individual data within the text string are separated by a "|" (pipe character).
- **Extend column groups**
  Further columns can be displayed by using the **Extend Column Groups...** menu command, depending on the selected column.

Additional information

- Online help for *PH*, *IEA* and *PO*

10.6 Importing/exporting the hardware configuration

Introduction

You can work on station configurations not only within the entire project (for example, saving or opening), but also independent of the project by exporting it to a text file (ASCII file, CFG file), editing it, and then importing it again. In this way the symbolic names of the inputs and outputs are also exported or imported (as long as you have not changed the default setting).

Application

You can use the import/export of the hardware configuration to do the following:

- To import hardware planning tool data
- To distribute data using electronic media (for example, e-mail)
- To print the export file using a word processor or to continue processing the export file for the purpose of documentation

Another important application of importing a station configuration exists in a plant when identical or almost identical configurations in different parts of the plant occur. Using the import function, you can create the required plant configuration quickly.

What is exported/imported?

When you configure the hardware, the data necessary for the configuration and parameter assignment of modules are exported/imported.

The following data are **not** collected:

- Data managed by other applications (for example, programs, connections, shared data)
- A selected CPU password
- Cross-station data (for example, the linking of intelligent DP slaves or configurations for direct data communication)

Note

If your configuration contains modules from older option packages, it is possible that not all the data of the module will be included with the "Export Station" function. In this case, check whether the module data are complete following the import.

10.6.1 How to export a station configuration

Procedure

1. Select the required station in the component view.
2. Select the menu command **Edit > Open Object**.
   The station configuration opens in HW Config.
3. Select the menu command **Station > Export...**.
   The "Export" dialog box opens.
4. Enter the path and name of the export file, format and other options.
   You can find information about this in the paragraph on "Export settings".
5. Click "OK".

Result

The station configuration is exported and stored in the selected path in the form of a CFG file.

Export settings

- Legible or compact format
  - In legible format the parameter identifiers are stored in the export file as strings.
  - In compact format the identifiers are stored in the export file in hexadecimal format.

  Note

  When you export the station configuration to read it in using other PCS 7 versions, select the "Compact" option.

- Name of the file (*.cfg) (open to choice)
- With or without symbols
  You can determine whether symbols you specified for the inputs and outputs should also be included in the export file.
- With or without subnets
  You can decide whether or not subnets are exported. When you select this option, the network data for the interfaces of the station is also exported (assignment to subnets, subnet parameters).
- Default values for module parameters can be omitted as an option (PCS 7 knows the default values and supplies them internally during import).

  NOTICE

  When you export a station configuration with symbols, you can no longer import this file with earlier PCS 7 versions.

Additional information

- Online help for HW Config

10.6.2 Structure and content of the CFG file

CFG file

The procedure for exporting the station configuration described in the section "How to export a station configuration (Page 600)" results in an ASCII file, which you can view and edit in a text editor such as "Notepad" or "WordPad".

This file (CFG file) contains all the data of the hardware configuration including the parameter assignments from the dialog boxes of the HW Config user interface and the corresponding symbols (if these were exported).

Based on the introductory text in the individual fields, the sections can be easily identified.

The example below includes a section of a possible CFG file structure.

Example

Section of the CFG file	Information/object properties for
FILEVERSION "3.2" #STEP7_VERSION V5.6 #CREATED "Montag, 10. April 2017 13:02:49"	File
STATION S7400 , "SIMATIC 400(1)" BEGIN ASSET_ID "B6BF...." USED_S7_VERSIONS "35 ....." REPORT_SYSTEM_ERRORS "0" OBJECT_REMOVEABLE "1" POS_X "0" POS_Y "0" SIZE_X "0" SIZE_Y "0" OBJECT_COPYABLE "1" CREATOR "" COMMENT "" END	Station
SUBNET INDUSTRIAL_ETHERNET , "Ethernet(1)" BEGIN COMMENT "" NET_ID_2 "00 31 00 00 00 13" NET_ID "003100000013" END	Subnet (Ethernet)

Section of the CFG file	Information/object properties for
SUBNET PROFIBUS , "PROFIBUS(1)" BEGIN PROFIBUS_HSA "126" PROFIBUS_BAUDRATE "1.5_MBPS" PROFIBUS_RETRIES "1" PROFIBUS_GAP "10" PROFIBUS_READY "11" PROFILE_SELECTION "DP" NETCONFIG_ENABLE "0" NETCONFIG_AKTIV "1" NETCONFIG_PASSIV "2" : : :	Subnet (PROFIBUS)
:	
RACK 0, SLOT 7, "6ES7 421-1BL01-0AA0", "DI32xDC 24V" BEGIN IPACTIVE "0" CPU_NO "1" ALARM_OB_NO "40" OBJECT_REMOVEABLE "1" POS_X "0" POS_Y "0" REDUNDANCY BEGIN END SIZE_X "0" MODULE_ADD_FLAGS "0" SIZE_Y "0" OBJECT_COPYABLE "1" CREATOR "" COMMENT "" LOCAL_IN_ADDRESSES ADDRESS 0, 0, 4, 0, 0, 0 SYMBOL I , 0, "I0.0", "" SYMBOL I , 1, "I0.1", "" SYMBOL I , 2, "I0.2", "" SYMBOL I , 3, "I0.3", "" : : : SYMBOL I , 30, "E3.6", "" SYMBOL I , 31, "E3.7", "" END	Digital input including symbols
:	
:	Baugruppen (PS, CPU, CP, DI, DO, AI, AO etc.)
:	

Section of the CFG file	Information/object properties for
IOSUBSYSTEM 101, "Ethernet(1): PROFINET-IO-System (101)" BEGIN PN_PHASE_RELATION "65536" PN_MIN_VERSION "" GUI_HIDE "0" OBJECT_REMOVEABLE "1" POS_X "459" POS_Y "232" SIZE_X "253" SIZE_Y "16" PN_USE_DEVICE_SPEC_UPD_TIME "1" SUBNET_NAME "Ethernet(1)" CAX_APP_ID "" DNS_CHECK "0" OBJECT_COPYABLE "1" PN_USER_DEF_UPD_TIME "0" CREATOR "" COMMENT "" IRT_GROUP_NR "1" END	Subnet (PROFINET)
:	
IOSUBSYSTEM 101, IOADDRESS 5, SLOT 3, SUBSLOT 1, "Analog Input (AI)short", "148" BEGIN ASSET_ID "7CC4EEC..." SLAVE_CFG_DATA "01 00 94" OBJECT_REMOVEABLE "1" RETAIN_LAST_VALUE "0" POS_X "0" POS_Y "0" SIZE_X "0" MODULE_ADD_FLAGS "0" NORMMODULE_PARAM_DATA "00 00" SIZE_Y "0" CAX_APP_ID "" OBJECT_COPYABLE "1" NORMMODULE_REFERENCE "2" CREATOR "" COMMENT ""LOCAL_IN_ADDRESSES ADDRESS 10, 0, 5, 1, 8, 0 END	Baugruppen (DI, DO, AI, AO etc.)
:	

Additional information

- Online help for HW Config

10.6.3 Expanding CFG files

Expansion

CFG files should always be created based on an existing exported station configuration. You can find information about this in the section "How to export a station configuration (Page 600)".

The CFG file should already contain all objects (passages of the file) required for station expansion. This allows you to make the required expansions simply by copying and pasting. Keep the configuration consistent by adapting the copied objects accordingly (for example, rack assignment, addresses, symbols).

For an explanation of the structure and content of the CFG file, refer to the section "Structure and content of the CFG file (Page 601)".

On this basis you can edit the individual sections of the file to suit your purposes (copy, paste, edit).

Note

You should be familiar with the content of the sections of the CFG file in detail because editing is not supported by the system. Errors will only be detected during the subsequent import. This can lead to inconsistent data that you would then have to re-edit in HW Config.

Procedure - Example

You want to add an additional digital input module to an ET 200M and change the existing slot assignments.

1. Identify the area you want to change.

Section of the CFG file	Information/object properties for
DPSUBSYSTEM 1, DPADRESS 7, SLOT 6, "6ES7 321-FH00-0AA0", "DI16xAC120/230V" BEGIN PROFIBUSADDRESS "0" CPU_NO "1" ALARM_OB_NO "40" OBJECT_REMOVEABLE "1" POS_X "0" POS_Y "0" REDUNDANCY BEGIN END SIZE_X "0" SIZE_Y "0" OBJECT_COPYABLE "1" CREATOR "" COMMENT "" LOCAL_IN_ADDRESSES ADDRESS 0, 0, 2, 0, 1, 0 SYMBOL I , 0, "I0.0", "" SYMBOL I , 1, "I0.1", "" SYMBOL I , 2, "I0.2", "" SYMBOL I , 3, "I0.3", "" : : : SYMBOL I , 30, "E3.6", "" SYMBOL I , 31, "E3.7", "" END	Digital input including symbols

1. Select and copy the required area.
2. Paste the copied area at the required location.
3. Adapt the inserted area (SLOT, SYMBOL, etc.)
4. If necessary, adapt the modules already configured.
5. Follow the same procedure if you want to add additional components.
6. Save the file.
7. Start HW Config.
8. Select the menu command **Station > Import...**.
9. Select the corresponding CFG file and click "Open".
   During import, queries may appear asking you whether existing data should be overwritten. The changed station configuration is imported into the opened station. A log is created and error messages are output, if necessary.
10. Click in the dialog box used for displaying the error messages on the "Save" button to save the error messages in a text file. To do so, select the path and enter the name of the text file.
11. Click "Close".

Additional information

- Online help for HW Config

10.6.4 How to import a station configuration (first import of an entire station)

Procedure

Recommendation: Do not import a station configuration that was previously exported from the same project. In this case, PCS 7 cannot handle the network assignment. Select a different or new project for the import. Follow these steps:

1. Select the HW Config menu command **Station > Import...** while an empty station configuration is open.
   If no station configuration is open, a dialog box opens in which you select a project. In this case, navigate to the project into which you want to import the station configuration.
2. Use the open dialog box to navigate to the CFG file you want to import.
3. Click "OK".
   The station configuration is imported. During import, the imported file is checked for errors and conflicts and messages are displayed.

Note

If you also want to import DP master systems during import, these must not have the same names as the DP master systems that already exist in the project.

Additional information

- Online help for HW Config

10.6.5 How to execute an expanded import (adding remote I/O, field device, module)

Importing into existing station

You can import a station into an open station configuration. During the import, PCS 7 asks whether you want to overwrite modules/interface modules that have already been configured. For each component, you can decide whether you want to retain it or overwrite it.

If a component is overwritten, all the settings (parameters) contained in the import file are applied. Settings that are not included in the import file are retained in the station configuration.

Procedure - Inserting a digital input module

You want to add an additional digital input module and change the existing slot assignments. Follow these steps:

1. Open the required CFG file with an editor (for example, WordPad).
2. Identify the area that describes the digital input module and then copy it.
3. Paste the copied passage directly after the digital input module you copied.
4. Adapt the slot number, address, symbols and any other relevant data and save the file.
5. Open the station where the changes were made in HW Config.
6. Select the menu command **Station > Import...** and import the required CFG file.
   A dialog box opens in which you can select whether you wish to overwrite the entire configuration ("All" button) or only the parts which have changed ("Yes" and "No" buttons). An error log is also created with the import.
7. Save the imported data.
8. Check the data consistency with the menu command **Station > Check Consistency** and eliminate inconsistencies, if necessary.

