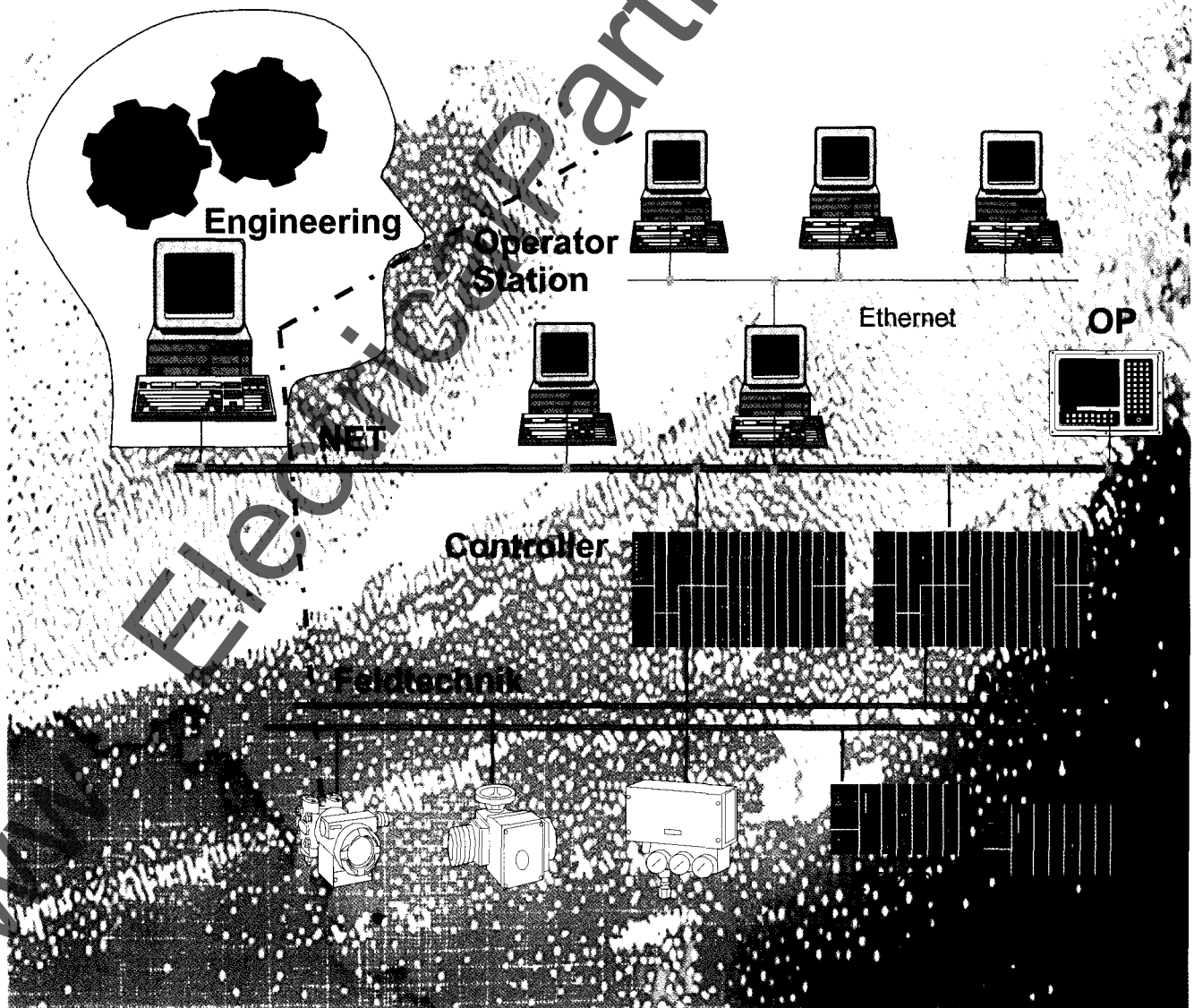


SIEMENS

SIMATIC Software

Process Control System PCS 7
Engineering System (ES)

Manual



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SIMATIC

Process Control System PCS 7

Engineering System (ES)

Manual

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C79000-G7076-C711-02

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Note

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6ES7813-2AX00-8BH0

Preface

Aim of this manual

This manual will help you to configure your control system with respect to the equipment contained in the plant, independently of the individual phases. It will provide an overview of the various views (plant and device-oriented), the individual engineering phases, how to configure your plant and how to create templates. You will also find detailed information on:

- working with the Plant Hierarchy (PH)
- working with the Import/Export Assistant (IEA)
- PLC and OS-independent configuration

The "PH / IEA" software for the SIMATIC S7 process logic control incorporates the latest advances in ergonomic design. The software is operated via SIMATIC Manager. It is also easy to learn and largely self-explanatory.

As each procedure is explained, you will also see the corresponding menu commands. However, there are no instructions on how to complete the dialog boxes, since this information should ideally be found in the on-line help and not in a manual.

Who should read this manual?

This manual is aimed at anyone working in the areas of configuration, commissioning and servicing.

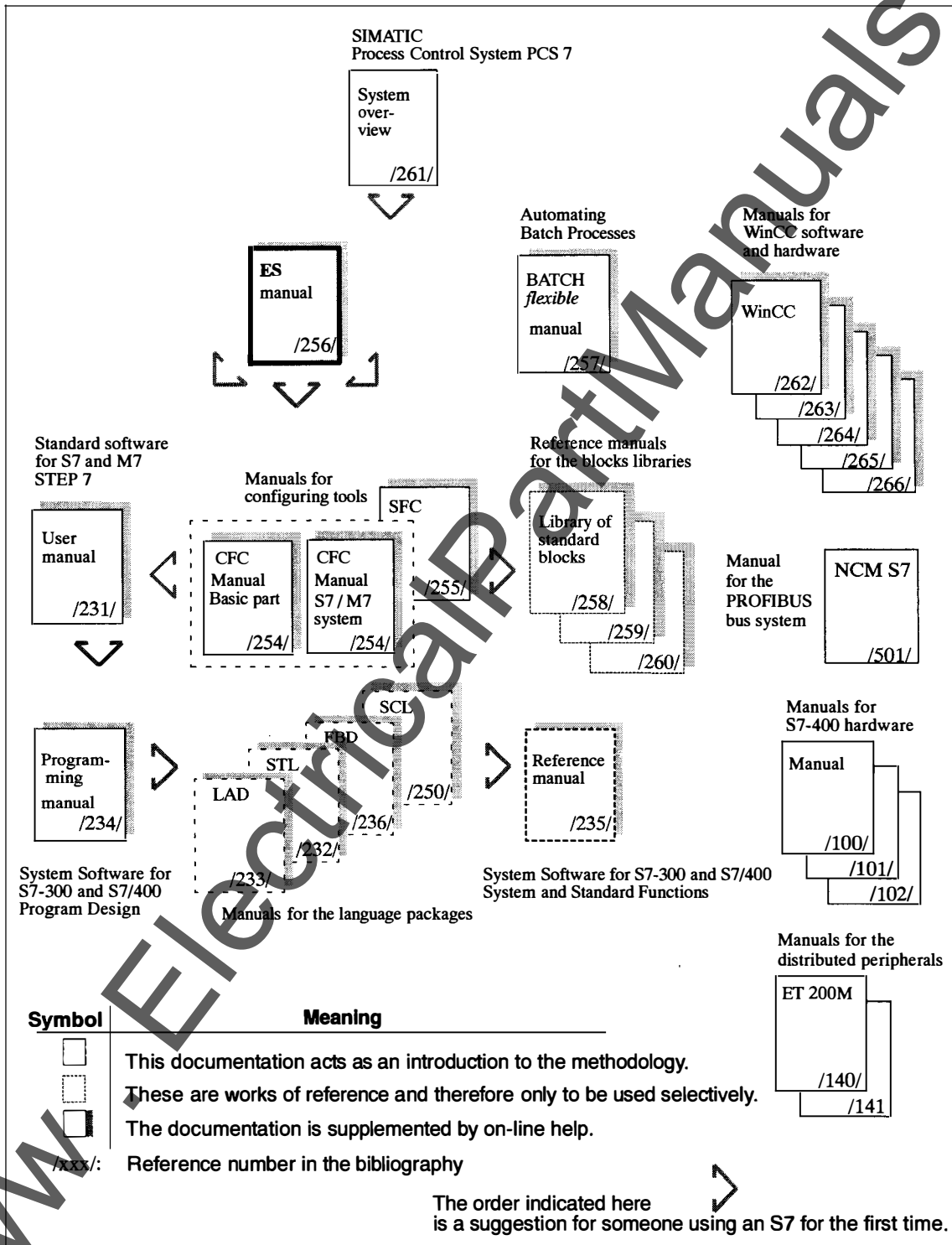
They must, however, be used to working with a PC/PG and be familiar with *Windows 95*.

Validity

This manual is valid for the engineering toolset in conjunction with the descriptions of the "Plant Hierarchy (PH)" and "Import/Export Assistant (IEA)" software components from the "PCS 7 engineering options".

Position within the available documentation

There is a considerable amount of User Documentation available to help you to plan, configure and program your S7 process logic control. This documentation should be used selectively. The following passages together with the illustration below are intended to facilitate use of the user documentation.



Title	Contents
Programming Manual Program Design	The Programming Manual provides basic knowledge of the structure of the operating system and user programs running on an S7-CPU. It will provide anyone using an S7-300/400 for the first time with an overview of the programming methods involved. This knowledge can then be put to good effect when designing the user program.
STEP 7 User Manual	The STEP 7 User Manual explains the fundamentals and functions of the STEP 7 programming software. The manual provides you, as a new user of STEP 7 and an experienced user of STEP 5, with an overview of the procedures of configuring, programming and commissioning an S7-300/400. While you are using the software, you can call up the on-line help. This will give you detailed answers to questions associated with the software application.
STL, LAD, FBD, SCL Manuals	The manuals for the STL, LAD, FBD and SCL language modules contain both a user's guide and a description of the language. While you are using the software, you can use the on-line help to answer all your detailed questions on use of the associated editors/compiler.
Reference Manual System and Standard Functions	The S7 CPUs contain system and standard functions integrated in the operating system. These can be used while programming your system. This manual provides an overview of the function and organization blocks available in S7, together with detailed descriptions of the interfaces (as reference information) for use in your user program.
System Overview PCS 7	This description provides an overview of the components and functionality of the SIMATIC Process Control System 7 and includes the topics which are of interest when operating a control system.
ES Manual	The Engineering System (ES) Manual for the Plant Hierarchy (PH) and Import/Export Assistant (IEA) from the optional PCS7 Engineering package sets out the basic principles and describes the procedure for configuring a plant, regardless of the phase, in relation to the equipment it contains.
CFC Manual	The manual for the CFC configuration tool (in the optional PCS 7 Engineering package) provides an overview and describes how to create an entire software structure from pre-defined blocks. While you are using the software, you can use the on-line help to answer all your detailed questions on use of the CFC editor.
SFC Manual	The manual for the optional SFC Control System module provides the information you need for planning sequential control systems. While you are using the software, you can use the on-line help to answer all your detailed questions on use of the SFC.
Reference manuals for the block libraries	The "Standard Blocks", "Blocks for PROFIBUS" and "Field Device Blocks" manuals contain detailed information on the blocks available in the libraries.
BATCH flexible manual	This manual describes how to automate batch processes, and includes sections on batch scheduling and batch data management.
Manuals for WinCC	The manuals provide information on planning and working with the operator control and monitoring system. They all contain descriptions of the hardware, software and process control.