Additional information

- Online help for HW Config

10.6.6 How to update an imported station configuration (changing attributes, signal assignments of modules)

Importing into existing station

If you have already modified configured modules/interface modules in the CFG file, you can update an existing station configuration by importing into the station.

During the import, PCS 7 asks whether you want to overwrite modules/interface modules that have already been configured. For each component, you can decide whether you want to retain it or overwrite it.

If a component is overwritten, all the settings (parameters) contained in the import file are applied. Settings that are not included in the import file are retained in the station configuration.

Procedure - Parameter changes

You have only changed the settings (parameters) of an existing station configuration.

1. With the station configuration open, select the menu command **Station > Import...** and import the required CFG file.
   A dialog box opens in which you can select whether you wish to overwrite the entire configuration ("All" button) or only the parts which have changed ("Yes" and "No" buttons). An error log is also created with the import.

   Note

   The import process is much quicker if only the changed parts are overwritten.

   ---

2. Save the error log if one is generated. You can then eliminate any errors based on the log.
3. Click "Yes" to save the imported data.
   Selecting "No" will terminate the import process. The station configuration remains unchanged in this case.

Additional information

- Online help for HW Config

10.6.7 Export for synchronization with higher-level engineering tools

Synchronization with higher-level engineering tools

You have configured the station configuration according to the plans of plant engineering and added and/or corrected it during hardware detail configuration. You can integrate these changes once again into the plant engineering data with the help of the export file.

- You can find a description of how to export a station configuration in the section "How to export a station configuration (Page 600)".
- The structure of the CFG file is described in the section "Structure and content of the CFG file (Page 601)".

Prepare the contents of the CFG file as you would for import into your engineering tool (plant engineering) and import the file.

11 Compiling and downloading

Overview

The functions for compiling and downloading are available in the following editors:

- HW Config
  Compiling and downloading the hardware configuration
  You can find information on this in the section "Configuring hardware".
- NetPro
  Compiling and downloading the network and connection configuration and the hardware configuration
  You can find additional information on this in the section "Creating network connections".
- CFC
  Compiling and downloading the CFC configuration
  You can find additional information on this in the section "Creating CFCs".
- SFC
  Compiling and downloading the SFC configuration
  You can find additional information on this in the section "Creating SFCs".
- SIMATIC Manager
  Compiling and downloading **individual** or **all** objects of a multiproject.

Actions after Merging Projects Edited on Distributed Stations

The following tasks must be performed during multiproject engineering after the distributed projects have been merged:

- Compiling the OS server with assigned AS components
- Only when downloading the first time: Assigning the OS server data packages to the OS clients
- Download to all target systems (for example, AS, OS server, OS clients, BATCH server, BATCH clients, Route Control server, Route Control clients)

Note

OS server data must only be downloaded once after the initial download to the OS clients. Each time an OS client is restarted in process mode or when downloading changes to the OS server, the OS server data is automatically updated.

Note on ensuring that the OS server data is up-to-date: the server data includes the computer name of the engineering station from which the data was first downloaded. If you change engineering stations or change the storage location of the project/multiproject on the engineering station, make sure that the OS is recompiled and remember that the server data must be downloaded once from the new computer (computer name) or storage location.

The compiling and downloading of the OS and the updating of the OS server data on the OS clients is described in detail in the configuration manual *Process Control System PCS 7; Operator station* and is therefore not dealt with in detail here.

Initially you only need to compile and download the AS data in order to test the program or the CFC and SFC configuration.

Overview

The sections about compiling and downloading for PCS 7 deal with the following topics:

- Requirements for compiling and downloading (Page 611)
- Downloading to all PLCs (Page 612)
- Options for compiling and downloading (Page 617)
- How to document changes in the ES log" (Page 621)

11.1 Requirements for compiling and downloading

Downloading the hardware configuration and network configuration

To use the "Compile and download objects..." function for the automation systems, the hardware configuration and the network configuration of each SIMATIC 400 station must first be downloaded.

One-time download of the OS server data

The data must be updated only once on the OS clients after downloading the OS server data to the OS server. Each time an OS client is restarted in process mode or when downloading changes to the OS server, the OS server data is automatically updated.

Downloading OS server data

1. Select the OS client in the SIMATIC Manager.
2. Select the **Options > OS > Assign OS Server...** menu command.
   The OS server data is uploaded to the OS client. The OS client then knows the assigned OS servers.

Additional information

- Configuration manual *Process Control System PCS 7; Operator Station*

11.2 How to download to all CPUs

Introduction

Use the "Compile and Download Objects" central function to download an entire project/ multiproject. PCS 7 provides the "Compile and Download Objects" dialog for this task. This dialog box displays the objects exactly the same way as in the SIMATIC Manager component view. All of the automation systems, operator stations, and SIMATIC PC stations that you created in SIMATIC Manager are displayed.

Use the "Compile and Download Objects" dialog box , to centrally carry out all of the required settings for compiling and downloading. In addition this is where you can specify, whether you want to compile and download the entire project or, for example, only individual operator stations.

Note

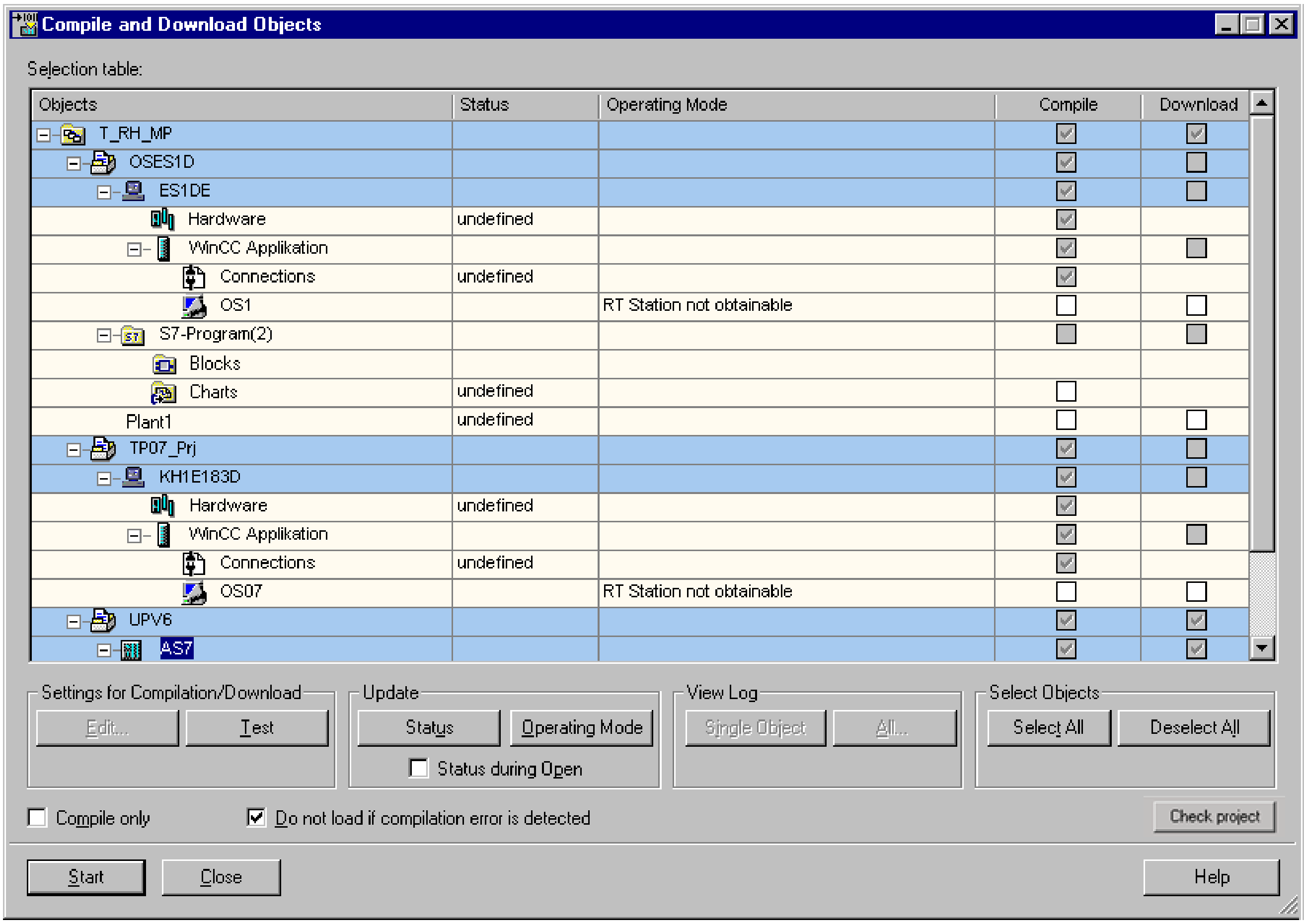
If you select the SIMATIC 400 station in the SIMATIC Manager, followed by the menu commands **PLC > Download** or **PLC > Compile and Download Objects...** ("HW Config" object activated for compiling and downloading), the capability of downloading changes will be lost.

"Compile and Download Objects" dialog box

All download relevant objects including their status and operating state can be found in the selection table of the dialog box.

The "Compile and Download Objects" dialog box is used to prepare the selected objects of your project or multiproject for downloading to the target system and then to download them to the target system. The dialog box can be applied to objects in a station, project or multiproject.

PCS 7 coordinates compiling and downloading, in other words, you do not need to pay attention to the order of the tasks.



Requirements

- The PC stations and automation systems are configured and downloaded from NetPro (the connections are also downloaded).
- The CFC and SFC configuration is completed.
- You have selected one of the following objects in the SIMATIC Manager:
  - Multiproject
  - Project
  - Station
  - S7 program without station assignment

Rules

- A complete automation system download is only possible when the CPU is in the STOP operating mode.
- Downloading the entire program to an OS is only possible when the OS servers are shut down (are not in process mode).

- Downloading changes to an OS is possible only if the OS is in process mode.
- When you have made changes during commissioning, we recommend you synchronize the projects of the multiproject before downloading to the target system. To do this, select the menu command **File > Multiproject > Synchronize Projects...**. You can the use the central "Compile and Download Objects" function to send the changes to the target system.

Procedure

Note

Read the information in section "Options for compiling and downloading (Page 617)".

1. Select the object that you want to compile or compile and download in the SIMATIC Manager.
2. Select the menu command **PLC > Compile and Download Objects...** in the SIMATIC Manager.
   The "Compile and Download Objects" dialog box opens.
3. Open the tree view and activate the corresponding check boxes in the "Compile" or "Download" columns for all objects that you wish to compile and/or download.
   If you tick both check boxes for an object, the object is compiled and then downloaded.
   Select the corresponding check box on the "Connections" object if you want to compile the and download connections.
4. Use the "Status" and "Operating Mode" buttons to check the statuses (changed, compiled, downloaded, etc.) and modes of your objects (RUN, activated, etc.), so that you can make the correct settings for compiling and downloading.
5. Select the object you want to compile and/or download and click "Edit".
   Enter the settings for the compiling and/or downloading (for example, compiling and downloading the entire program or only changes).

   Note

   When you have completed the settings for compiling an operator station, it takes some time for the compiling settings to be saved and for the download dialog box to be opened. The target path of the OS should already be entered here (but if it is not, enter it).

6. Click "Test".
   The admissibility of the settings is checked. If settings are not valid, the download is not performed.
7. Make the required settings for the individual objects.
   Click "Help" in the dialog box for detailed information about the settings.
8. Select the "Compile only" option if you only want to check the blocks and not download them to the CPU.
9. Select the "Do not load if compilation error is detected" option if you want to prevent downloading corrupt blocks to the CPU.
10. Click "Start".
    The compile/download operation starts.