How to use this manual

This manual is divided into the following topics:

- Chapter 1 contains general information on the Engineering System, its components and views. It covers the device-independent aspects and the individual engineering phases.
- Chapter 2 contains brief description for total beginners. It shows what to do – from starting the program for the first time through to configuring an entire plant – all with reference to an example (session model).
- Chapter 3 describes the plant hierarchy. It will answer your questions on how a plant is structured, how the HID is formed and how devices and objects are assigned, for example.
- Chapter 4 describes how to import and export configuration data, create templates and generate the software using the Import/Export Assistant .
- Chapter 5 describes PLC and OS-independent configuration.
- Chapter 6 contains information on how to document your work.
- The appendix contains a chapter with the Technical Data, a list of abbreviations used in the Engineering System and a description of the available documentation.
- At the end of the documentation there is a glossary with the explanation of important terms and an index which help you to find texts on important points rapidly.

Conventions

References to further documentation are made by means of the literature numbers between slashes, for example /.../. These numbers will allow you to take the precise title of the document from the documentation list.

Further support

If you have any further questions on the software which are not answered in the paper documentation or in the on-line help, please contact your Siemens representative or branch.

If you have any questions or remarks on this manual, please complete the questionnaire at the end of the manual and send it to the address indicated. Please let us know what you think about the manual as well.

We offer courses to help you start working with the SIMATIC S7 PLC.

Please contact your local training center or the central training center in:

1. D-90327 Nürnberg, Tel. + 49 911 / 895 3202 Fax: +49 911/895 3252
2. D-78187 Karlsruhe, Tel. + 49 721595 2917, Fax: +49 721/595 6087.

Note

The user section of this manual does not contain precise instructions for the individual steps, but rather explains the fundamental procedure. More detailed information on the individual dialogs of the software and editing them can be found in the respective the on-line help.

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The Engineering System

Overview

In the first chapter, we introduce you to the principles of the Engineering System (ES), together with its "Plant Hierarchy" (TH) and "Import/Export Assistant" (IEA) software components and the interaction between these components within the ES.

You will learn the difference between a plant-oriented and a device-oriented view, what are the device-independent aspects and the appearance of the individual engineering phases.

In this Chapter

This chapter deals with the following topics:

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1.1	Components of the ES	1-2
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1.1 Components of the ES

ES software in SIMATIC PCS7

The components of the engineering system (ES) in the SIMATIC Process Control System 7 (PCS7) are tools which enable you to configure your system comprehensively and in a device-independent manner. These ES components are the following software packages:

- **STEP 7 basic software**
This contains the **SIMATIC Manager** which forms the superstructure for all the ES components and manages these components centrally. It is a graphical user interface running under Windows 95. Hardware is configured, i.e. racks, modules and interface modules are arranged in the SIMATIC Manager dialog via a configuration table (**HWKonfig**).
- **Plant Hierarchy (TH) and Import/Export Assistant (IEA)**
Both "PH" and "IEA" are optional control system packages. They supplement the SIMATIC Manager and, therefore, are not separate applications. The functions are called up via menu commands.

PH and IEA support the phase-independent and plant-wide configuration of process and production plants. This type of engineering is based on aspects relating to the equipment in the plant.
- **Sequential Function Chart (SFC)**
This is a software package that can be configured using sequential control systems. A sequential control system is used to control and selectively run basic automation functions (which are usually created using CFCs) by means of operation and status changes.

The SFC software package, together with "PH" and "IEA", is part of the optional control system package.
- **Continuous Function Chart (CFC)**
This is a software package for configuring the flow of data for basic automation functions. The CFC is used to create an overall software structure from prepared blocks, i.e. to graphically interconnect the functions of individual items of equipment.

The blocks are classified by functionality and are contained in libraries. You can drag & drop the blocks you want from these libraries (which can be displayed as a tree view) and insert them into the CFC.
- **Structured Control Language (SCL)**
This is a programming language for programming complex tasks in a PLC. In the ES, it is used to create block types, for example.
- **WinCC configuration software**
This is used to configure the operator interface system (Windows Control Center) in PCS7.

Plant-wide engineering

Plant-wide engineering has the following benefits:

- It enables objects of significance to the plant (units, PICS units, etc) to be handled independently of the component view.
- It enables objects to be arranged in a plant hierarchy, thus structuring the system according to functions or equipment (see Figure 1-2).
- Objects are given a unique name, throughout the project, by allocating a higher level designation (HID).
- Data can be taken from previous planning and configuration phases and reused (phase-independent engineering).
- Data can be returned to the previous planning and configuration tools in order to compare the system documentation.

1.2 Component view and plant view

Various views in the ES

The objects of the control system can be represented in different views for various tasks. For example, a commissioning engineer will want to know which functions are running on the CPU, and the technicians will need to know which units belong to a system.

The ES contains the **component view** (standard hierarchy) and the **plant view** (plant hierarchy) for configuring a process control system. In the component view, you can toggle between the off-line and on-line views. To switch between views, select one of the following menu commands from the View menu in SIMATIC Manager:

- Standard hierarchy
- Plant hierarchy
- Off-line
- On-line

Another view is the local view, which shows the three-dimensional structure of the plant. This local view is implemented with other tools and is not a part of the ES.

One important feature of these views is that the objects displayed in them exist only once, but will appear and can be handled in different views.

Objects of the ES

In plant hierarchy or standard hierarchy window, the objects in the left-hand pane are displayed in a hierarchical tree structure. In the right-hand pane, the objects are displayed in the form of an open container. The containers of the individual hierarchical levels may contain "leaf objects". A leaf object, such as a CFC chart, cannot be opened further within the hierarchy and consequently will only appear in the right-hand pane. Double-click on the icon representing the leaf object to start its application.

Standard hierarchy

The standard hierarchy (component view or device-oriented view) is used to configure the hardware for your project (control system hardware, such as PLC and OS). The objects concerned are designated as components according to their significance (e.g. chart container, OS, PLC, station, etc).

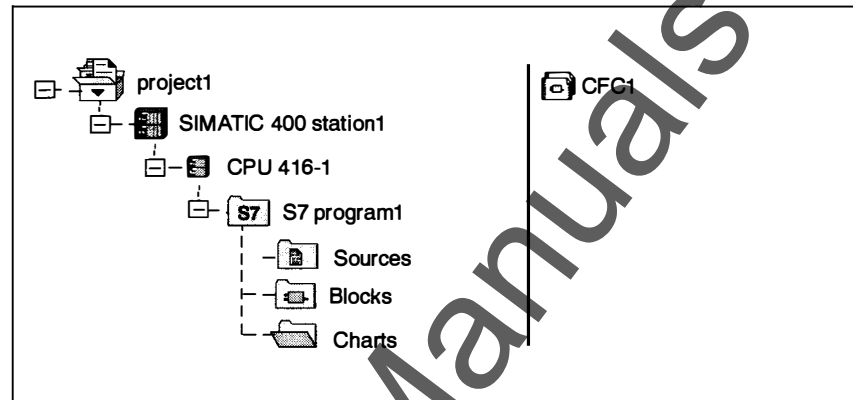


Figure 1-1 Standard hierarchy

Plant hierarchy

The plant hierarchy (plant or functional view) is used to structure a project on the basis of the equipment used, i.e. you classify the automation, operating and monitoring functions in a hierarchical format. This classification increases the clarity and enables you to handle the plant objects (systems, units, PICS units, etc) as a single unit. In the plant view, you can handle objects independently of the devices to which they are actually allocated. The objects concerned, i.e. the hierarchical containers, are designated according to their importance within the plant.

Please note that chart names must be unique within the CPU.

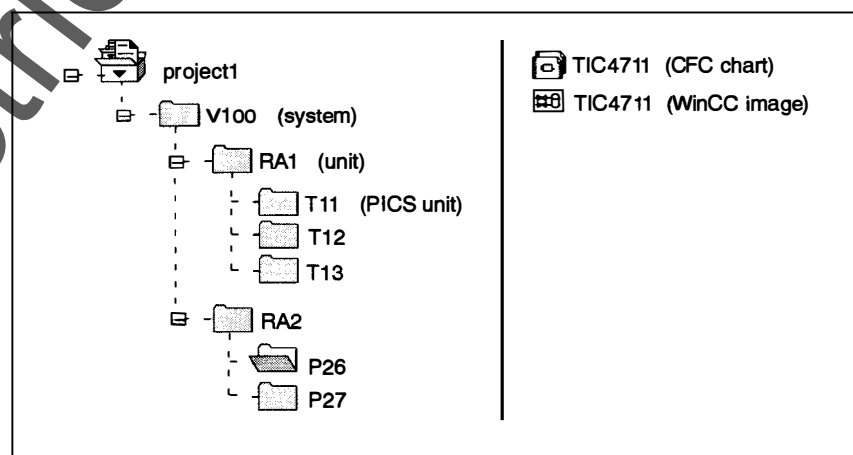


Figure 1-2 Plant hierarchy

HID

The hierarchical container of the plant hierarchy can be used to create the naming convention on the basis of functional aspects. This hierarchical path forms the higher level designation (HID). This is used, via a dialog, to specify which levels (containers) are to be used for naming.

Example (from Figure 1-2) for an HID: V100\RA2\P26

Working with both views simultaneously

The component view and plant view can be displayed simultaneously in the project viewer window: (select from the Options menu → Customize... → "Always generate window when switching between views"). Objects such as CFC charts, etc, can be transferred (allocated) from the component view (off-line) to the plant view using Drag&Drop.

You can also change the view in the active window without having to open a new window. In the SIMATIC Manager "Options" menu, simply deselect "Always generate window when switching between views" in the "Customize" dialog box.

Recommended procedure

We recommend the following method:

- First configure the hardware (PLC and OS) in the component view.
- Then create the structure of the system in the plant view and allocate the hierarchy containers to the hardware.
- You can now place and edit all the charts and images in the plant view.
Since they have already been assigned to the hardware, the charts and screen are stored in the chart containers and OS stations concerned.
- You can now add further hardware at any time.

1.3 Device-independent aspects

Device - independent relationships

When you create an automation task, there are almost always device-independent relationships between the individual structures, e.g. automation sequences in the PLC must be run and monitored on an OS or several PLCs of a device have to communicate with one another.

The plant objects used in the plant view (systems, units, PICS units, etc) in turn contain other objects (leaf objects, such as CFC/SFC charts with blocks, OS screens, etc), which are normally distributed between several devices (PLC, OS, field devices) that make up the control system.

When you use the plant objects (New, Copy, Rename, Move, Delete), the functions generally affect several devices. With plant-wide engineering, the device-independent relationships within the engineering system (ES) are managed, thus guaranteeing consistency and functional capability of the automation structures.

Functions

The functions that can be executed during plant-wide engineering and their device-independent relationships are managed by the ES and include, for example:

- Copying an entire unit containing charts for the PLC and screens for the OS.
- Deleting a unit, thus deleting all objects belonging to that unit.
- Moving a unit to other devices (PLC and OS).

Restrictions

In the current version of the PCS7 optional package "TH/IEA", the PLC-PLC and PLC-OS links and data are not automatically corrected. Please note the following restrictions:

- In the case of PLC-PLC links, you must map these links onto CFBs and link the CFBs in turn via a communication channel.
- In the case of PLC-OS functions, the display blocks are copied or moved together with the image, although they still refer to the previous WinCC DM variables. These must be corrected in WinCC. When you move or copy to another OS, you are supported by the function which list graphics objects that are no longer connected. When you copy within an OS, the ES does not provide this support.

1.4 Phase-independent aspects

General

The engineering of a process control system is just one part of the overall configuration of a process or production plant. Data that has already been recorded or created using other tools may be reused during engineering. This assumes that the phase-independent work has already been carried out.

Engineering phases

The engineering for a plant comprises the following phases (as specified in Namur worksheet NA 35: "Implementation of EMR/PICS projects"):

- **Determination of the basic principles**
This stage involves determining the aims of the project, rough costings, etc.
- **Preliminary planning**
This phase is used to specify the plant concept and calculate the costs.
- **Basic planning**
In this phase, the PICS functions and the process-related data are specified, technical implementation clarified and the resulting costs calculated.
- **Implementation planning**
This phase is used to plan which devices and central equipment will be used. The control system is specified, the unit charts, the unit function charts and the assembly documents are drawn up.
- **Set-up**
In this phase, equipment is ordered, deliveries confirmed, the software for the control system is configured, the plant is assembled and its functions are tested.
- **Commissioning**
In this phase, the personnel are trained and the commissioning takes place. The documentation is drawn up for the entire plant.
- **Project completion**
In the final phase, the completion report is drawn up and the final costs of the project are billed.

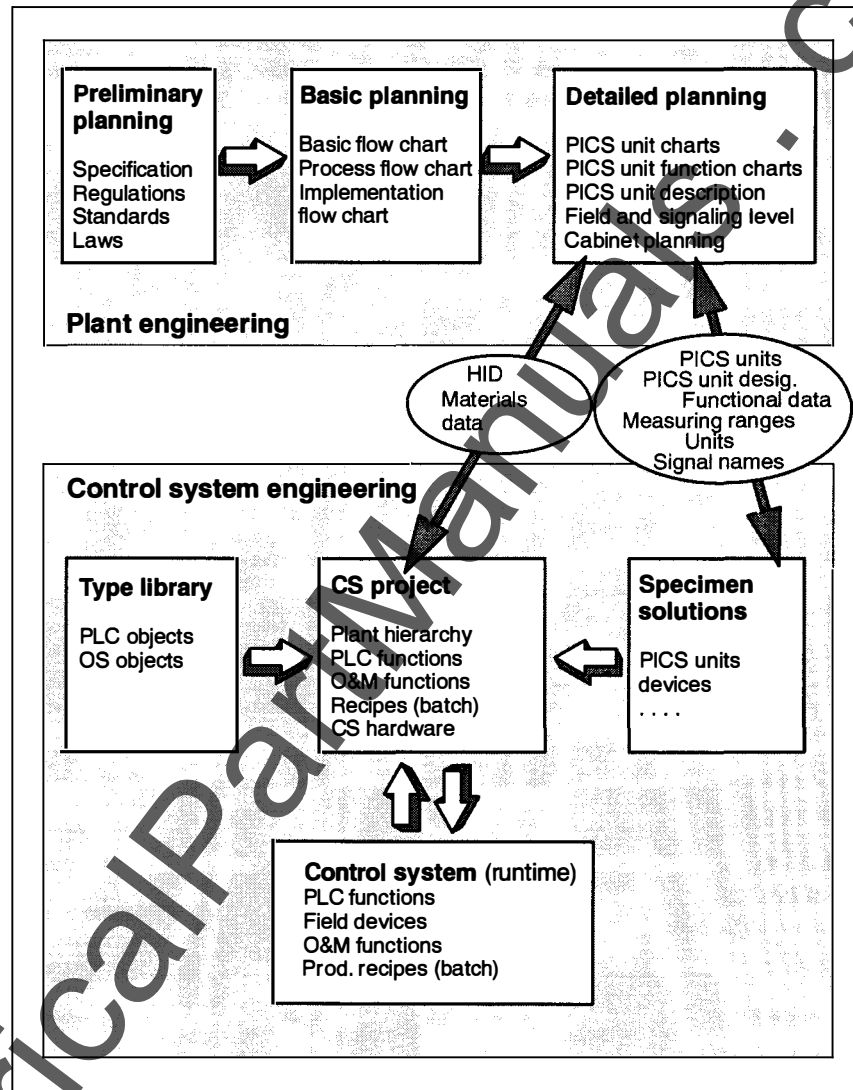


Figure 1-3 Interaction between plant and control system engineering

1.5 Engineering procedure

Plant planning

The plant planning procedure is as follows:

- Use of the library with functional units (application standards)
 - Binary input with message
 - Measured value acquisition with messaging function
 - Fixed setpoint control with measured value acquisition
 - Cascaded control
 - Ratio control
 - Split range control
 - Setpoint generator / output value generator
 - Metering
 - Motor control unit
 - Motor control unit with two speeds
 - Motor control unit with two directions of rotation
 - Motor control unit for variable-speed drives
 - Open/close valve
 - Three-way valve

The plant functions are carried out by functional units, each of which has its own data sheet (PICS unit description).

- The functional units are allocate specific values.

CS engineering

The procedure for CS engineering with the IEA is as follows:

- Use the library of specimen solutions for automation, operating and monitoring, adapting them to suit the functional units.

When automation solutions are created for medium-sized and large-scale projects, partial solutions that have already been implemented (called specimen solutions below) can often be reused. The engineering system supports the reuse and adaptation of specimen solutions. This will enable you to edit CFC charts and process signals via the dialogs and in list form. You can specify or edit the parameters and signals without having to open the CFC charts or symbol tables concerned.

- Allocate specific values to the links between blocks.

You can import datasets, allocate their structure to the specimen solution and automatically copy and configure specimen solutions.

The procedure used in the past had the disadvantage that the same data had to be entered several times.

For working with the IEA, see chapt. 4.

Getting Started

2

Overview

This "Getting Started" chapter is intended for users who are not yet familiar with the ES and want a brief overview of the system. An example will be used to show how, after starting the SIMATIC Manager, a project is created, how a plant is structured in the plant hierarchy and how specimen solutions can be used with the IEA.

In this Chapter

This chapter deals with the following topics:

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2.1	Creating a project	2-2
2.2	Structuring a plant in the plant hierarchy	2-4
2.3	Working with the Import/Export Assistant	2-7

2.1 Creating a project

SIMATIC Manager Standard hierarchy

After starting SIMATIC Manager, create the project in the "Standard hierarchy" view:

File ► New ► Project...

This will open the dialog box containing all the existing projects. Enter the name of the project ("proj97" in this example) and click on "OK" to confirm.

The project viewer window will appear on screen. This is divided into two fields: The left-hand field contains the container with the name "proj97" and the right-hand field contains the symbol for the MPI network.

First enter the hardware in the following order:

Insert ► Station ► SIMATIC 400 station

Edit ► Open Object

This will start HWCONFIG and open the hardware catalog. Select the rack:

SIMATIC 400 ► RACK 400 ► UR1

The window "UR1" with the table of slots will appear in HWCONFIG. Now Drag&Drop from the hardware catalog to insert the power supply and CPU:

PS 400 ► PS407 10A

CPU 400 ► CPU416-1

The PS407 occupies slots 1 and 2 and the CPU is in slot 3. Now exit HWCONFIG with

Station ► Save

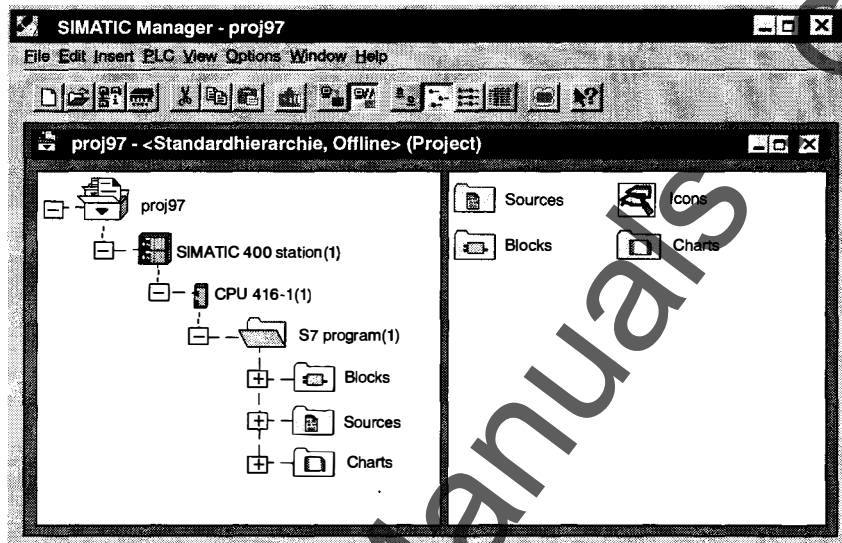
Station ► Exit

The SIMATIC Manager project viewer window now contains the icon for the station and, below that, the icon for the CPU and the icon for the S7 program.

Browse through the project viewer window until you find the container for the S7 program and double-click on it. This will open the S7 program with the containers for the source code "Sources", for the "Blocks" user program and the symbol list "SY".

Now insert the "Charts" container:

Insert ► S7 software ► Chart container



This will place the project in the standard hierarchy. The next control system engineering steps are carried out from the plant view.

2.2 Structuring a plant in the plant hierarchy

Switching between views

Now switch from the "Standard Hierarchy" view to the "Plant Hierarchy" view.

View ► Plant Hierarchy

The switch for "Always generate window when switching between views" is set in the SIMATIC Manager settings. To set this switch, use the "Customize..." function from the "Options" menu). When you now switch to the plant hierarchy, another window will be opened.

Plant hierarchy

The plant hierarchy window contains the icon for an open container. This container represents the project. You can specify further hierarchical levels and thus the plant structure from here.

Insert ► S7 Program ► Hierarchy Container

This inserts a hierarchy container representing the hierarchical level of the plant. The name will be highlighted and the cursor activated. You can now change the name if you wish (in this case: to "V100").

Defaults

You can now define the plant hierarchy, i.e. set the defaults for the rest of the plant structure. To do this, select:

Options ► Define Plant Hierarchy

The dialog box with the same name is divided into three areas:

In the "Identifier" area, enter the maximum number of hierarchical levels (in this example "4").

The separator "\" remains unchanged. This is used to separate the container names are listed one after another in the HID.