11. Follow the instructions on the screen.
12. If you wish to see a log once the compiling/downloading is completed, click the following buttons in the "Open log" area:
    - "Single Object" - The detailed compilation and download log of the selected AS or the compilation log of the selected OS is displayed.
    - "All" - The results of all compiling and download actions (without details) are displayed.

    Note

    Do not use the "Compile and Download Objects" function for S7 PLCSIM downloading.

Reading back settings after changes during commissioning

Read the operator control and monitoring settings that were made during the test back into the project.

Parameter settings, for example, controller parameters, must also have the required values in the offline program (CFC) as they were set during commissioning.

The CFC supports the readback of CFCs. You should only read back CFCs when your plant is in a defined safe state.

Once you have completed the readback, you can perform a download of changes in order to maintain consistency between the offline and online program. In the "CPU Comparison" dialog box, check whether the time stamp "Last download-relevant change", "Last compilation" and "Compilation of the loaded program" agree.

Reading back the AS parameter settings

Note

"Version Trail" add-on package

If you are using the "Version Trail" add-on package you can read parameters back automatically. You can find additional information on this topic in the section "Introduction to archiving, versioning and documenting (Page 646)".

1. Open the multiproject in the SIMATIC Manager and select your project.
2. Double-click on the CFC of the modified program.
   The CFC editor opens.
3. Select the menu command **Chart > Read Back...**.
4. Select the "Program on the CPU" and "OCM-capable parameters" or "Designated parameters" check boxes in the "Read Back" dialog box.

   Note

   If the "Marked parameters" check box is selected, only the block I/Os with the "Can be read back" attribute (S7_read_back = true) are read back. This setting must first be entered at the I/Os of the block type. The attribute cannot be modified in the block instances.
5. Click "OK".

Additional information

- Section "Options for compiling and downloading (Page 617)"
- Section "How to load individual changed charts into the CPU (Page 453)"
- Online help on the "Compile and Download Objects" dialog box

11.3 Options for compiling and downloading

Central settings for compiling and downloading

In the "Compile and Download Objects" dialog box, make the required settings for compiling and downloading separately for each object. In the "Compile" and "Download" columns, specify if you want to compile and download the entire project or individual components.

Compiling the charts generates an executable program that can run on the CPU. The consistency of the blocks and interconnections are also checked.

Options in the "Compile and Download Objects" dialog box

Table 11-1 Settings for compilation/download

Settings	Description
"Edit..." button	Opens a dialog in which the compiling and downloading settings can be changed for the object selected in the "Objects" column. • Settings for download mode – Entire program The entire content of the "Block" folder is downloaded and, following a prompt, the CPU is set to STOP. – Changes The CPU can be in the "RUN-P" mode. The download of the modified blocks is as safe as possible (bumpless) to avoid the CPU changing to "STOP". – In test CPU (entire program) With this type of download, you can download a modified program to another CPU or to an S7 PLCSIM, without losing the delta download capability in the original CPU. **Note:** The CPU may still change to STOP. The reasons for this include temporary inconsistencies that cannot be checked by the loader (for example, local requirements of blocks that do not include reference lists). • Include user data blocks This option is set as default and is only relevant when you download changes (when downloading the entire program, all the blocks are downloaded including the user data blocks). • Auto archiving with Version Trail If you are using the "Version Trail" add-on package, a project version can be automatically created after a successful download process. You make the settings for auto archiving using the "Download Versioned Project" button.
"Check" button	Checks the compiling and downloading properties of objects selected for compilation or download in the "Objects" column. This button is not active for block folders. The button is only active if the objects support this function. The following is checked for a "hardware" object: • Are the modules in the STOP mode (not with modules that automatically stop and can be started again, for example, CPs)? • If password protection has been configured and a password has been entered: the entry takes place via the "Edit" button with the selected block folder or CPU.

Table 11-2 Update

Settings	Description
"Status" button	Updates the current status of the objects in the selection table. With the "Hardware" object, "undefined" is displayed after a status update if the station contains a cross-station PROFIBUS subnet. In this case, the editing of the other station that is also connected to this PROFIBUS subnet can have effects on the currently displayed station.
"Operating Mode" button	Updates modified operating modes in the display.
"Status on opening" check box	When the check box is not selected (default), the "Compile and Download Objects" dialog box opens immediately after the menu command **CPU > Compile and Download Objects...** is selected. "Undefined" is however entered everywhere in the "Status" column. To update for the first time, click the "Status" button. When the check box is selected, expect a long delay before the dialog box opens regardless of the number of objects.

Table 11-3 View log

Settings	Description
"Single Object" button	Shows the log of the most recent compilation or download process for the object selected in the "Objects" column
"All..." button	Opens the "Open Log" dialog box where you can select the type of full log. This may be the log of the most recent compilation or of the most recent download process or the last "Settings for Compilation/Download" check log that was generated by pressing the "Test" button. The full log lists all messages for the individual objects.

Table 11-4 Select objects

Settings	Description
"Select All" and "Deselect All" buttons	With this button, you can select or deselect all objects in the "Compile" or "Download" columns. If the "Compile only" check box is selected, the button only affects the "Compile" column. If the "Compile only" check box is deactivated, the "Select All " and "Deselect All" buttons select or deselect all objects in both columns.
"Compile only" check box	Select this check box if you only want to compile the selected objects. The objects will not be downloaded to the CPU and the "Download" column is hidden.
"Do not load if compilation error is detected" check box	If the check box is selected, a compilation error (for example, a time stamp conflict) means that no object is downloaded. If the check box is not activated, all objects are downloaded that were compiled without error. Objects that caused an error during compilation are not downloaded.

Settings for downloading HW objects

Note

A hardware configuration can only be downloaded when the CPU is in STOP mode.

The download procedure will not be interrupted by acknowledgment prompts when the following settings are made for downloading multiple HW objects.

When several CPUs are installed in a station, the settings must be made for every CPU.

- **CPU password**
  Enter a password here if the CPU is password-protected. If you do not enter a password, the download process will be interrupted later by a prompt for the password.
  The default settings must be:
  - A minimum password length of 8 characters
  - The following character types must be supported for a password:
    uppercase letters
    lowercase letters,
    numbers
    special characters (ASCII 0x20 - 0x7E)
    Optional: other character sets could be additionally supported by the product
  - It must be guaranteed that a password has minimum one number, uppercase and lower case character

Special considerations when downloading HW objects for high availability CPUs

- Stopping the H system before downloading
  The same hardware configuration is in both CPUs following the download.
- Downloading to the S7-400H-CPU
  Before beginning to download, you must ensure that the selected CPU or CPUs is/are actually in STOP mode. If they are not, downloading is canceled with an error message. This prevents inadvertent stopping of the entire H system.
  If there is only one CPU activated for downloading and only this CPU is in STOP mode, you can start this CPU with "Switch to CPU with Modified Configuration" following the download. This avoids stopping the H system.

Special considerations in compiling and downloading connections

If you select the "Connections" object for a module for compiling, the corresponding "Connections" objects of the connection partner will be automatically selected. In this way, the generated configuration data (system data blocks) always remains consistent.

If you select the "Connections" object for a module for downloading, the corresponding "Compile" check box will be automatically selected. The "Compile" and "Download" check boxes for all connection partners are selected.

If you only select "Connections" type objects, you can also download the connections during the RUN-P operating state of the CPU.

Additional information

- Online help for "Compile and Download Objects" dialog box (Station properties)
- Section "Versioning (Page 650)"

See also

SIMATIC Password directives (https://asrdwiki.siemens.com/swq/index.php/Password_directives_for_Industry_Products_or_Solutions)

11.4 How to document changes in the ES log

Introduction

You can use the ES log to document actions in chronological order. The most recent action appears in the first line.

Content per action:

- Main line: Date and time, user, action, object
- User's reason for taking the action
- Log of the action (e.g. download log)

When you activate the option "ES log active", all downloads are logged in the CFC/SFC in addition to the protected functions.

Requirements

- The SIMATIC Logon Service is installed.
- The change log is activated.

Rules

- The "ES log active" check box is only available in the "Advanced" tab of the "Object Properties" dialog box when SIMATIC Logon service is installed.
- An activated ES log can only be deactivated on the computer on which SIMATIC Logon Service is installed.
  Reason: The deactivation and activation tasks themselves must be recorded in the ES log.
- If copy the program or the chart folder with an active ES log to a computer on which the SIMATIC Logon Service is not installed, the "ES log active" check box cannot be selected.
- Before the download is performed to each individual CPU with the "Compile and Download Objects" function in the SIMATIC Manager, there is a pause in the operation brought about by the opening of the ES log if it is activated for the currently selected chart folder.

Activating the ES Log

You activate the ES log for the currently selected chart folder as follows.

1. In the component view of the SIMATIC Manager, select the chart folder for which you want to activate the ES log.
2. Select the menu command: **Edit > Object Properties...**
   The "Chart Folder Properties" dialog box opens.
3. Switch to the "Advanced" tab.
4. Select the "ES log active" check box.
5. Click "OK".

Deactivating the ES log

If protected functions do not need to be logged, for example, within the context of initial configuration, you can deactivate the ES log.

1. In the component view of the SIMATIC Manager, select the chart folder for which you want to activate the ES log.
2. Select the menu command: **Edit > Object Properties...**
   The "Chart Folder Properties" dialog box opens.
3. Switch to the "Advanced" tab.
4. Clear the "ES log active" check box.
5. Click "OK".

Calling the ES Log

The ES log is opened when a protected action that is to be logged is opened (select the chart folder and the menu command **Options > Charts > logs...** "ES Log" tab).

Protected actions for logging are:

- Download to CPU (entire program)
- Download to CPU (changes only)
- Test mode

Logon is performed in the SIMATIC Logon Service dialog box.

If a user is already globally logged on, the ES log for this user is opened immediately when a protected action is started. The user name can be changed for pending actions - and only for pending actions. The setting of the global user remains unchanged.

When no user is logged on, the SIMATIC Logon Service dialog box opens before the ES log opens.

Logging

The following is logged in the "Logs" dialog box:

- For the action "Download entire program", the ES log is deleted from the log but archived as a file with a date identifier at the same time. The archiving action and the file name used (including the path) are recorded in the log.
- For the action "Start test mode", all subsequent actions resulting in a change (of value) in the CPU are logged. The logging includes the value and how it changed (address, old value, new value).
  Specifically, these are:
  - In the CFC
    Configuration of I/Os
    Enable/disable forcing and force value changes
    Activating and deactivating of runtime groups
  - In SFC:
    Configuration of constants in steps
    Configuration of constants in transitions
    Configuration of constants in sequencer properties

Additional information

- Online help for the dialog boxes "Advanced" and "Logs"

11.5 How to document changes in the change log

Introduction

The change log enables you to document the user, time, changes made, the affected CPU and the reason for the changes.

Requirement

- The SIMATIC Logon Service is installed.
- The access protection is activated.

Activating the Change Log

You activate the change log for the currently selected folder as follows.

1. In the component view of the SIMATIC Manager, select the folder for which you want to activate the change log.
2. Select the menu command: **Options > Change log > Activate.**
   The change log for the selected folder is activated.

Deactivating the change log

You deactivate the change log for the currently selected folder as follows.

1. In the component view of the SIMATIC Manager, select the folder for which you want to deactivate the change log.
2. Select the menu command: **Options > Change log > Deactivate.**
   The change log for the selected folder is deactivated.