As the documentation prefix, enter the name of the factory and the area, in this case "22/DRAL". This prefix does not appear in the HID since it is only of relevance to the documentation.

In the area "Settings for each level", specify the following for each hierarchical level:

- the maximum number of characters for the container name in the HID: Set under "Max. number of characters" using the UP / DOWN arrows.
- whether the container name should form part of the HID: click on the "Identifying" check box.
- whether there should be a separator after the name: click on the "With separator" check box.

The **"Preview"**, displays the HID (with the prefix in brackets) as it was specified in the defaults, i.e. the number of digits corresponds to the maximum number of characters and the number designates the hierarchical level.

Example:

111111\22222222\3333333333

The name of the first hierarchy container may contain up to 6 characters, the second name up to 8 characters and the third name up to 10 characters.

Structuring the plant

Once you have updated the defaults and closed the "Define Plant Hierarchy" dialog box by clicking on "OK", you can now continue to structure the plant.

Let us insert two further levels: for the unit and for the PICS unit. Change the names to "RA1" for the unit and "T01" for the first PICS unit.

Allocation to the PLC

Call up the Properties dialog for the selected container "RA1". Right-click with the mouse pointer on the container in order to call up the context menu. Then click on "Object Properties" and, in the dialog box, on the "Allocate to PLC and OS" index.

To complete the "Allocated PLC" field, click on the "Browse..." button. In the "Open" dialog box and the project structure

- browse until you find the S7 container, and select it,
- then select the chart container from the **right-hand window**,
- click on "OK" to confirm.

Please note: If you browse through the project structure until you find the chart container and select it, it will not have an object name and an error message will appear.

Click on "OK" to return to the "Properties" dialog box; you will see that the path "S7 program(1)\charts" has been entered.

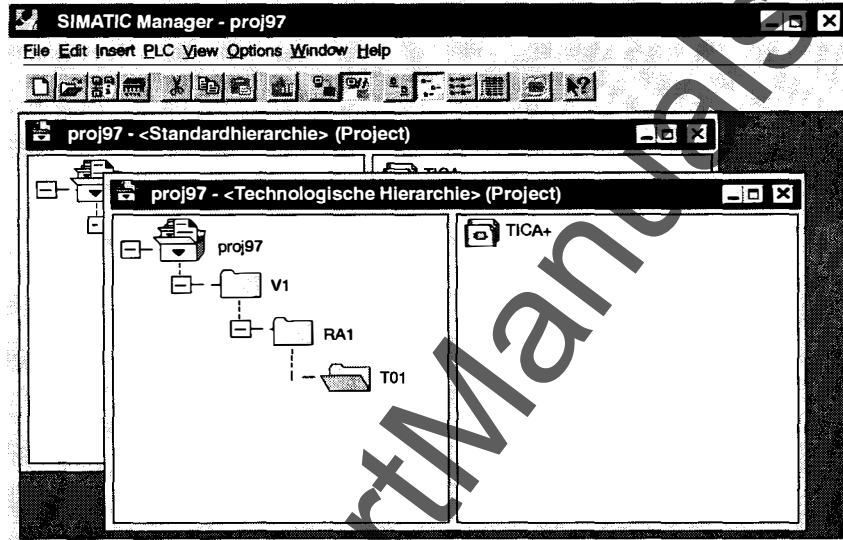
- Click on the "Pass selected allocation to lower-level hierarchy container" check box.
- Click on "OK" to close the dialog box.

Inserting CFC charts

Select the container "T01" and insert a CFC chart:

Insert ► S7 program ► CFC

Change the chart name to TICA+



If a sequential control system is required in the project, insert an SFC chart as well.

Insert ► S7 program ► SFC

Note

Configuration of CFCs and SFCs is described in the Getting Started chapter of the relevant documentation, so it will not be described in further detail here. See /254/ and /255/.

2.3 Working with the Import/Export Assistant

Task You want to prepare so-called specimen solutions for functional units (e.g. a cascaded control from the plant planning) which can subsequently be copied and modified to suit the specific solution whenever necessary.

What used to happen.... The charts were created with the CFC editor. The necessary blocks were incorporated and interconnected in these charts, and the parameter and signal I/O points to be used for the specimen solution were determined.

You already have an import file containing the import data (parameters / signals) which can be assigned to the specimen solution.

You must create a separate import file for each different type of functional unit or type of specimen solution.

Importing

Select the container "RA1" and then:

Options ► Import/Export Assistant ► Import...

Once the block I/Os have been read in, the "Import" dialog box with the first sub-dialog is opened:

"Specimen solution: Select parameters and signals".

The parameters and signals have already been selected for the IEA in the CFC editor, so you can switch to the next sub-dialog using the "More>" button:

"Allocate import data structure to specimen solution" (see 4.2.2)

Enter the name of the import file in the "Import file" field. To do this, click on the "Browse" button and look for the file you want in the pop-up dialog box.

Once the file has been read in, the column headers for the parameter and signal I/O points appear in the left-hand field.

Now allocate all the column headers to the parameter and signal I/O points (using Drag&Drop or by selecting the source and destination and clicking on the ">") button.

This is a 1:1 allocation, i.e. there must be the same number of lines in each window and, at the end, all the column headers must have been allocated.

Click on "More" to move on to the next sub-dialog:

"Carry out import process" (see 4.2.3)

Each line in the import file represents one HID. The IEA will now create the hierarchy container as specified in the import file, i.e. the project structure will be supplemented with the number of HIDs (if they are not already present).

The specimen solution "RA1" is copied to the hierarchy container (as per the HID). The parameter and signal descriptions on each line are written to the parameter and signal I/O points for the copied specimen solution. Each line therefore corresponds to exactly one specimen solution.

Testing and commissioning

You can now use your specimen solutions for testing and commissioning (see /254/). To do this, compile the chart container and load the program into the CPU.

You can now check the program and modify any parameters, if necessary.

After modification, the documentation should be compared with the plant planning. To do this, you must first export the current data for the project.

Export

To export (see 4.3), select the container "RA1" (or another container by importing a copied specimen solution and click on:

Options ► Import/Export Assistant ► Export...

In the Export dialog you can rename the export file if you do not want to overwrite the import file.

The data in all specimen solutions of this type will now be written line by line to the export file.

Compare system documentation

The export file can now be used to compare the system documentation with another planning tool.

Plant hierarchy

3

Overview

This chapter describes how to use the ES "Plant hierarchy" function package and the way in which it works.

In this Chapter

This chapter deals with the following topics:

Section	Topic	Page
3.1	Introduction	3-2
3.1.1	User interface	3-2
3.2	Structuring a plant	3-3
3.2.1	Creating the plant hierarchy	3-3
3.2.2	Inserting objects into hierarchy containers	3-3
3.2.3	Detailed view of leaf objects	3-4
3.3	Settings and properties of the PH	3-5
3.3.1	Defining the plant hierarchy	3-5
3.3.2	Properties for hierarchy containers	3-7
3.4	CFC and SFC charts in the PH	3-10

3.1 Introduction

Plant objects

The plant hierarchy can be used to break a project down on the basis of the equipment it contains. Plant objects are systems, units, PICS units, etc which are created as hierarchy containers within a tree structure (may also be nested). The leaf objects are also regarded as plant objects.

- CFC and SFC charts
- OS objects, such as images and reports
- Standard documents (from WORD, EXCEL, etc.)

3.1.1 User interface

SIMATIC Manager

The "Plant hierarchy" is mapped on the SIMATIC Manager user interface. The general SIMATIC Manager functions are described in /231/.

The menu have been extended with functions specific to the "Plant hierarchy". These are, in the "View" menu, the functions for switching between the views

- Standard hierarchy (see Figure 1-1)
- Plant hierarchy (see Figure 1-2)

and, in the "Options" menu, the function

- Plant hierarchy
 - Define
 - Check naming convention
 - Display log

(see section 3.3.1)

View

The "Plant hierarchy" or "Standard hierarchy" function in the "View menu is used to either to switch the view in the current window of the called project or to generate another window with the selected view, depending on the defaults.

To set this default in the "SIMATIC Manager", select the "Customize..." function from the "Options" menu and then either select or deselect the "Always generate window when switching views" check box.

3.2 Configuring a plant

Requirement You must first have created a project in SIMATIC Manager and created an S7 program, together with a chart container in the "off-line" view of the standard hierarchy. This will ensure that you have the resources required to insert CFC charts, for example, into the plant hierarchy.

There must also be an OS in order to incorporate OS screens and reports.

3.2.1 Creating the plant hierarchy

Call PH From the "View" menu, select the "Plant hierarchy". The PH window will contain the project container for the hierarchical levels of the project to be configured.

Insert hierarchy container When you insert the first and subsequent hierarchy containers, even if they are nested, you create the structure and thus the subdivision of the plant.
To create new hierarchy containers, select the "Hierarchy container" function from the "Insert" menu or "Insert new object" from the context menu.

Editing equipment names Once you have inserted a hierarchy container, it will be displayed on the right-hand side of the window. You can now change the name if you wish: The name field with the name assigned by the system is highlighted and the cursor is positioned after the last characters of the container name. You can now enter the desired name using the keyboard (Delete and Edit).

Copy / delete hierarchy container If you copy or delete hierarchy containers, all the objects contained in them will be copied or deleted as well. This will enable you, for example, to copy a complete unit in a single step. You then simply have to make the modifications to the copied unit (e.g. by linking it to the process signals).

3.2.2 Insert objects into hierarchy containers

Leaf objects Leaf objects, such as CFC and SFC charts, OS leaf objects (images, reports) and additional documents (Standard WORD, EXCEL documents, etc.) can be inserted into hierarchy containers.

Leaf objects that were created in the standard hierarchy can be assigned to the desired hierarchy container (using Drag&Drop). If they have already been assigned to a hierarchy container, the objects will be copied.

Names When you create a new leaf object, it will automatically be assigned a name + number (e.g. CFC chart: CFC3). The name space is that specified in the standard hierarchy. When you insert an object from the standard hierarchy, it will be given its old name (assigned by the system or user) (e.g. SFC-LaLi).

Move When you move leaf objects to a hierarchy container with another resource assignment, the previous assignment of the leaf object will be changed as well.

If you move entire hierarchy containers, this will not affect the resource assignment of the leaf objects in the container.

Connections between the views Since the views of the standard hierarchy and the plant hierarchy show various aspects of the same leaf objects, certain functions on these leaf objects will also take effect in both views.

- **If you delete** objects, they will be deleted from both views
- If you create **New** objects in the **plant hierarchy**, they will also be created in the PLC / OS assigned to the hierarchy container.
- If you create **New** objects in the **standard hierarchy**, this will have no effect on the plant hierarchy.

Tip: If the plant hierarchy has been created, you should only edit objects in this view. The standard hierarchy will then only be used to edit the PLC and OS.

3.2.3 Detailed view of the leaf objects

Path name In the detailed view (which can be set using the Toolbar or the "View" menu in SIMATIC Manager) the hierarchy paths of the leaf objects are shown in the right-hand window below the "symbolic name" column header, thus identifying the assignment to any other hierarchies (in the PH, this is the path of the standard hierarchy and in the standard hierarchy it is the path of the plant hierarchy).

3.3 Settings and properties of the PH

3.3.1 Define plant hierarchy

The HID

The naming convention for the plant hierarchy is defined for each project. The names of leaf object do not form part of the name, i.e. the higher level designation (HID) is formed only from the names of the hierarchy containers.

Define PH

Once you have created the first hierarchy container, you can then define the plant hierarchy. This means that you set the defaults for subsequently created hierarchy containers and for the designation and settings for the individual levels.

Once you have selected or opened an hierarchy container, call up the "Define plant hierarchy" function from the "Options" menu (or from the context menu via the "Options" function). A dialog box with the same name will appear on screen (Figure 3-1).

Level	Max number of characters	Identifying	With separator
1	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	15	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Preview:
(22/DRAL)11111111112222222222333333333344444444444444

Figure 3-1 "Define plant hierarchy" dialog box

Higher level designation

The following options are used to determine the display of the PH:

Number of hierarchical levels

You can configure up to 5 hierarchical levels. Use the "UP / DOWN" buttons in the input field to set the maximum number in your project.

Documentation prefix

Here you can enter up to 32 characters. This prefix does not appear in the HID since it is only of relevance to the documentation. It can be printed out in the footers of the objects (CFC/SFC charts, images/reports). The documentation prefix can be used, for example, to preset the works designation and the area (22 / DRAL) for the project.

The "Preview" box shows the prefix in brackets (see Figure 3-1).

Settings per level

This part used to specify, for the individual hierarchical levels, whether they are to contribute to the **identifier formation**, the **maximum number of characters** that can be entered and whether they should be followed by a **separator**.

Use the "UP / DOWN" buttons in the input field to set the maximum number of characters in your project. The "Preview" area will display the setting in the form of the appropriate number of digits (with the separator, if set).

The names of identifying hierarchy containers are included in the HID. You can use non-identifying containers to create other "pigeonholes" (e.g. for additional documents such as: plant descriptions, measuring point data sheets, etc). You can also specify or change whether the name is to form part of the HID or not at a later date for a specific object using the "Object properties" (see section 3.3.2).

When doing this, you should ensure that the name of the hierarchy container must be unique within an identifying hierarchy container.

Checking the naming convention

You can use the "Options ► Plant hierarchy ► Check naming convention" to specify whether the settings have been followed within the project. The settings may be violated, for example, if you subsequently modify settings or move containers to other levels.

3.3.2 Properties for hierarchy containers

Call dialog

You can assign certain properties to the hierarchy containers. To do this, call the Properties dialog for the selected container. Select the "Object Properties" function from the "Edit" menu or Context menu to call up the dialog box containing the following indexes:

- General
- Assignment to PLC and OS

"General"

The "General" index is used to set or view the general properties of the hierarchy container:

- Name:

Here you can change the name of the hierarchy container. You stipulated the maximum number of characters in the "Define plant hierarchy" dialog (see Figure 3-1).

- "Name is part of the higher level designation" check box:

The "Define plant hierarchy" can be used to change existing defaults, i.e. you determine whether the selected hierarchy container should contribute to the name of the HID.

- OS area identification:

Here you can enter an OS area identification if none of the containers in the higher hierarchical levels has an OS area identification. The OS area identification is passed on to (inherited by) all lower level hierarchy containers, OS images, OS reports and messages.

The OS area identification is used in WinCC to ensure that various operators are offered only those images, reports and messages that belong to their particular areas.

- Higher level designation (HID):

Here you can see the HID of the hierarchy container, i.e. the path of the hierarchy container from the topmost level down to the selected hierarchy container (for identifying containers).

- Author:

Here you can enter the name of the author (programmer) of the hierarchy container.

- Created on:

Last modified on:

Here you can see the date on which the hierarchy container was created and the date on which it was last modified.

- Comment:

Here you can enter a comment (up to characters)

"Assignment to PLC and OS"

In the "Assignment to PLC and OS" you can assign a PLC and an OS to the hierarchy container. In this way you will set which PLC resource (chart container) contains the CFC/ SFC charts and which OS resource (WinCC station) contains the images and reports contained in this hierarchy container or which have been inserted into this container.

Note

You cannot insert CFC/ SFC charts or images / reports into the hierarchy container unless the PLC or OS has already been assigned.

- **Assigned PLC:**

Here you can see the path of the "Charts" container from the standard hierarchy view or the text "Not assigned"

To assign a PLC resource, click on the "Browse..." button to open a dialog box and select the desired chart container from the current project.

The assignment will be immediately adopted by all objects inserted into the hierarchy container (CFC/ SFC charts, hierarchy containers).

You can Undo the assignment by selecting "Not assigned" from the combination field.

- **Lower-level hierarchy containers**

If you click on the "Pass selected assignment to lower-level hierarchy containers", all the lower-level hierarchy container will inherit the assignment set at the current hierarchy container.

Above the check box, you will see a text which indicates the type of assignment:

- "All lower-level hierarchy containers have the selected assignment":

From the selected hierarchy container downwards, all the hierarchy container will be assigned the same PLC.

- "There are hierarchy containers with a different or no assignment":

Below the lower-level hierarchy containers, there are some which do not have the same assignment as the selected hierarchy container.

- "There are no lower-level hierarchy containers":

The selected hierarchy container is at the topmost level of the hierarchy.

- Assigned OS:

Here you can see the OS currently assigned to the hierarchy container or the text "Not assigned".

Click on the "Browse" button to open a dialog box in which you can select an OS from all those available in the current project.

The assignment will be immediately adopted by all objects inserted into the hierarchy container (images / reports, hierarchy containers).

You can Undo the assignment by selecting "Not assigned" from the combination field.

- Lower-level hierarchy containers

The conditions for the OS assignment are the same as those for the PLC assignment (see above).

Note

The PLC or OS assignment will only be passed on to the lower-level hierarchy containers. The assignment of existing CFC/ SFC charts or images/reports will not be changed.

3.4 CFC and SFC charts in the PH

Title row of the CFC and SFC

In the PH, you can open and edit leaf objects such as CFC and SFC charts by double-clicking. The title row shows the hierarchy path of the PH. This will also be displayed if the chart is opened in the standard hierarchy, i.e. if the chart has been assigned to a hierarchy container, this will determine the path name.

Marginal entry in the CFC

The hierarchy path (HID) of the PH is displayed in the margin of the CFC chart, before the chart name and block name.

SFC zoom configuration

In the SFC, the operands of actions and conditions that represent the parameters of objects (e.g. chart name, block name, block I/O) which have been allocated to the PH are also displayed with this hierarchy path.

This also applied to charts that were created and edited in the standard hierarchy and have subsequently been assigned to the PH.

Import-Export-Assistant

4

Overview

This chapter describes the structure of the user interface and basic principles for using the Import/Export Assistant.

In this Chapter

This chapter deals with the following topics:

Section	Topic	Page
4.1	General information on working with the IEA	4-2
4.1.1	Import / export combinations	4-4
4.1.2	The IEA user interface	4-6
4.2	Import	4-10
4.2.1	Configuring specimen solutions	4-11
4.2.2	Assigning the import data structure to the specimen solution	4-12
4.2.3	Carrying out the import process	4-13
4.3	Export	4-14
4.3.1	Select specimen solution	4-15
4.3.2	Structure and creation of the export file	4-12
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4.4	Edit	4-17
4.4.1	Selecting parameters and signals	4-18
4.4.2	Entering the parameter description	4-18
4.4.3	Entering the signal description	4-19
4.4.4	Saving your changes	4-20

Requirements

You need a basic knowledge of Windows 95 in order to understand this chapter.

4.1 General information on working with the IEA

Specimen solutions

In order to configure specimen solutions, you must first prepare the I/Os between the CFC blocks. This includes identifying the I/Os between blocks that are intended to supply parameter values or signals. This is done using the "Parameter I/O point" (IEA para) and "Signal I/O point" (IEA signal) attributes.

- Parameter I/O point
 - all non-interconnected block inputs that can be assigned parameters in the CFC but cannot be interconnected
 - all block outputs that can also be assigned parameters in the CFC
- Signal I/O point
 - all block inputs that can also be interconnected in the CFC, but cannot be interconnected with other block I/Os
 - all block outputs that can also be interconnected in the CFC

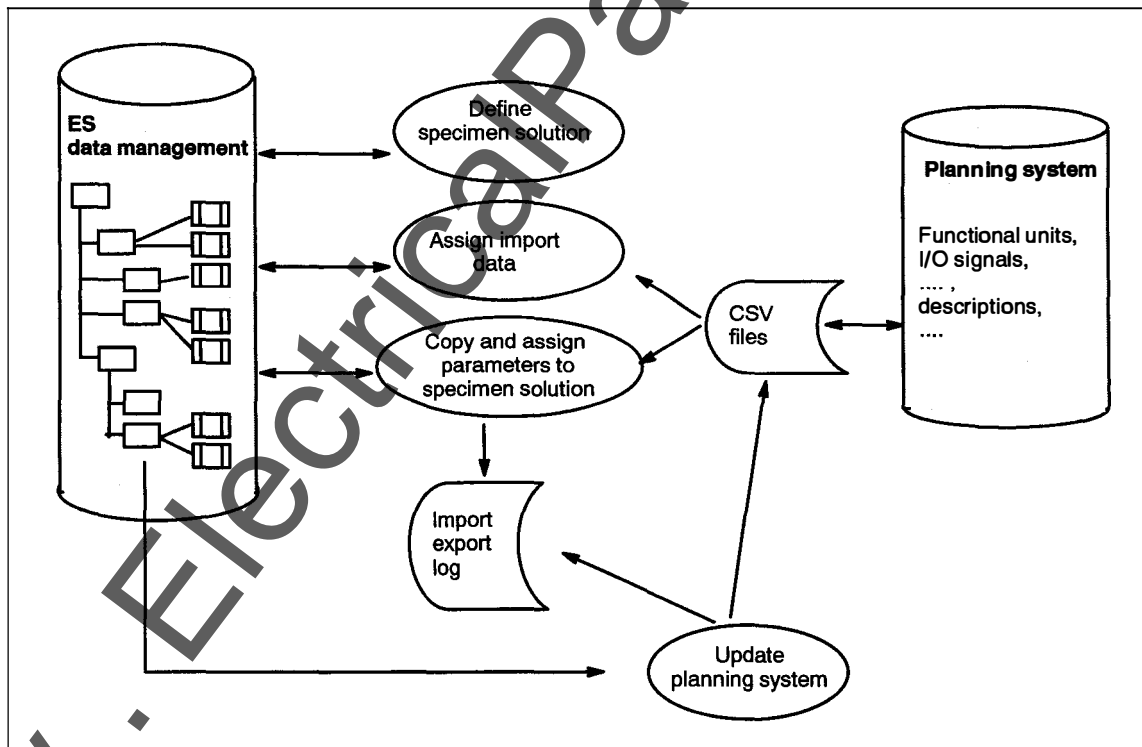


Figure 4-1 Exchange of data between the planning system and the engineering system

Functions of the IEA

The Import/Export Assistant (IEA) enables you to handle specimen solutions and their instances (PICS units). The following functions enable you to reuse and adapt specimen solutions:

- **Import**
First declare the parameter and signal I/O points or modify existing declarations. Then select the import file, assign the parameter and signal I/O points for the import data structures and start the import process.
- **Export**
Once you have reproduced specimen solutions by importing or copying and have edited the parameter values and signals, you can then export the current data in the same format as it was imported.
- **Edit**
This function is used to select from a table and edit the parameters and signals for all I/Os between all blocks of all CFC charts. This will enable you to assign other values, units and designations to the parameter I/O points. For the signal I/O points, you can enter new signal names, units and designations.