Rules

- Note that an activated change log can only be deactivated on the computer on which SIMATIC Logon Service is installed.
  Reason: The deactivation and activation tasks themselves must be recorded in the change log.
- Before the download is performed to each individual CPU using the "Compile and Download Objects" function in the SIMATIC Manager, there is a pause in the operation caused by opening the change log if it is activated for the currently selected chart folder.

Note

If you copy the program or chart folder with an activated change log to a computer on which the SIMATIC Logon Service is not installed, you receive an error message when you attempt to download or switch to test mode and the action is not carried out.

- The Change log can be enabled/disabled in SIMATIC Manager (menu command **Options > Change log > ...**).

Displaying the change log

You can have the change log displayed as follows:

1. In the component view of the SIMATIC Manager, select the folder for which you want to display the change log.
2. Select the menu command: **Options > Change log > Display...**.
   The change log for the selected folder is opened.

All the logged changes are displayed in the change log. You can comment every entry and export the change log.

Enabling/disabling the ES log

The "ES log" can be enabled/disabled in a chart folder.

1. Select the "Object Properties" command from the shortcut menu.
2. Click "Properties".
3. Make your settings in the "Chart Folder Properties" dialog box.

Additional information

- Online help for change log
- Online help for the ES log

12 Testing

Test options

The **Process object view** provides a test mode for assisting you in testing and commissioning process tags and CFCs online on the CPU.

You can find additional information on this in the section "How to test in the process object view (Page 550)".

You can document changes made in test mode with the **ES log** (which user, when, on which CPU, what change was made, etc.).

Requirements:

- The SIMATIC Logon Service is installed.
- The ES log for the currently selected chart folder is activated.
  You can find additional information on this in the section "How to document changes in the ES log (Page 621)".

You can also find the essential test functions in the editors with which you configured the programs. With these functions, you can test the configuration. The following editors provide test functions:

- **CFC**
  Testing the CFC configuration
  You can find additional information on this in the section "How to test CFCs (Page 455)".
- **SFC**
  Testing the SFC configuration
  You can find additional information on this in the section "How to test SFCs (Page 517)".

Overview

The following procedures should be distinguished for testing:

- How to test with S7 PLCSIM (Page 628)
- Testing in running plants (Page 630)
- How to test field devices (Page 631)

Additional information

- Manual *Process Control System PCS 7; Getting Started – Parts 1 and 2*

12.1 How to test with S7 PLCSIM

Introduction

S7 PLCSIM is an optionally available software package for simulating an AS. After installation it can be started in the SIMATIC Manager.

You can use S7-PLCSIM to edit and test your program on a simulated automation system. Since the simulation is implemented in S7 PLCSIM using the PCS 7 blocks, you do not require any S7 hardware (CPU or signal modules). You can test programs for S7-400 CPUs with a simulated automation system. This allows you to test operator control and monitoring of the simulated AS (OS process mode) on the engineering station.

S7-PLCSIM provides a simple user interface for monitoring and modifying the various parameters that are used in your program (for example, for switching inputs on and off). You can also use the various applications in the PCS 7 software while the simulated CPU is processing your program. For example, you have the option of operator control and monitoring of I/O values in S7-PLCSIM.

Rules

Note

Please note the following:

- The simulation of I/O modules is not carried out with S7-PLCSIM but by the blocks Pcs7AnIn, Pcs7DiIn etc. within the CFCs (see also in the manual *Process Control System PCS 7; Advanced Process Library*).
- S7-PLCSIM is not suitable for the simulation of large-scale configurations in the PCS 7 environment.

Installation of S7 PLCSIM

S7-PLCSIM is not automatically installed as part of the PCS 7 installation routine, but if you select the relevant option it will be installed at the same time.

The software for a subsequent installation can be found on the DVD *Process Control System; SIMATIC PCS 7*.

To run the software, you require a separate license key.

Requirements for working with S7 PLCSIM

The following requirements must be fulfilled in order to use S7-PLCSIM:

- No connections exist with a present automation system during the simulation.

Procedure

The simulation can be started from the SIMATIC Manager when there are no connections to actual automation systems. The following sequence applies for a standard configuration with a CPU 410.

1. Start the SIMATIC Manager.
2. Select the AS that you want to simulate.
3. Select the menu command **Options > Simulate Modules**. S7-PLCSIM1 is launched.
4. In PLCSim, select interface parameterisation "PLCSim (TCP/IP)".
5. In "HW Config", select the menu command **PLC > Download**.
   The hardware configuration is downloaded into the simulated AS.
6. In the SIMATIC Manager, select the "Charts" object in the tree view.
7. Select the menu command **PLC > Download**.
   All of the required data is downloaded into the simulated AS.
8. Configure S7-PLCSIM for testing by adding inputs/outputs in S7-PLCSIM so that the input values can be simulated and the output values can be monitored. Please also check that the program can be executed.
9. Switch the simulated CPU to the "RUN" mode.
10. Open SFC or CFC charts and select the menu command **Debug > Test Mode**.
11. Select the "OS" object in the SIMATIC Manager and start the OS-Compiler. In the compiler parameters, connect to sub net type "Ind. Eth." and the WinCC-Unit "TCP/IP". Under "Scope", activate "Changes".
12. Open WinCC-Explorer and then Tag Management. Select channel "TCP/IP" and in the "Context" menu and then select "System parameter". A window opens. Select the "Unit" tab and change the logical device name to "PLCSIM.TCPIP.1". Confirm with "OK".
13. Select the menu command **Options > OS > Start OS simulation**.
    The OS simulation starts up.
14. Test the program.
    For more information related to block simulation, refer to the *Process Control System PCS 7* and *Advanced Process Library* documents.

Note

After using PLCSIM (TCP/IP), the changes in WinCC must be undone. Subsequently, the corresponding OS is compiled again (changes only) with the real connection.

Additional information

- Online help for S7-PLCSIM
- How do I use S7 PLCSIM with SIMATIC PCS 7? (https://support.industry.siemens.com/cs/ww/en/view/16522013)

12.2 Testing in running plants

Introduction to testing in running plants

⚠ WARNING
Testing a program while a process is running can lead to serious damage to property or persons if errors occur in the function or in the program.
Ensure that no dangerous situations can occur before you execute this function.

Testing in a running plant does not differ significantly from the procedure described in the section "How to test with S7 PLCSIM (Page 628)" or from the test configuration with an AS. The number of AS and OS that can be reached, however, is usually larger than in a test configuration.

The safety requirements during operation and of the persons involved in the test are greater. The warning above should make this clear.

In addition, you must ensure that any disruption or interruption in the operation of the plant due to the test is kept to a minimum. The plant operator should be usually consulted beforehand.

12.3 How to test field devices

Note to reader

The options for parameter configuration and diagnostics using SIMATIC PDM are not described in this manual.

Additional information

- Online help for SIMATIC Manager and SIMATIC PDM
- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*

Comparing project versions with the Version Cross Manager 13

Introduction

The Version Cross Manager (VXM) is a separate application you can order as an option. The Version Cross Manager enables you to quickly and reliably compare the project data from two PCS 7 projects in order to identify differences. This feature allows you to recognize if and what has changed.

Requirements

Archived configuration versions must be compared to determine any changes since the last supply and acceptance, for example, after it was delivered to the customer or after certification by the Technical Inspectorate or FDA authorities.

This information is important, for example, in the following areas of application:

- A previously accepted project status is to be approved after changes were made and expansions were added. You therefore need to know the status of changes since the last acceptance.
- The contractual and accepted project status has been expanded due to subsequent changes in requirements and the expansions are to be verified.
- In parallel to the commissioning of a project status at a plant, the status was expanded at an engineering office. The expansions are to be identified in order to add them to the current project status.
- The documentation of an already completely documented project status is to be updated. It is to be determined which object documentation requires revision due to changes.
- The process control project data of a plant should be synchronized with the planning data of the plant. To do this, export the project data in the manufacturer-independent XML-format and import it into CAx systems (CAD, CAE, E-CAD or E-CAE).

13.1 Application of the Version Cross Manager (VXM)

Introduction

Automation solutions are configured in the PCS 7 engineering system in the form of CFC and SFCs using blocks. The project version is compiled as a program and downloaded to the AS. This version can be saved by archiving the project (for example, after the customer, Technical Inspectorate or FDA representative have accepted the project).

This project will be changed over time, errors will be corrected and additions will be made, for example. If a further acceptance test becomes necessary, the Version Cross Manager (VXM) can be used to indicate all the changes that have been made.

Functions

The VXM offers the following main functions:

- Comparison of projects and XML files
- Import and export of project and planning data
- Generation of process tags based on CAx function charts

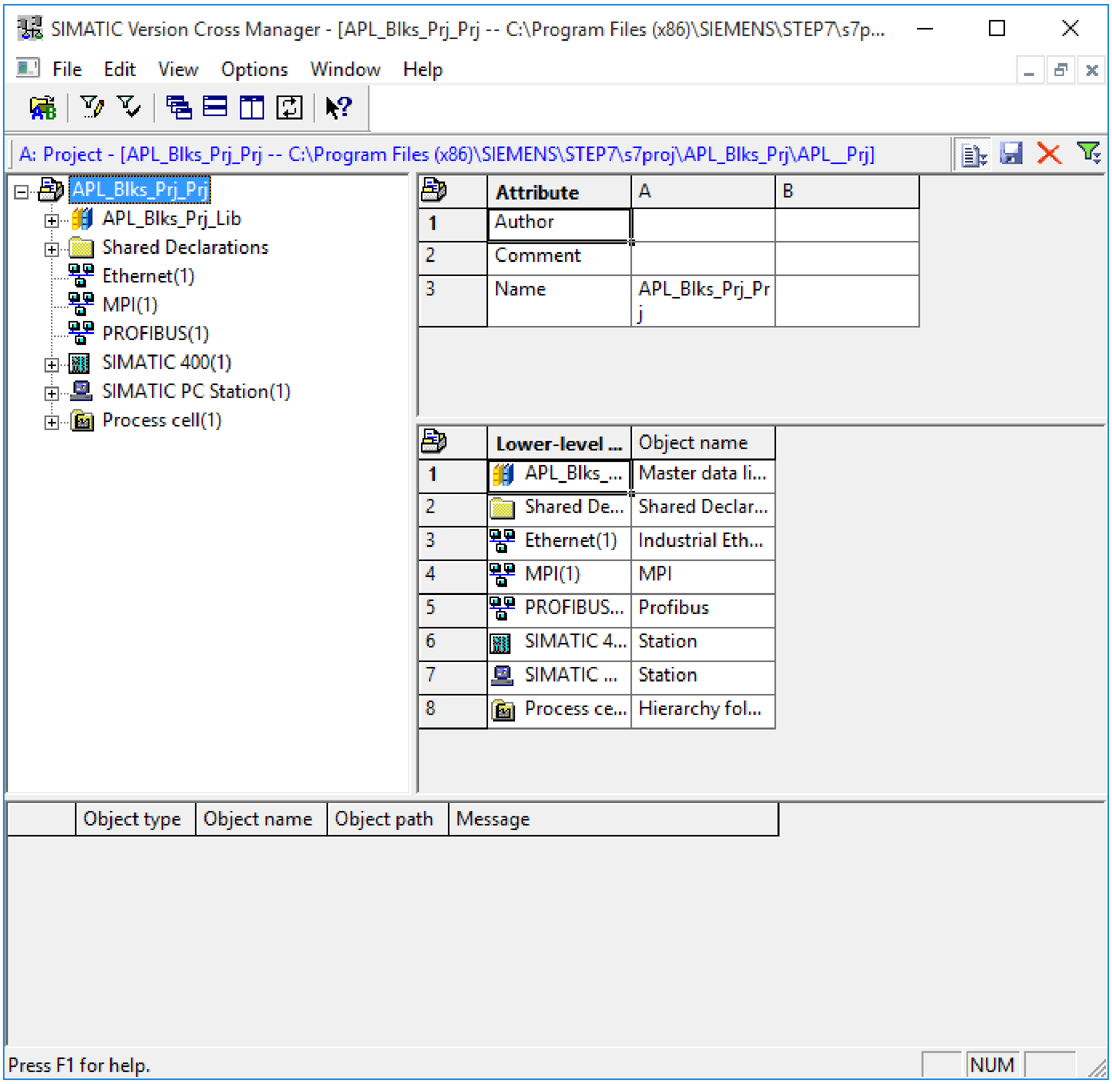
What is compared?