Please note:

You can also edit the parameter descriptions directly at the block I/O in the CFC chart ("Object Properties" dialog in the "I/Os" index) and, if the signals have been entered in the symbol table, you can also edit the signals in the table.

However, for larger quantities of parameters and signals, we recommend using the IEA and the "Edit" dialog.

The IEA para and IEA signal attributes are used for all three IEA functions (Import, Export, Edit). Thus, if you modify these attributes in one of the functions, then the modification will also affect the other two functions.

4.1.1 Import / export combinations

Possible conflicts

You can assign import/export files to the specimen solutions. This assignment is associated with the hierarchy container concerned. If you copy the hierarchy container, then the assignments will be copied as well. The following combinations may occur with this process:

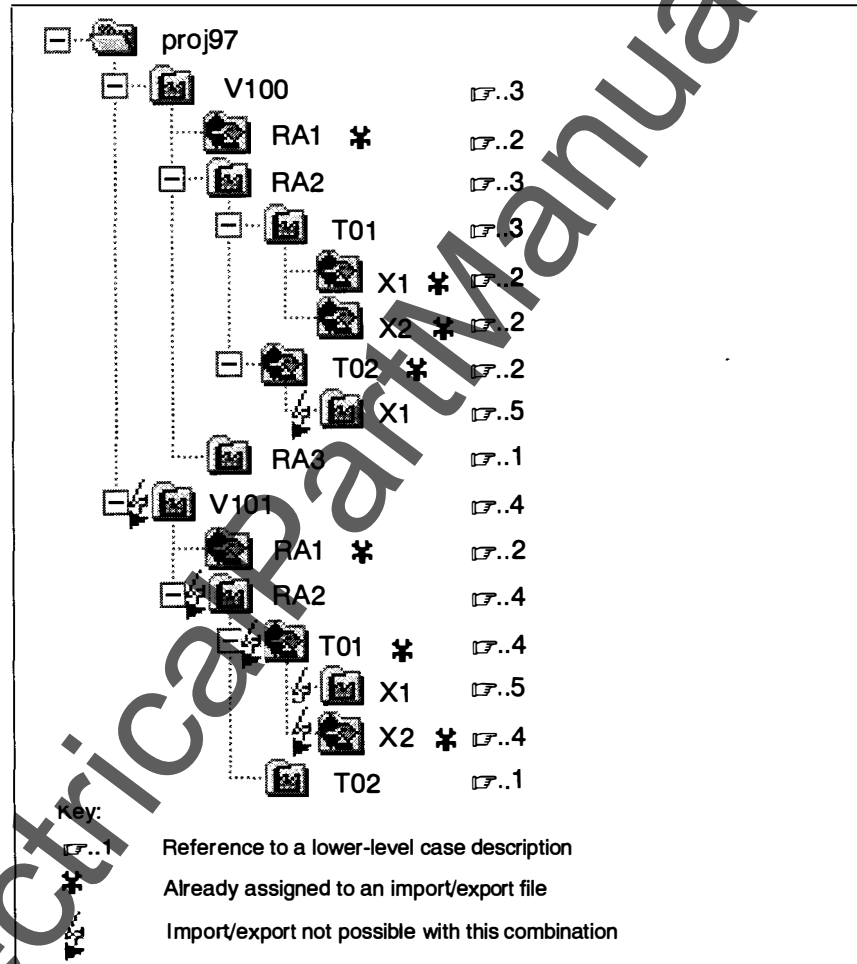


Figure 4-2 combinations

1. Neither the selected nor other hierarchy containers in the branch of the hierarchy are assigned to an import/export file.
You can assign attributes to the block I/Os as required (parameter I/O point or signal I/O point) and assign the structure of an import/export file without conflicts occurring.
2. The selected hierarchy container has been assigned to an import/export file, but no other hierarchy containers in that branch of the hierarchy have such assignments. If you change the attributes of the block I/Os, you must revise the previous assignment to the import/export file. No other conflicts will occur.

3. The selected hierarchy container has not been assigned to an import/export file, but at least one lower level hierarchy container has been assigned to an import/export file (in this situation, the possibility of case 4 is excluded).
Here, if you modify the attributes of the block I/Os (only possible in "Import/Export Assistant: Edit"), you may have to revise the assignment to the import/export files in several hierarchy containers. No other conflicts will occur.
4. At least two hierarchy containers in different hierarchical levels of the same branch of the hierarchy have been assigned to import/export files. In this case, an error message will be displayed, since it is not logical to carry out the import or export. You will either have to move the hierarchy container to another level or to another branch of the hierarchy or you will have to remove the assignment to import/export files.
5. The selected hierarchy container has not been assigned to an import/export file, but a higher-level hierarchy container in that branch has been assigned (in this case, the possibility of case 4 is excluded). In this case, if you modify the properties of the block, you will also have to revise the assignment to the import/export file in the higher level hierarchy container. Import / export is not possible with such a hierarchy container.
6. Specimen solutions have been defined in this branch of the selected hierarchy container and these specimen solutions contain more than one CFC chart per hierarchy container. Since the name of the CFC chart is not part of the HID, no more than one CFC chart may be assigned to each hierarchy container. If this were not the case, the parameter and signal I/O points could not be clearly determined.

Note

The properties of the block I/Os can be modified both in the CFC editor and using the IEA functions "Edit", "Import" and "Export". Given the possible conflicts described above, you must ensure that you do not accidentally modify properties of block I/Os that have already been assigned to an import/export file. In this case, the IEA will display a warning message. However, the CFC editor does not have all the information required to respond to a warning message.

4.1.2 The IEA user interface

Start IEA

The Import/Export Assistant is started from the plant hierarchy view with selected hierarchy containers.

From the "Options" menu, select the "Import/Export Assistant" function and, from the sub-menu, select one of the following dialogs:

- Import
- Export
- Edit

Classification

In all three dialogs, a dialog box with the same structure and appearance is opened. Each dialog is divided into other, different sub-dialogs which are carried out in the order specified by the Assistant. You can control the dialog using the buttons at the bottom of the dialog box.

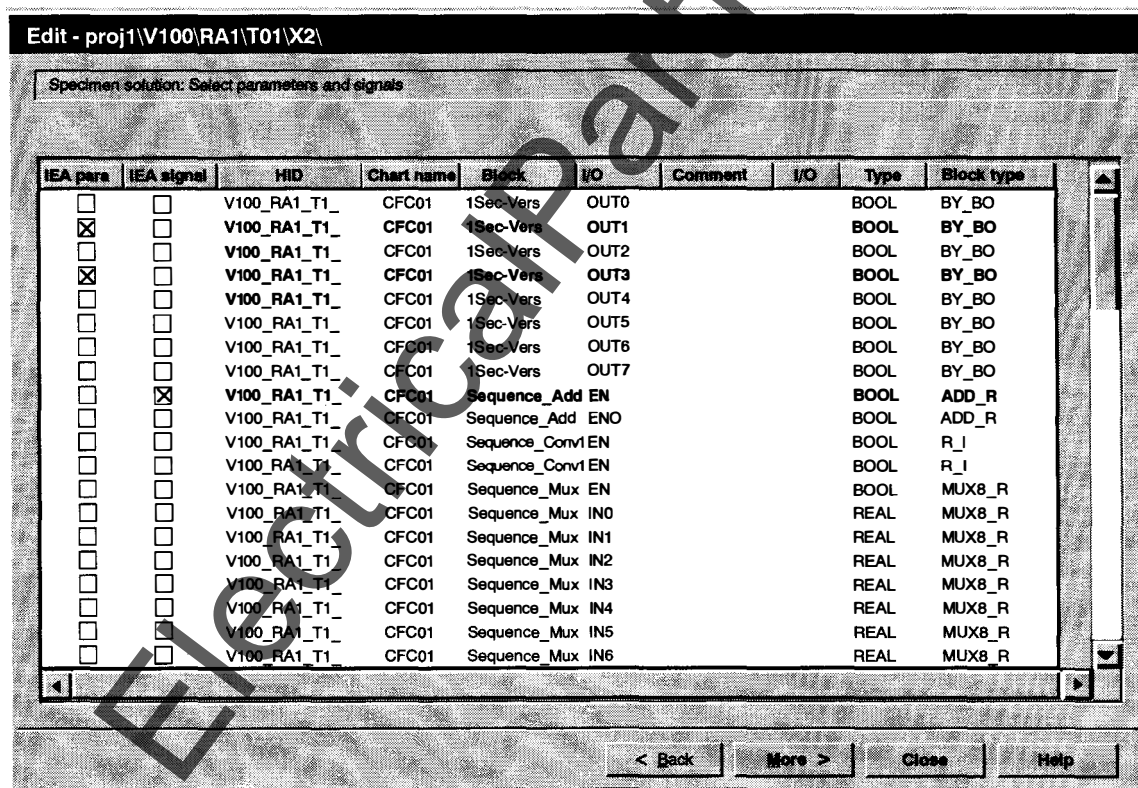


Figure 4-3 ♦ Dialog box with table for the specimen solution (example)

Table of block I/Os

The first dialog box contains a window divided into columns (table) listing all the block parameters. The columns can be resized as required by dragging the boundaries between the column headers with the mouse.

Significance of the columns

IEA para

IEA signal

Here you can see whether a block I/O is a parameter or a signal I/O point. Click on the attribute in order to change it.

HID

This column shows the higher level designation.

Chart

This contains the name of the CFC chart, whose block I/Os have been read in for the specimen solution.

Block

I/O

Comment

This column contains the name of the CFC block, the block I/O and any comment associated with the block I/O.

I/O

This column describes the type of block I/O:
IN = input, OUT = output, IN_OUT = inout.

Type

This shows the data type of the block I/O (e.g. BOOL). A list of data types is given in the Appendix A.1.

Block type

This column shows the type of the block from which the block I/O originates (e.g. BY_BO).

Table properties

Click on the right mouse button to call up a context menu within the table. The "Table Properties" function calls up a dialog box for modifying the table display, e.g. display horizontal / vertical boundaries, change colours, highlight current column, etc. The modified settings can be stored as the default.

The block I/O selected for the specimen solution is highlighted in colour in the table:

Parameter	blue
Signals	green

The colours are fixed and cannot be changed.

Editing in the table

In the first dialog box, you can only select or deselect the check boxes in the "IEA para" or "IEA signal" column. In the following sub-dialogs, you can only modify the entries with a white background. Text with a grey background cannot be modified in this dialog.