With the VXM you select an object as "Master" and an additional object as "Compare Object". When you open the object to be compared, the comparison starts automatically.

The following objects are supported:

- Project
- Library
- HW configuration
- CFC/SFC engineering data, such as charts, types, chart folders, block folders.
- Shared declarations
- S7 Program
- S7 blocks
- S7 symbols
- Messages

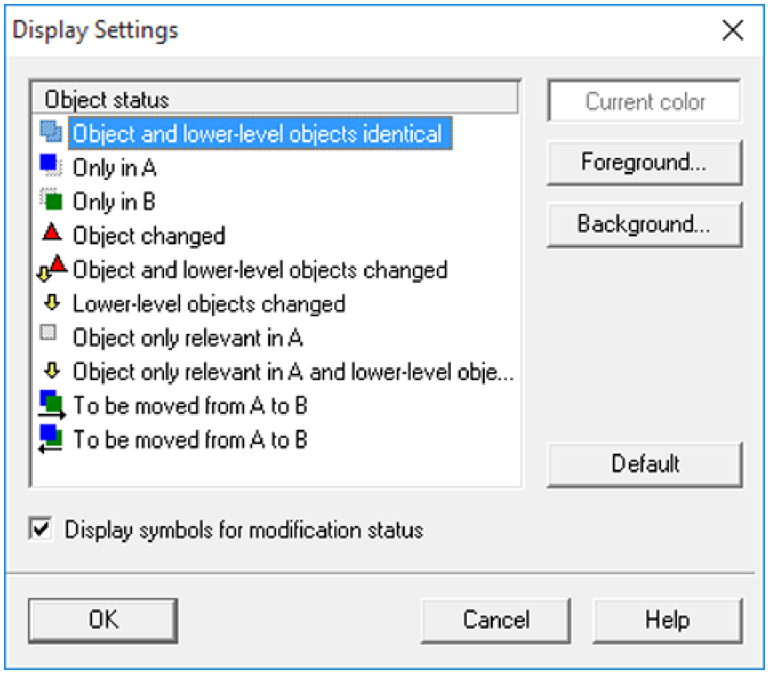
Example



Display of changed states

Use the menu command **Options > Display...** to access the "Display Settings" dialog box that shows you the display of the change states.

In this dialog box you can adapt the display of the change states individually.



Import and Export

The ability to exchange project data in an independent format is becoming increasingly important. Nowadays, a variety of software tools from various manufacturers is involved in the work process during the configuration phases of an industrial plant. The possibility of data exchange considerably improves the integration between the various software tools. In the planning phase of a plant, for example, the relevant CAx systems are being used with increasing frequency. The term CAx stands for CAD, CAE, E-CAD or E-CAE. The synchronization of the control system project data with the planning data from the plant can be supported by export and import.

XML (Extensible Markup Language) has established itself as a data exchange format in many areas. The VXM uses the SimaticML format. This is a general purpose XML format that contains all relevant data such as hardware, CAx function diagrams, plant description, etc..

Generating process tags

The CAx function diagrams, which are generated at the planning level, can be used to generate or compare process tags in PCS 7 projects.

Additional information

- Online help for VXM

13.2 How to compare project versions

Requirement

The Version Cross Manager is installed.

Procedure

1. Start the Version Cross Manager.
2. Select the menu command **File > Open/Compare....**
   The "Open/Compare" dialog box opens.
3. For A, select:
   – First object
     
     Make the selection and settings you require in the "Open" dialog box.
   – First XML file
     
     Select the XML file you require in the "Open" dialog box.
4. For B, select:
   – Compare with object
     
     Make the selection and settings you require in the "Select comparison object" dialog box.
   – Compare to XML file
     
     Select the XML file you require in the "Select comparison file" dialog box.
5. If you want to view only certain objects, click on the icon:
   
   Make your desired filter settings.
6. Click the icon:
   
   The filtering is performed.

7. Click "OK".
   The VXM reads the selected objects/files, including all lower-level objects, and carries out a comparison at the same time.
   The two objects are superimposed in a comparison result tree. The deviations are displayed with color coding.
8. Navigate in the hierarchy or detail window to the objects for which you require detailed change information.

Filtering

You can use a filter to restrict the comparison of the object trees to specific objects and attributes.

The filter setting is taken into account by VXM not only during the comparison but also when displaying the results. As a result, only the objects and attributes actually used in the comparison are displayed.

You can use them to specify whether or not a file is to open with a new filter setting or without a filter or, if the file appears in the list under the "File" menu, whether or not it should open with its default setting.

A number of filter criteria are set by default in VXM.

Setting/activating/deactivating the filter

- Select the menu command **Options > Filters** to activate/deactivate the set filter.
- Select the menu command **Options > Set Filters...** to change the default filter criteria.

Updating the comparison data

If the project data has been changed in the meantime with a PCS 7 application, you can update the comparison data. For this purpose press the <F5> key or select the menu command **View > Update**.

The VXM then deletes the internal management structures and reads both objects again - including all of the objects contained within - and performs a full comparison of the objects one more time.

Saving comparison data

You can save the differences to a CSV file and print the data.

- Select the menu command **File > Save Differences...** to save the differences revealed by the comparison to a CSV file.

Additional information

- Online help for VXM

14 Servicing and diagnostics

14.1 Maintaining a project

Introduction

You should save your project at regular intervals with "Reorganization" and/or "Save As". The importance of the functions and their benefits for the project are explained in the following sections.

Reorganization

If inexplicable problems occur when working with STEP 7, it often helps to reorganize the data management of the project or the library.

Select the menu command **File > Reorganize**. Reorganization eliminates gaps created by deletion, that is, it reduces the memory requirements for the project/library data.

The function optimizes the data storage for the project or the library in much the same way, for example, as a program that defragments your hard disk.

The time it takes to perform reorganization depends on the data movement required, and it can take a long time. The function should therefore not be carried out automatically (for example, when closing a project).

Save As

You can save a project or a library with a new name. This offers you the option of saving "With reorganization (slow)".

If you select this option, the project is copied and saved under a different name, whereby the project is reviewed and reorganized. If an object cannot be copied and saved (for example, because an add-on package is lacking, or the object's data are corrupt), an appropriate message appears. Reorganization eliminates the gaps created by deletions, thereby reducing the memory requirements for the project data.

The **Save As > With reorganization (slow)** function has an effect on the project structure deeper than the "Reorganization" function. For example, if you are having problems with the project database after a hardware failure on your PC, run the menu command **Save As > With reorganization (slow)**.

Note

When you save the project without reorganization, the configured path of the storage location in configuration file is maintained. The result is that the NetPro "Save and Compile" feature overwrites the configuration file of the original project in the copied project!

Remedy: Use the option "With reorganization (slow)"! In this case, all paths are converted.

When the **Save As > With reorganization (slow)** option is selected, it provides the user with an option to select "With downward compatibility".

The **Save As > Create new project** option has an effect on the project structure. By default this option is not checked. If this option is checked, a new ID is created for project structure (important for a plant with Process Historian).

Additional information

Online help "Help on the SIMATIC Manager"

14.2 Diagnostics with maintenance station (Asset Management)

Overview

A maintenance station can be used to provide full diagnostics for a PCS 7 plant. The maintenance station provides information on the status of all PCS 7 components in hierarchically structured diagnostic screens. As part of this process, the data of a component are analyzed using the available online functions of the associated tools. You can access ES data from the diagnostics screens. Access can be controlled via protective mechanisms.

Diagnostic screens for process control diagnostics are generated automatically for the entire PCS 7 system. The topmost level of the diagnostics screens forms an overview for the entire system.

Configurations and forms

A maintenance station can be configured in the form "MS basic" and "MS standard" as a single station system or multiple station system. The "SIMATIC PDM MS" version is configured as an MS single station system. The form is selected in the settings of the plant hierarchy.

We particularly recommend the use of a maintenance station in medium and large PCS 7-systems.

Requirements

- The cross-project consistency checks have been successfully performed (for example, names of the S7 programs are unique throughout the multiproject).
- Blocks from a PCS 7 library beginning with version V6.1 are used in the project.
- The module drivers are generated and interconnected with the signal-processing blocks in the CFCs.
- The diagnostic blocks are set to "OCM possible".
- The check box "Derive diagnostic pictures from the plant hierarchy" is activated in the PH settings.

Diagnostics options

You can find information on the states of individual PCS 7 components with diagnostic capability on the maintenance station's special diagnostics screens.

The table shows an example of which components can be monitored and in which areas the components are displayed.

Diagnostics for ...	Area	MS Standard	MS Basic	SIMATIC MS PDM
• Siemens industrial PCs, for example – Operator stations – BATCH stations – Route Control stations – Process Historian – SIMATIC PCS 7 BOX • Premium server • Third-party PCs	PC stations	X	X	X
• Switches, for example, SCALANCE X • Other components that support SNMP services – For example printers, bridges, routers	Network objects	X	X	X
• CPU and connections • SIMATIC PCS 7 BOX • Distributed I/O, such as: – ET 200iSP, ET 200M, ET 200S, ET 200SP, ET 200SP HA, ET 200pro – Input and output modules • Field devices (HART, PROFIBUS PA, ...) • Fail-safe modules • Interface modules (IM) • Diagnostics-capable non-transparent coupler • Link modules • Diagnostic repeaters	AS objects	X	X	
• EDD objects that can be detected by SIMATIC PDM • Distributed I/O, such as: – ET 200M, ET 200S, ET 200SP, ET 200iSP, ET 200pro – Input and output modules • Field devices (HART, PROFIBUS PA, ...) • Interface modules (IM) • Diagnostics-capable non-transparent coupler • Link modules	Field objects			X
• User objects for which a diagnostics can be generated by an application	User diagnostics	X		

Additional information

You can find a description of the configuration and process mode of the maintenance station in the manual *Process Control System PCS 7; Maintenance station*.

14.3 Remote diagnostics functions

Security requirements

If you wish to perform remote diagnostics in a PCS 7 plant, you need to protect the this plant against unauthorized access.

Several measures are required to realize a security concept. Optimal protection is only provided with all security measures as a whole.

Transmission paths

The data can be sent as follows:

- Via a telephone line (modem)
- Via TCP/IP connection (internal plant network connection)

Possibilities for remote diagnostics and remote administration of a PCS 7 plant

For PC stations, we recommend the following tools for remote diagnostics and administrative access to PCS 7 plants:

- VNC
  The "RealVNC" Enterprise Edition software is approved for use for remote service access as of PCS 7 V8.0.

  Note

  Access to PC stations and applications

  Functions may not be available or operations not allowed when accessing PC stations via VNC. Please read the information on Remote Service accesses in the documentation of the applications and PC stations which you wish to access.