In fields in which only certain input is permitted, a combination box will be overlaid when you select (see Figure 4-5), e.g. only "0" or "1" can be entered for parameters of data type "Bool".

Go To ...

Double-click on a row of block I/Os to open the associated chart after confirming the prompt.

Start CFC and open chart for currently selected parameters? by clicking on "OK".

More / Back in the dialog

Click on the "More" or "Back" button to accept the settings and move to the next or previous sub-dialog.

Complete

After you click on the "Complete" button, a dialog box containing a log of the procedure appears in the last sub-dialog (in this case, in Figure 4-4: "Export").

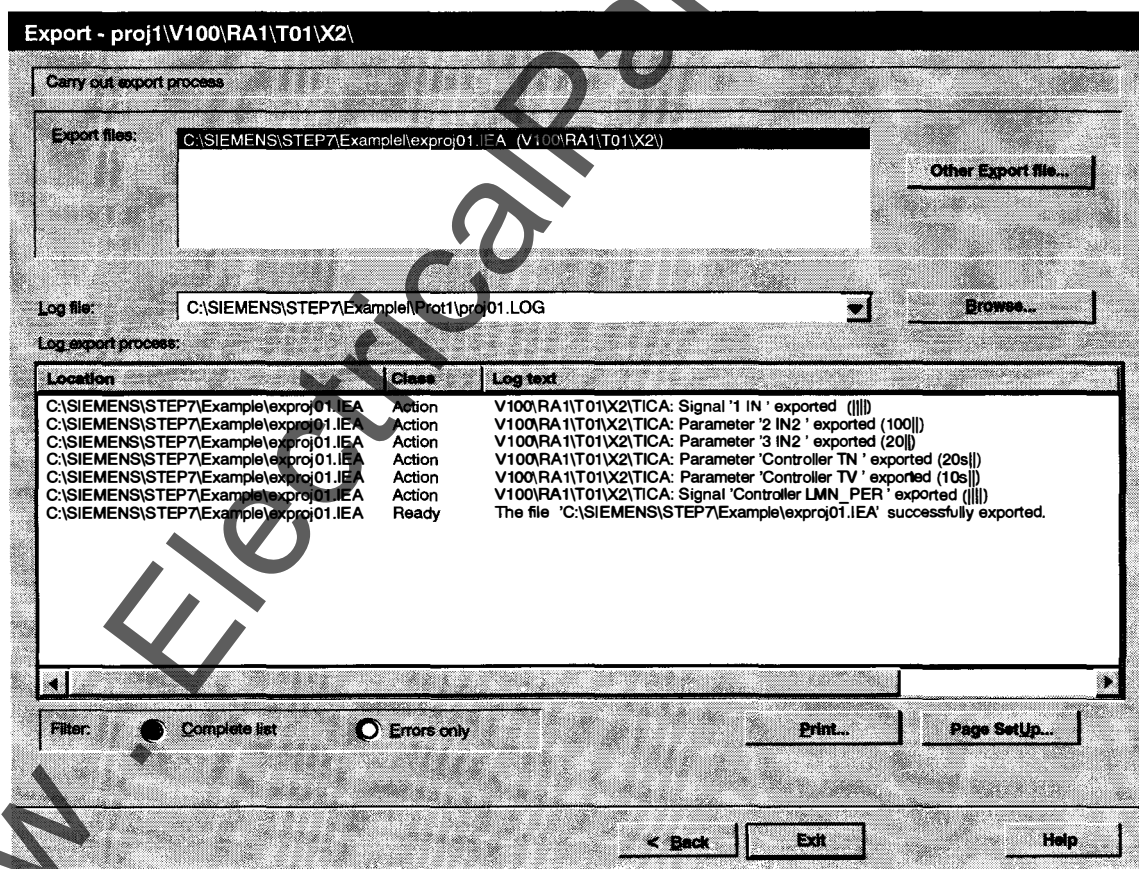


Figure 4-4 Dialog box after export is complete (example)

The log window is divided into three columns:

- **Location**
This shows which object is affected. The "location" is the HID.
- **Class**
This indicates whether it is an "Action" or an "Error".
- **Log text**
This indicates what the action does or the cause of the error.

4.2 Import

Plant planning data

A great deal of data is used during plant planning and some of this data occurs before a decision has been taken to opt for a specific control system. The import function enables this data to be used for control system engineering.

File format

The import data is available as files in CSV format. The CSV format is supported by many applications (Excel, Access, etc) and is based on ASCII. This makes it an excellent general data interface between any planning tool and the ES. The IEA expects these files to have the extension .IEA.

CSV file

The file is structured as a table and is made up as follows:

- the **columns** correspond to the various parameters and signals e.g. upper limit, lower limit, sensor, etc.
- each **row** corresponds to a PICS unit, e.g. pressure control in a boiler.

Functional units

A plant is generally structured by dividing it into smaller functional units which can be classified, e.g. fixed setpoint controls, motor control units.

Rather than recreating these functional units every time, you can create a stock of prepared functional units which then simply have to be copied and modified for the new system.

Specimen solutions

In the ES, there must be a suitable specimen solution for each functional unit used in the plant, e.g. a hierarchy container with a CFC chart containing the fixed setpoint control and a WinCC image for operating and monitoring the fixed setpoint control.

An IEA file is created for each different functional unit used in the plant.

Import data

The following data is imported:

- Higher level designation of the function (corresponds to the plant view)
- Parameter descriptions for the functional units used
- Signal descriptions for the signals used by the functional units

Procedure

To import:

- Link each different specimen solution to the associated IEA file
- Start the import process

Import dialog

The import dialog comprises the following steps that are displayed by the IEA as successive sub-dialogs:

- Specimen solution: Select parameters and signals
- Assign import data structure to the parameters and signals of the specimen solution
- Carry out the import process

4.2.1 Configuring specimen solutions

1. Sub-dialog

Once you have activated the import function in the first sub-dialog, the IEA reads in all the block I/Os of the specimen solution for the selected plant hierarchy container. A dialog box with the specimen solution table appears on screen (see Figure 4-3).

Note

If you modify the parameter or signal I/O points specified in the specimen solution, this will affect the assignment of the data structure of an import/export file (if one has already been assigned). If this occurs, a warning will appear on screen. If you click on "OK" to confirm, the assignment will be invalidated and will have to be recreated in the "Assign import data structure to specimen solution" sub-dialog. These changes will **not** affect specimen solutions that have already been copied or generated by importing.

Select parameters and signals

In the first sub-dialog you determine whether the block I/O concerned is to be used as a parameter or signal I/O point. Click on the check box in the "IEA para" or "IEA signal" column to select the block I/O. The IEA will not allow you to select both columns at the same time since a block I/O cannot be both a parameter and a signal I/O point. An "X" is set in the check box and the text in that row will be highlighted in colour ("blue" for parameter, "green" for signals).

4.2.2 Assigning an import data structure to the specimen solution

2. Sub-dialog

The second sub-dialog is used to assign the data of the import file to the specimen solution data. The dialog box contains a list of column headers for the parameters and signals in the import file. The assigned data appears in the list of specimen solution data under the "Parameter / Signal" heading.

The assignment ensures that, during the import process, the "right" data can be written to the "right" block I/Os.

Between the fields in the list, there are buttons which are used to assign the import data to the specimen solution data.

">" This is used to assign the selected column header to the selected I/O point.

"<" This is used to return the assigned column header for the selected I/O point to the "Import data" list and cancel the existing assignment.

"<<" This is used to return all assigned column headers from the "Specimen solution data" list to the "Import data" list and to cancel all existing assignments.

Alternatively, you can drag and drop the column header assignments.

For the import process, all the column headers must have been assigned and there must be no remaining I/O points that have not been assigned (complete 1:1 assignment).

4.2.3 Carrying out the import process

3. Sub-dialog

Click on "More >" to open the "Carry out import process" sub-dialog. A dialog box will be displayed containing the entry for the assigned import file and the selected log file.

Click on the "Enter signals in symbol list" check box to enter the signal descriptions into the symbol table for resources of the hierarchy container concerned as well. This will also assign the specimen solutions copied during the import process to suitable input and output signals.

Complete

Click on the "Complete" button to start the actual import process. Depending on how you have set the "Filter" check boxes, the log window will contain either the complete list or only any errors that have occurred.

This function may take a long time to execute, depending on the scope and complexity of the data to be imported.

Exit

Once the "Complete" function has been executed, the button changes to "Exit". Click on this button to leave the "Import dialog".

4.3 Export

Data for control system engineering

Specimen solutions are modified during control system engineering. This will also affect data programmed with other tools during the plant planning stage that was imported for the control system engineering stage. The following applications may arise:

- If you want to compare plant documentation with the currently programmed data, then you should export the current data for the specimen solutions created by importing, in the same format as was used to import.
- You can export the data for the plant configured with specimen solutions, re-edit this data using other tools (e.g. Excel or Access) and then import it again. This enables you to make changes in the project quickly and easily.

The following data is exported:

- Higher level designation of the function (corresponds to the plant view)
- Current parameter descriptions for the specimen solutions
- Current signal descriptions for the control system input/output signals and their links to the specimen solutions

Export dialog

The export dialog comprises the following steps which are displayed by the IEA as successive sub-dialogs:

- Select specimen solution for export
- Structure and create export file (edit column headers)
- Carry out export process

4.3.1 Select specimen solution

1. Sub-dialog

Once you have selected a hierarchy container and activated the export function, the IEA reads all the block I/Os of the specimen solution for the selected plant hierarchy container. A dialog box with the specimen solution table appears on screen (see Figure 4-3).

Note

If you modify the parameter or signal I/O points specified in the specimen solution, this will affect the assignment of the data structure of an import/export file (if one has already been assigned). If this occurs, a warning will appear on screen. If you click on "OK" to confirm, the assignment will be invalidated and will have to be recreated in the "Structure of export file" sub-dialog.

This recreated assignment will only affect the current specimen solution, and any other hierarchy containers created by importing will remain unchanged and, in this case, will not be exported.

Select parameters and signals

In the first sub-dialog you determine whether the block I/O concerned is to be used as a parameter or signal I/O point. Click on the check box in the "IEA para" or "IEA signal" column to select the block I/O. The IEA will not allow you to select both columns at the same time since a block I/O cannot be both a parameter and a signal I/O point. An "X" is set in the check box and the text in that row will be highlighted in colour ("blue" for parameter, "green" for signals).

4.3.2 Structure and creation of the export file

2. Sub-dialog

While the export file preview is being prepared, a dialog box appears on screen to indicate the time remaining. The operation can be cancelled, if necessary.

The "Structure of export file" dialog box will appear on screen. This dialog is used to change the column headers, although you must first have selected a specimen solution. If the file contains other copies of a specimen solution (several rows), the boxes for the column headers will be greyed out and cannot be changed.

A column and header is created for each parameter and signal I/O point.

Structure of the export file

The file is an ASCII text file in CSV format. The first row contains the column headers; the second row contains the information that tells the IEA how to interpret the columns.