- RDP
  Use of the Remote Desktop Protocol (RDP) is permitted only for remote maintenance of PCS 7 clients. In addition, no server services (e.g. Web Navigator server, DataMonitor server, OPC server) are permitted to be active on these computers.

You can find additional information on this in the installation manual *Process Control System PCS 7; PCS 7 - PC Configuration*.

Additional information

- Installation manual *Process Control System PCS 7; PCS 7 - PC Configuration*
- Online help of the operating system
- Whitepaper *Security Concept PCS 7 and WinCC*

14.4 Additional service support and diagnostics

Overview

You can find a detailed description of the additional diagnostics options that are available with PCS 7, as well as what to do if service becomes necessary, in the Manual *Process Control System PCS 7; Service Support and Diagnostics*.

This manual contains the following information for your support:

- Measures to ensure the availability of a PCS 7 plant.
- Requirements that need to be met for effective diagnostics of your PCS 7 plant.
- Understanding the alarm concept of a PCS 7 plant.
- Using the right procedure if a problem occurs, and providing detailed information about the state of the PCS 7 plant for service experts.
- Selecting the correct diagnostic tool to enable you to perform diagnostics on your PCS 7 plant with the specified aids.

14.5 Archiving, versioning and documenting

14.5.1 Introduction to archiving, versioning and documenting

Introduction

SIMATIC PCS 7 provides archiving, versioning, and documentation functions.

Archiving

PCS 7 provides various archiving functions:

- **Archiving of process values** (e.g. measured values, messages)
  The operator station saves measured values and messages in archives for long-term availability of the data.
  For more information, refer to:
  - The Configuration manual *Process Control System PCS 7, Operator station*
  - The documentation for SIMATIC Process Historian
  - Section "How can project and process data be archived? (Page 41)"
- **Archiving BATCH data**
  SIMATIC BATCH data can be archived using SIMATIC Process Historian.
  For more information, refer to:
  - the section "How can project and process data be archived? (Page 41)"
  - The documentation for SIMATIC Process Historian
- **Archiving projects**
  Archives the multiproject, including all projects and the master data library.
  You can find information about this in the following sections:
  - How to archive a multiproject and the project master data (Page 647)
  - How to retrieve a multiproject and the project master data (Page 648).

Note

Create backup copies of your project as often as possible.
You should keep at least 5 older versions of the data. If there is a network failure, network or hard disk crash or network disruption, you can revert to a backup of your project at any time.

Versioning

In PCS 7, versioning represents documented backup of data for a PCS 7 plant in version archives.

Version Trail (add-on package) is used for versioning in PCS 7. In a version archive, you can manage multiple backups (versions) of an object (for example, a project or a library). The archived data can not be changed after this.

Version Trail takes over the complete management of the version history. The system automatically sets the versioning based on specifically configured guidelines. You can increment the version numbers in whole number steps, for example. Version Trail ensures that there is only one valid version of a project with the same designation in the version history.

You use Version Trail, for example, to pass a project version of a plant to others (transfer version) and if you wish to determine the changes in a current project version.

Version Trail offers you the following options:

- You can archive objects (such as libraries, multiprojects and single projects) at a time of your choice. The saved object is assigned versioning when it is entered into the version archive. The versioning is the unique ID for this object.
- Retrieve and re-use versioned project data.
- Automatic archiving
- Automatic readback
- Comparison of an archived version with an existing project or with a second archived version. You start the Version Cross Manager (VXM) to perform the comparison.

You can find additional information about this in the section "How to save versioned project data (Page 650)".

Document

Documenting involves the creation of the plant documentation. The DOCPRO add-on package for PCS 7 is used for this purpose.

- Creating and managing plant documentation
- Centralized control of printing (project segments or entire project)
- Custom layout (e.g. DIN 6771)

You can find additional information about this in the section "Creating the project documentation (Page 653)".

14.5.2 Archiving/retrieving multiprojects and project master data

14.5.2.1 How to archive a multiproject and the project master data

Introduction

You can save a multiproject in compressed form in an archive file just like projects or libraries. The compressed files are saved to a hard disk or transportable data media.

If parts of the multiproject are stored on network drives, you can use the following file compression tool to create an archive for multiproject data:

- PKZIP for Windows (available on *Process Control System; SIMATIC PCS 7* DVD; installed at the same time as PCS 7)

Requirements for the archiving procedure

- No single process can access one of the projects in the multiproject (since archiving is a cross-project function).
- Projects or libraries can be stored locally or in the network.
  If you wish to store projects or libraries in the network, you need to create a release for the storage folder in the network.
  On the engineering station, create a connection to the network drive in Windows Explorer for the storage folder.
  Enter the path for the storage folder in the network in UNC notation "\\Computer name \Share name".

Procedure

1. Select the multiproject in the SIMATIC Manager.
2. Select the menu command **File > Archive...**.
   The "Archive" dialog box opens.
3. Select the required multiproject and click "OK".
   The "Archive - Select an Archive" dialog box opens.
4. Select the name and path of the archive, as well as the archiving program (PKZip).
5. Click the "Save" button.

Note

When SIMATIC PDM is used:

1. Select the SIMATIC PDM Asset Service in the info area of your operating system toolbar.
2. Start SIMATIC PDM Asset Service.

Additional information

- Online help for the SIMATIC Manager
- Manual *Process Control System PCS 7; Service Support and Diagnostics*
- Operating Manual *Process Control System PCS 7; Help for SIMATIC PDM*

14.5.2.2 How to retrieve a multiproject and the project master data

Procedure

1. In the SIMATIC Manager, select the menu command **File > Retrieve...**.
   The "Retrieve - Select Archive" dialog box opens.
2. Select the archive you want to retrieve.
3. Click on the "Open" button.

4. In the "Select target directory" dialog box that appears, select the target directory for unpacking the archive files.
5. Click "OK".

Note

The multiproject is retrieved in the target directory with an additional sub-directory. The system bases the name of this sub-directory on the name of the multiproject (to prevent any multiprojects with the same name from being overwritten).

Following retrieval, you must generate the server data, assign it to the OS clients, and download it to all OS target systems.

Result

A new directory is created in the selected directory and all project directories of an unpacked multiproject now appear on the same level below this directory.

Additional information

- Online help for the SIMATIC Manager
- Manual *Process Control System PCS 7; Service Support and Diagnostics*

14.5.2.3 Data backup

Recommendation

Always back up multiple project versions.

Create a backup in the following cases:

- After configuration changes
- Before and after system component upgrades
- Before and after software update of the configuration software

Additional information

A detailed step-by-step instruction on how to back up ES and OS project data and create a backup is available in the manual *Process Control System PCS 7; Service Support and Diagnostics*.

14.5.3 Versioning

14.5.3.1 How to save versioned project data

Introduction

You can save versioned PCS 7 project data with Version Trail. Data archived in this way can no longer be changed. You can retrieve stored versioned project data and use it again or compare it with other versions or with the current project.

You use Version Trail, for example, to transfer a project version of a plant (transfer version) and later compare it to the current plant project version (using VXM).

Note

You can assign access permissions for archived objects using SIMATIC Logon.

Requirements

Ensure the following to work with Version Trail:

- SIMATIC Logon is installed.
- A user must be logged on and all relevant actions must be logged under this user's name.
- Version Trail is **not** open.
- The object to be versioned (multiproject, project, library) is **not** open.

Procedure

The procedure described here assumes that you have not yet created an archive in the versioned project.

To save a versioned multiproject, single project or a library, proceed as follows:

1. Select the menu command **File > Versioned Project > Archive...**
   The "Open Project" dialog box opens.
2. You can specify the object (multiproject, project, library) for which you want to create a versioned backup as follows:
   – Select the object.
   – Search for the object using the "Browse" button.
3. Click "OK".
   The "Save SIMATIC Project <path> in Versioned Project" dialog box opens.
4. Click "Open".
   The "Open Versioned Project" dialog box opens.
5. Select the required versioned project from the list and click "OK".
   The "Save SIMATIC Project <path> in Versioned Project" dialog box opens.

6. Select the versioned project in the tree view and select the context menu command **Insert New Object > Archive....**
   The "Open Project" dialog box opens.
7. Select the required object as described in step 3.
   The "Properties" dialog box opens.
8. Enter the name and any comment and click "OK".
   The "Properties" dialog box closes.
9. In the "Version designation" group, select the appropriate check box to indicate whether to increment the main or secondary version.
   Note that only "Increment main version" is possible during the first archiving.
   The "Save SIMATIC Project <path> in Versioned Project" dialog box opens.
10. Enter the name of the version and click "Archive...".
    Compression is started and the name of the versioned object ultimately appears in the detail window.

Result

The object has been assigned a version and saved in compressed form.

If you wish to create a new version of the same project in the same versioned project, some intermediate steps may be skipped.

Security

Version Trail is protected by the SIMATIC Logon Service. SIMATIC Logon Service check if a user is logged on in SIMATIC Manager.

To log on a user, select the menu command **Options > SIMATIC Logon Service...** in the SIMATIC Manager.
If no user is logged on, the "SIMATIC Logon Service" dialog box appears in Version Trail before every protected action.
This also applies to creating a new versioned project.

Additional information

- Online help for the SIMATIC Manager
- Online help for Version Trail

14.5.3.2 How to retrieve a project with version ID

Procedure

To retrieve a versioned multiproject, single project or a library, follow these steps:

1. Select the menu command **File > Versioned Project > Retrieve....**
   The "Open Versioned Project" dialog box opens.
2. Select the required versioned project from the list and click "OK".
   The "Retrieve SIMATIC Project from Versioned Project" dialog box opens.

3. Select the project in the tree view and the version that you want to retrieve in the detailed view.
4. Click "Retrieve".
   The "Select Directory" dialog box opens.
5. Select the target directory and click "OK".
   Decompression is started.
   If there is already a folder with the same name at the storage location, a dialog box opens informing you of this.
   You can cancel the retrieval with the "Cancel" button or save the retrieved data under a new name with "Rename".
   You receive a message informing you of the name of the project and the path where it has been saved.

Result

You have now decompressed and restored the desired version of your project.

Additional information

- Online help for Version Trail

14.5.3.3 Versioning CFC and SFCs

Overview

You can assign a version number in the object properties for each CFC/SFC. The version number is automatically set to "0.0001" when you create CFC/SFCs and is then managed by the user.

When a CFC/SFC is closed, the "Version" tab of the "Properties" dialog box opens, and you are given the option of assigning a version number (ranging between 0.0001 and 255.4095).

Note

If the dialog box with the "Version" tab appears automatically, this means that versioning is active in the project properties and a change has been made in the chart. In this case, it is expected that the version level will be increased.
You cannot set a version number that is smaller than that previously saved.

The object properties of a CFC/SFC also include information on the software version last used to edit the charts (PCS 7 Vx.y).

14.5.4 documenting

14.5.4.1 Creating the project documentation

Overview

After you have created a plant, you need to document all project data in a clear, organized format. An appropriate documentation structure makes it easier to edit and service your project.

DOCPRO is an application that helps you create and manage your plant documentation efficiently. It enables you to:

- Structure the project data as needed
- Prepare the project data in standardized technical documentation format
- Print the project data with a uniform print image

Additional information

- Online help for DOCPRO
- Manual *DOCPRO; Creating documentation in compliance with standards*

14.5.4.2 How to convert the documentation into a PDF file

Introduction

You can also convert documentation created with DOCPRO into a manual (PDF format). An automatic conversion is not part of PCS 7.

Requirement

You have a full license of the Adobe Acrobat program from Adobe Systems Incorporated.

Basic procedure

1. Generate documentation of the project in DOCPRO, for example, with the help of the DOCPRO wizard.
2. Generate a printout of the documentation into a file in DOCPRO. To do so, select the check box "Print to File" in the Windows print dialog box.
3. Open Acrobat Distiller and drag all files created by DOCPRO from the Explorer to the Distiller.
   The Distiller generates the associated PDF file for each individual file.

Note

Siemens is not liable for any of the programs offered by Adobe Systems Incorporated. Detailed instructions on using Acrobat Reader are available in the Acrobat online manual that you can access with the **Help** menu.

Additional information

- Online help for DOCPRO
- Manual *DOCPRO; Creating documentation in compliance with standards*

Appendix 15

15.1 Installation guidelines for PCS 7

Introduction

The installation guidelines must be observed to ensure correct operation of a PCS 7 control system. This appendix contains additional information about lightning protection, grounding and EMC-compliant installation. The basic installation guidelines can be found in the installation manuals of the components (for example. Installation Manual *Programmable Controllers S7-400, Hardware and Installation*).

Components

The configuration method is largely determined by the components used in PCS 7:

- SIMATIC PC stations
- SIMATIC NET
- S7-400/S7-400H/FH
- Distributed I/O (stations with modules; field devices)

Each component has numerous configuration variations that can be adapted to meet the requirements of a particular application.

There is also the option of installing programmable controllers and the distributed I/O systems in cabinets.

For more detailed information about the installation of an entire plant (lightning protection, grounding, etc.) refer to the relevant sections below. The options available for connecting process signals to the CPUs are described in detail in the section Installation of the.

Note

ET 200M is used as an example of distributed I/Os in the following document. Refer to the relevant product manuals for more information about installing other ET models.

Rack or wall mounting

The PCS 7 control system can be mounted in racks or on a wall if the system is being operated in an environment with low noise levels in which the permitted environmental conditions can be maintained. To discharge voltages coupled in on large metal surfaces, you should install rails, shields and the lightning conductive bar on reference potential surfaces made of sheet steel.

Cabinet Installation

S7-400 programmable controllers and ET 200M modules can be installed in cabinets for the PCS 7 control system. The following illustration shows the S7-400 programmable controller and distributed I/O system ET 200 M installed in a cabinet. The different racks can be combined as necessary to allow you, for example, to install the distributed I/Os in separate closets (electronics closets, wiring closets).

The cabinets consisting of system-specific (system and I/O units) and system-neutral modules (basic cabinets, power supply units and add-on packages) offer adequate protection against the following factors:

- Unauthorized access
- Mechanical influences
- Contamination and corrosion

Due to the modularity and associated variability, the cabinets can be adapted to different types of system and different sizes of system.

EMC compliance

The PCS 7 control system and its components comply with the EMC requirements of European standards. These standards require that EMC-compliant devices have sufficient immunity to noise during operation when correctly installed, suitably maintained, and be used for correct purposes in a normal EMC environment. The emission of noise is limited to guarantee normal operation of radio and telecommunication devices.

The cabinets of the PCS 7 control system consisting of the system units, I/O units, basic cabinets, power supply units and add-on packages are CE compliant. This means that the cabinets and the PCS 7 control system comply with the EMC regulations such as:

- Electromagnetic compatibility (89/336/EEC; 92/31/EEC)
- Low voltage directive (73/23/EEC; 93/68/EEC)
- Hazardous areas directive (94/9/EEC)

15.2 Lightning protection

Introduction

Industrial plants and power stations must be equipped with lightning protection to protect people, buildings and equipment from damage resulting from lightning strikes. Process control systems with extensive cabling networks are often at risk since high voltages can occur between points at great distances from each other. The destruction of electronic components due to lightning can lead to plant failure with extremely expensive consequences.

The risk of damage by lightning can result from

- A building being struck directly
- A lightning strike in the immediate vicinity of the plant
- A remote strike (for example, in an overhead line)
- Cloud-to-cloud discharge

Originating in the lightning channel, lightning creates a cylinder-shaped electromagnetic wave that penetrates buildings where it induces voltages in cable loops. The closer the lightning strike, the more powerful the fields it creates.

Both with lightning from cloud-to-cloud or from cloud to earth, the charges induced in overhead lines (high voltage, low voltage and telecommunication lines) change. These changed charges then flow as traveling waves along the cable. When these traveling waves reach equipment at the end of the cable, they can also enter the plant or system that you want to protect. Generally, only signal and bus cables in the vicinity of transformers and signal and telecommunication lines are actually at risk.

The lightning protection for a process control system can be roughly divided into exterior and interior lightning protection.

Exterior lightning protection

Exterior lightning protection includes all the equipment used outside a building for discharging lightning to earth.

Interior lightning protection

Interior lightning protection includes the measures taken to counteract lightning and the effects of its electrical and electromagnetic fields on metallic installations and electrical systems within the building.

Lightning protection zones concept

The principle of a lightning protection zones states that facilities to be protected from overvoltages, such as a section of a factory, should be divided into lightning protection zones based on EMC considerations.

The division of the lightning protection zones is made according to the distance from a point liable to lightning strikes and the resulting high-energy electromagnetic fields. Lightning protection zones are as follows:

Exterior lightning protection of the building (field side)	Lightning protection zone 0
The shielding of	
- Buildings	Lightning protection zone 1
- Rooms and/or	Lightning protection zone 2
- Devices	Lightning protection zone 3

Additional information

The rules for bridging the interfaces between the lightning protection zones and an example circuit for networked SIMATIC 400 stations are explained in the installation manual "*Automation System S7-400 Hardware and Installation*".

15.3 Electrical installation

Introduction

The correct operation of PCS 7 components depends to a large extent on adherence to certain rules of electrical installation. This involves the following aspects:

- Equipotential bonding (VDE 0100)
- Grounding
- Overvoltage protection
- Shielding
- Cabling

Equipotential bonding

In accordance with VDE 0100, all electrically conductive metal parts of a system (cabinet panels, racks, terminal blocks, etc.) must be interconnected. This ensures that any potential differences are reduced to such an extent that there is no danger for either human beings or equipment.

Grounding

Low-resistance ground connections reduce the risk of electrical interference in case of short circuits or faults in the system. By using low-impedance connections for grounding and shielding cables and devices, the effects of noise on the system and the emission of noise from the system can be reduced.

The SIMATIC S7-400 automation system and the distributed I/O system ET 200M allow both grounded and ungrounded operation.

Grounded reference potential or ungrounded installation

The modules used in the S7-400 are always grounded via the backplane bus of the rack. This strategy is usually used in machines or in industrial plants and interference currents are discharged to local earth.

In the chemical industry or in power stations, it may be necessary to operate systems with an ungrounded reference potential due to the ground-fault detectors. In this case, a jumper on the rack can be removed so that the reference potential is connected to local earth via an integrated RC network.

Overvoltage protection

Overvoltages can occur at module outputs when inductors are turned off (at relays, for example). The digital modules of the SIMATIC S7-400 have integrated overvoltage protection. In certain situations (for example, when there is an additional contact between the module output and inductor), an external overvoltage suppressor (for example, an arc-suppression diode) must be installed directly on the inductor.

Balanced signal circuits

In balanced signal circuits, all signal routes have the same impedance. This means that if there is interference, the induced longitudinal voltages in the signal cables are of the same magnitude and no interference current can flow. A balanced signal circuit is typically used for highly sensitive measurement circuits and for systems operating at high frequencies. Balanced measuring circuits have a high degree of immunity to noise but are extremely complicated and hardly found in process control systems. In process control systems, shielding of cables is preferred.

Shielding of electrical cables

Electrical cables are shielded to reduce the effects of magnetic, electrical, and electromagnetic disturbances on the cables. The interference currents induced in the shields are discharged directly to ground via low-impedance connections.

Braided shields are preferred to foil shields since foil shields can be damaged easily, reducing the efficiency of the shield. Grounding shields via long, thin wires also makes the shield ineffective. Due to the high inductance, interference currents can not flow to ground.

If the shielding effect of the cable shield is inadequate, the cables should be pulled into metallic conduits that are grounded at both ends.

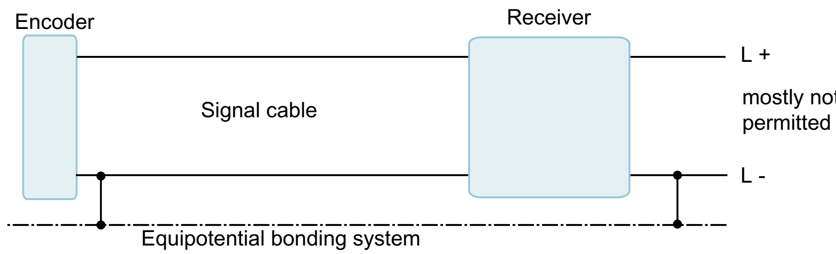
With high-frequency disturbances, it is advisable to contact the shield at both ends of the cable (at the start **and** at the end of the cable), whereas for low-frequency interference, the shield should be contacted at the start **or** end of the cable. The effectiveness of the shield with low frequencies is determined by the ohmic resistance (shield cross section), while with high frequencies the inductance and therefore the structure of the sheath (closed conduit better than braid, etc.) decides the effectiveness.

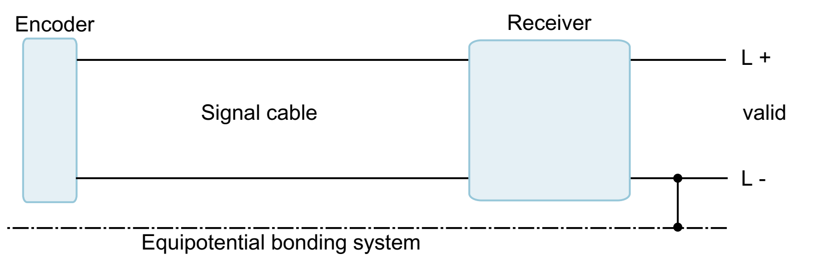
To prevent coupling in magnetic fields, shields should, whenever possible, be connected to an equipotential bonding system at both ends. Indoors, this is often not done due to fears of violating specifications for the current load on the foil shields that can be caused by power-frequency interference currents.

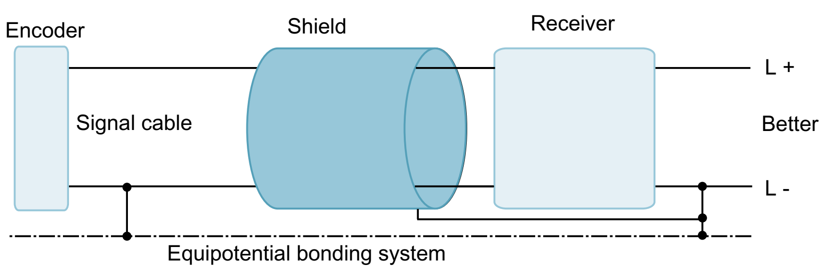
Grounding both ends of a shield is not permitted when strong magnetic inference fields are present (generators, conductor bars). Connecting the shields at both ends would form a loop into which power-frequency interference voltages could be coupled.

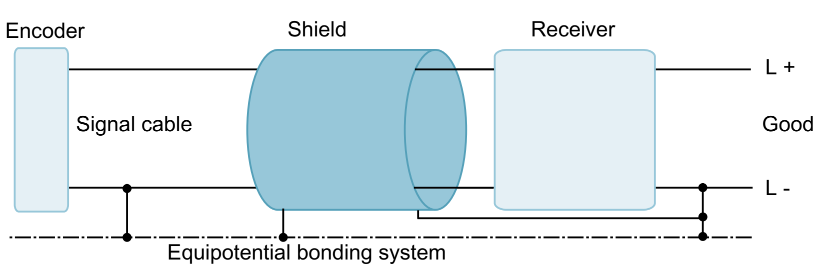
To avoid the effects of induced voltages resulting from magnetic fields, signal cables are twisted. The twisting results in a positive induced voltage in one half of the twist and a negative voltage in the other. These voltages cancel each other out over the length of the full twist.

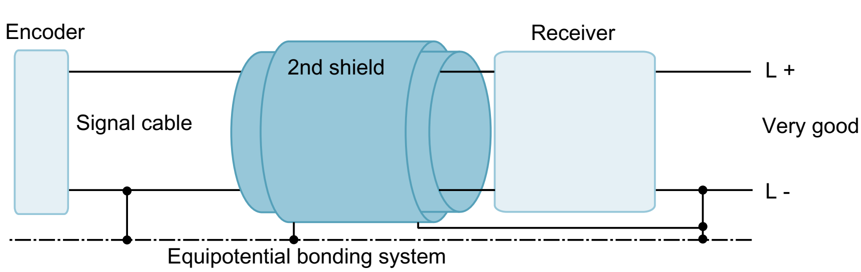
The following schematics illustrate possible shielding configurations.











Connecting the cable shield of electrical cables at the entrance to the electronics cabinet

Care must be taken that interference running along the cable shield is not allowed to enter electronics cabinets.

If the cable shields are grounded inside the cabinet or housing, the field generated in the shield grounding cables by the shield current is coupled not only into the unshielded signal cables but also into the loops on the modules behind the inlet protection circuits and generates interference voltages. For this reason, when grounding both ends of a shield, the grounding should take place directly at the housing opening.

Also ensure that the shields contact the grounding rail over a sufficiently large area. Long thin wires between the shield and ground bar have high inductance and are therefore unsuitable for discharging interference currents with high frequencies.

Note the following points:

- Use short wire lengths (if possible do not use wires at all but make direct large-area contact)
- Choose a suitable route for the shield grounding wires (do not lead them close to sensitive electronics)
- Use a short, thick cable from the shield bar to the equipotential bonding system

If cabinets or housings are included to shield the control system, remember the following points:

- Cabinet panels such as side panels, back panels, ceilings and floors should be contacted at adequate intervals when cascaded.
- Doors should have extra contacts to the cabinet chassis.
- Cables leaving the shielding cabinet should either be shielded or routed via filters specified for PCS 7.
- If there are sources of strong interference in the cabinet (transformers, cables to motors, etc.), they must be separated from sensitive electronics through partitions. The partitions should be connected with low impedance to the equipotential bonding system via the cabinet.

All housings, cabinets, etc.should be connected to the equipotential bonding system over the shortest route possible. Often, an independent equipotential bonding system is created. This is connected to the equipotential bonding system of the remaining plant by a single cable.

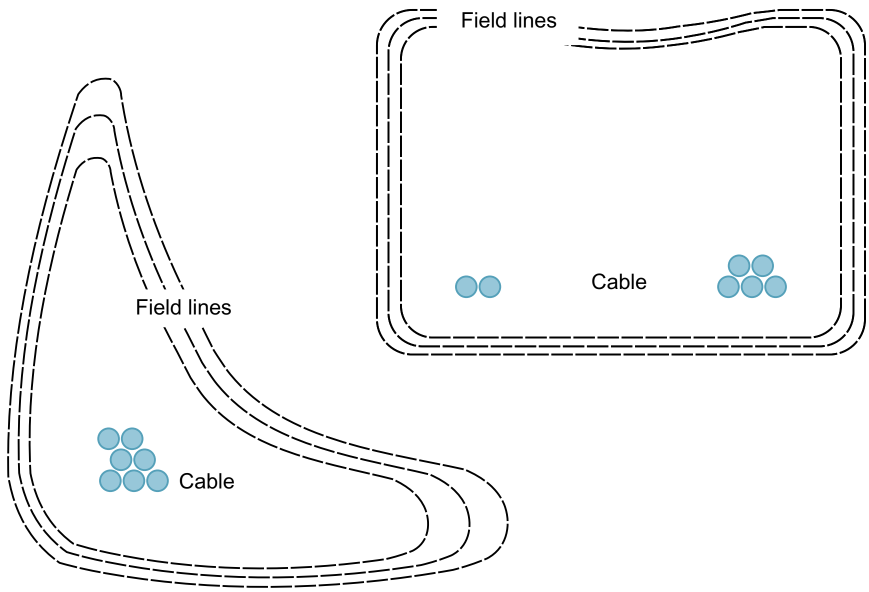
It is a mistake to connect the PCS 7 process control system to a ground point outside the plant. The magnetic fields generated by the interference currents flowing in the equipotential bonding system induce voltages in the additional surface between the equipotential bonding conductors and the connection to ground.

Laying electrical cables

The aim of cabling is to reduce the field of interference current between the source and the signal cable to a minimum, by laying the cable directly on the conductor carrying the interference current.

Signal and bus cables should be laid next to cables with a large diameter since the field strength is lower here than with cables with a smaller diameter.

If the conductor carrying the interference current is a plate (for example, belonging to the building structure) lay the signal cable in the middle of the plate where the field strength is at its lowest. The cable should be fixed to the side of the plate with the least noise. This also applies to brackets and girders.



The lines of a signal or bus connection should be in one cable and be surrounded by a common shield. The cable should be laid as close as possible to the exciting cable to keep the insulation stress to a minimum.

The existing cable carriers (for example, cable racks) should be connected to the equipotential bonding system if there is no interference-carrying part of the equipotential bonding system within close proximity. The cable shield can then be contacted at both ends with the housings of the electronic equipment and in turn connected to the equipotential bonding system.

Additional information

For more detailed information about the electrical installation, refer to the installation manual *Automation System S7-400 Hardware and Installation*.

15.4 Use of modules in potentially explosive atmospheres of Zone 2

See product information "Use of modules in Zone 2 potentially explosive atmospheres" (https://support.industry.siemens.com/cs/ww/en/view/19692172).

15.5 Basics of EMC-compliant installation of PCS 7

Introduction

Although the PCS 7 control system and its components were designed for use in an industrial environment and meet strict EMC requirements, an EMC assessment should be performed prior to installing the control system and possible sources of noise identified.

Possible sources of noise

An automation system can be affected by different sources of electromagnetic interference in different ways:

- Electromagnetic fields can affect the system directly.
- Interference can be transported by bus cables.
- Interference can be transferred via the signal wiring.
- Interference can reach the system via the power supply or the protective earth.

Mechanisms

Interference arising from various coupling mechanisms can affect the PCS 7 control system. The type of coupling mechanism depends on the distance between the source of the interference and the PCS 7 control system and the transmission medium.

Coupling mechanisms	Cause	Sources of interference
Conductive coupling	Occurs when two circuits share a cable	Clocked devices; starting motors; static discharge
Capacitive coupling	Occurs between two cables at different potential	Interference from parallel electrical signal cables; contactors; static discharge from operator
Inductive coupling	Occurs between two cables carrying current. The magnetic fields of the current induce interference voltages.	Transformers; motors; parallel power cables; cables with switched currents; high-frequency electrical signal cables
Radiation coupling	Occurs when an electromagnetic wave meets an electric cable. Voltages and currents are induced.	Adjacent transmitters (walkie-talkie); radio links

Rules for ensuring electromagnetic compatibility

Adherence to the following rules is normally sufficient to guarantee electromagnetic compatibility:

- Protect the programmable controller from external noise by installing it in a metal cabinet or enclosure. Include the cabinet or casing in the chassis connections.
- Shield against the magnetic fields generated by inductors (transformers, motors, contactor coils) using separating plates (steel, highly permeable material) from the programmable controller.

- With shielded signal and bus cables use metallic connector housings (not metalized plastics).
- Connect all inactive metal parts together using low impedance and making large-area contact and also to local ground.
- Create a central connection between the inactive metal parts and ground.
- The shield bar should be connected to chassis with low impedance and making large-area contact.
- Divide cables into cable groups and lay them separately.
- Always lay power cables, electrical signal cables and bus cables in separate channels or bundles.
- Lay cables for hazardous areas and normal signal cables in separate channels.
- Only feed cables into a cabinet from one side.
- Lay electrical signal cables and bus cables as close as possible to chassis surfaces (e.g. supporting bars).
- Use twisted cables.
- Contact the shields of electrical signal cables at both ends.
- Lay analog cable with double shields. The inner shield must be contacted at one end and the outer shield at both ends.
- Contact cable shields with the shield bar over a large area immediately where they enter a cabinet and secure with clamps.
- Continue the contacted shield to the module without interrupting it.
- The cable shield must not be interrupted between the functional units and must be contacted at both ends.
- Do not interconnect cable shields.
- Only use line filters with metal enclosures specified for PCS 7.
- Connect the filter casing over a large area; in other words, with low impedance to cabinet chassis.
- Never secure filter casings to painted surfaces
(this will scratch the paint!).
- Install filters at the point where the electrical cable enters the cabinet.
- Do not lay unfiltered electrical cables in the cabinet.

Additional information

For additional information about plant installation, refer to the manual *Automation System S7-400 Hardware and Installation*.

15.6 Degrees of protection (housing protection)

IP standard

Housing protection is stipulated in standard EN 60529 in Europe by the IP codes IPxx with 2 numbers.

The following table explains the IP standards conforming to EN 60529/IEC529:

First number	Contact and solid body protection	Comment
0	No protection	
1	Protection against solid objects up to 50 mm	For example, inadvertent hand contact
2	Protection against solid objects up to 12.5 mm	For example, fingers
3	Protection against solid objects up to 2.5 mm	For example, tools and small wires
4	Protection against solid objects in excess of 1 mm	For example, tools and small wires
5	Protection against dust, limited penetration al-lowed	No damaging deposits
6	Completely dust proof	

Second number	Degree of protection against water	Comment
0	No protection	
1	Protection against dripping water	Vertically falling drops of water
2	Protection against dripping water	Direct dripping inclined at 15° vertical angle
3	Protection against spraying water	
4	Protection against spraying water	Water spray from any direction should not result in damage
5	Protection against water jets	Low pressure water jets from any direction should not result in damage
6	Protection against high pressure water jets	Water jets from any direction should not result in damage
7	Intermittent immersion at specified pressure for specified time should not result in damage	
8	Protection against extended submersion under pressure	Agreed upon definition between the manufacturer and the user; however, the conditions must be more severe than under Number 7

Degree of protection

The housings of most SIMATIC components have ventilation openings. To allow more effective cooling of the electronics components, ambient air can flow through the housing. The maximum operating temperatures quoted in the technical specifications apply only when there is unrestricted flow of air through the ventilation openings.

Depending on the size of the ventilation openings, such modules comply with the degrees of protection IP 20, IP 30 to IP 40. You can find the actual degree of protection of a SIMATIC component in its documentation.

Components with the degrees of protection mentioned above do not provide protection against dust and water. If the installation site requires protection of this kind, the components must be installed in an additional enclosure (such as a switching enclosure) that provides a higher degree of protection (for example, IP 65/IP 67).

Installation in additional enclosure

When you install these components in an additional enclosure, make sure that the conditions required for operation are maintained.

Note

Make sure that the temperature inside the additional enclosure does not exceed the permitted ambient temperature for the installed components. Select an enclosure with adequate dimensions or use heat exchangers.

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