H\	Hierarchy and separator for the hierarchical levels
P	Parameter description
S	Signal description
	Separator (e.g. between parameter value, designation and unit)

All the other rows contain data. One row is output for each HID of a specimen solution with the same assignment to the import/export file.

4.3.3 Exporting data

3. Sub-dialog

Click on "More >" to open the "Carry out export process" sub-dialog. A dialog box will be displayed containing entries for the assigned export file and the selected log file. Click on the "Other export file..." button to call the browser in order to select or create another file for export.

Complete

Click on the "Complete" button to start the actual export process. Depending on what you have set the "Filter" check boxes, the log window will contain either the complete list or only any errors that have occurred.

This function may take a long time to execute, depending on the scope and complexity of the data to be imported.

Exit

Once the "Complete" function has been executed, the button changes to "Exit". Click on this button to leave the "Export dialog".

4.4 Edit

Call dialog

The "Edit" dialog is used to put together your specimen solution. To do this, select, from the project, the container of the plant hierarchy containing the charts with block I/Os that you want to edit.

From the "Options" menu, select the "Import/Export Assistant" function and then select the "Edit" function from the submenu.

This will start the search process in the IEA and the first dialog box will contain all the block inputs that have not been interconnected and all the outputs from all the charts in list format. Figure 4-3 shows an example with the parameters already selected.

Sub-dialogs

The entire "Edit" dialog consists of four sub-dialogs that are called one after another ("More" button):

1. Select parameters and signals
2. Enter parameter description
3. Enter signal description
4. Save the changes

4.4.1 Selecting parameters and signals

1. Sub-dialog

The first sub-dialog is used to determine whether the block I/O concerned is to be used as a parameter or signal I/O point. Click on the check box in the "Parameter" or "Signal" column to select the block I/O. The IEA will not allow you to select both columns at the same time since a block I/O cannot be both a parameter and a signal I/O point. An "X" is set in the check box and the text in that row will be highlighted in colour ("blue" for parameter, "green" for signals).

Note

Since the properties IEA para and IEA signal are used by all three functions, if you change one of these properties, it will affect the assignment of the data structure of an import/export file. If this occurs, a warning will appear on screen. If you click on "OK" to confirm, the assignment will be invalidated and will have to be recreated in the "Structure of export file" sub-dialog.

This recreated assignment will only affect this specimen solution and any other hierarchy containers created by importing will remain unchanged and, in this case, will not be exported.

4.4.2 Entering the parameter description

2. Sub-dialog

The second sub-dialog is used to enter or modify the parameter values for the selected I/Os. The list also contains the selected signal I/O points, although they cannot be edited. Only the parameter I/O point columns with a white background can be edited.

- Value
- Unit/Text0
- Desig./Text1

Edit - proj1\V100\ra1\tp1\

Enter parameter description

Value	Unit/Text0	Desig.	I/O	Chart	Block	I/O	Comment	I/O	Type	Block type
0			V100/ra1	CFC01	1Sec_vers	OUT1		OUT	BOOL	BY_BO
I/O			V100/ra1	CFC01	1Sec-Vers	OUT3		OUT	BOOL	BY_BO
1			V100/ra1	CFC01	Sequ_Add	EN		IN	BOOL	ADD_R

Figure 4-5 Dialog box (section) with the table of selected parameters and signals

4.4.3 Entering the signal description

3. Sub-dialog

The third sub-dialog is used to enter or modify the signal names for the selected I/Os. The list also contains the selected parameter I/O points, although they cannot be edited. Only the signal I/O point columns with a white background can be edited.

- Signal name
- Unit/Text0
- Desig./Text1

Depending on the data type of the block I/O, "Unit/Text0" and "Desig./Text1" may have different meanings.

Table 4-1 Meaning of the columns according to the data type

Data Type	Unit/Text0	Desig./Text1
Bool	Text for value "0"	Text for value "1"
All others	Unit, e.g. kg	Designation, e.g. setpoint value

Note

If properties have been assigned to a block I/O point, you must enter at least one signal name.

4.4.4 Saving the changes

4. Sub-dialog

The fourth sub-dialog is used to save the parameter and signal descriptions you entered in the previous sub-dialogs and to make various settings, such as

- Enter signals in symbol table:
This check box is used to determine whether the signal descriptions should be entered at the signal I/O points of the CFC blocks only or in the symbol table as well.
- Log file:
The "Log file" field contains the path of the log file to which all operations, including any errors which occur, are written. If you have not yet created a log file or have specified one which you do not want to use, call the dialog for selecting or creating new files by clicking on the "Browse..." button.

Complete

Click on the "Complete" button to start the actual save process. Depending on how you have set the "Filter" check boxes, the log window will contain either the complete list or only any errors that have occurred.

Structure of the log window: see "Complete" in Section 4.3.3.

Exit

Once the "Complete" function has been executed, the button changes to "Exit". Click on this button to leave the "Edit dialog".

PLC and OS-independent configuration

5

Overview

This chapter describes the parts of engineering that are required for the overall configuration of a plant and provides an overview of the connections and interaction between the individual components, such as the PLC and OS, in the PCS 7 control system.

In this Chapter

This chapter deals with the following topics:

Section	Topic	Page
5.1	Configuring links between PLC and OS	5-2
5.1.1	Preparatory work in the S7 project	5-2
5.1.2	Special object properties	5-3
5.1.3	Transfer to the OS	5-4
5.1.4	Configuring the OS	5-4
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5.1.6	WinCC properties with the CFC editor	5-5
5.2	Message Planning	5-7
5.2.1	Create block-related message type	5-7
5.2.2	Create block-related message	5-8
5.3	Visualize SFC on OS	5-10
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5.4	Transfer configuration data	5-11
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5.6	Creating block types	5-14
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5.1 Configuring links between PLC – OS

Overview

The PLC – OS link configuration is used to create, even during PLC configuration, the data required on the WinCC OS for communication between the PLC and OS, and thus for operator communication and monitoring. This data is transferred to one or more destination OSs, where it is used by graphics objects or display driver blocks.

The data is saved as properties of the PLC objects, and is copied, moved and even deleted together with these objects. The assignments made for an FB, when it is inserted into a chart, will be inherited by the instance DBs, where they can be modified if necessary. You only have to enter the data once, even if you want to access the same PLC block from several OSs.

Installation requirements

To create one or more WinCC OSs within the same STEP 7 project, WinCC must be installed. For transfer purposes, you will also require the "PLC<-->OS Engineering 2" software package.

5.1.1 Preparatory work in the S7 project

Preparatory work on the OS

In order to be able to operator or monitor blocks, flags or I/O signals on the OS, you must carry out the following preparatory work during the configuration stage:

- in the S7 project, give unique names to the S7 programs
- at the FB, set the system properties for all OS-related block I/Os (see section 5.6.1):
 - S7_m_c
 - S7_shortcut and S7_unit for analog data types
 - S7_string_0 and S7_string_1 for binary data types
- Block with messaging characteristics:
 - S7_server for the server assignment
 - S7_a_type for the type of message / archive block
- Import the FB (implicitly or explicitly) into the CFC and generate CFC instances by inserting the FB into the chart
- If necessary, define OS-related symbols (flags, I/O signals)
- create one or more OSs in the S7 project

5.1.2 Special object properties

Determining the special object properties

Some of the special object properties of a PLC object are determined automatically from data that you have already entered at another point in the project. Other object properties are entered using a dialog (see sections 5.1.5 and 5.1.6.)

The automatically determined data includes the names and data types of block I/Os or symbols, the addresses of DBs and the offsets of block I/Os, plus the texts you have entered via system properties.

The name shown in the dialog is the same as the name created when the variables were transferred. It is composed of the following:

- S7_program_name_symbol
- S7_program_name_DB_no
- S7_program_name_symbol_name of the DB

- S7_program_name_CFC_chart_name_CFC_block_name
- Plant hierarchy_CFC_chart_name_CFC_block_name

Restrictions

The "underline" character in parts of names is not permitted since it is used as a separator in the path name.

The name may also not contain the following characters since WinCC works in on-line mode:

' \ + - * / and space

For special functions in WinCC, other restrictions should be noted (see WinCC documentation /301/ to /304/).

Note

Please note that name changes can also be caused implicitly, e.g. by changes to the assignment in the plant hierarchy.

5.1.3 Transfer to the OS

Before transfer

Since some of the data stored in the special object properties indicates the status of the S7 project, e.g. as it was at the time a block was instantiated, adjustment functions must be run before the transfer. Adjustment is not required if you have not made changes to names, addresses or texts in the system properties since the last transfer.

Transfer to the OS

Once you have completed all the preparatory work, you can then transfer the configuration data to the OS (see section 5.4). When you transfer to the destination OS, the variables required for communication between the PLC and OS are inserted into the stock of variables of WinCC. The names of these variable are the same as the names displayed in the special object properties dialog.

For a block, a structured DM variable is created, whereas symbols receive a simplified DM variable.

5.1.4 Configuring the OS

OS images

In parallel with and independently of the PLC configuration, you can also configure the images in the OS and insert graphics elements and display blocks. However, you cannot interconnect them with DM variables until these variables have been created by the transfer, since the interconnection dialog displays the available DM variables.

5.1.5 WinCC properties with SIMATIC Manager

Call dialog

The WinCC properties for FBs can be configured in STEP 7 with STL, LAD and FUP. Call the dialog via SIMATIC Manager. The procedure is described in detail in STEP 7 User Manual /231/. Block creation is also described in section 5.6.

Note

If the block was generated in the CFC, i.e it is a CFC generated object (generator designation *CFC/SFC* at the DB), you can only call the dialog via the CFC editor.

5.1.6 WinCC properties with the CFC editor

Call the OS dialog in the CFC

A CFC chart is opened. In the "Object Properties" dialog box which you select by double-clicking on the block concerned, in the bottom part of the "General" index, set the "Special Object Properties" field with the "Can be operated and monitored" check box and the buttons for "Operator Control and Monitoring..." and "Message...". If you click on "Operator Control and Monitoring...", you will obtain a new dialog box containing the "General" and "WinCC Properties" registers.

You can also reach the "Operating and Monitoring" dialog box by selecting a block using the "Special Object Properties" function in the "Edit" menu and then clicking on the "Operator Control and Monitoring..." function in the sub-menu.

In the "General" index, you will see, under "Name", the block names together with the full paths. If the chart has been assigned to the plant hierarchy, then enter the names of the hierarchy container, the chart and the block at this point. If you have not yet assigned a plant hierarchy, then specify the path of the standard hierarchy (component view).

The text in the "Comment" box is additional information on the block. You can edit this text.

The "Description" field displays information that has been generated by the system. You cannot change this text.

WinCC properties

The "WinCC properties" index contains a table with all the OS-related parameters. The order of the parameters corresponds to the order of the block I/Os, although only for the OS-related parameters.

Note on the terms "parameter" and "block I/O":

The same objects are given different names by different groups of users. The term **parameter** used in the OS dialog and in the "world of programming" for the block inputs and outputs is also known as a **block I/O** in the "control system world". In the message planning dialog, you will also see the designation **formal parameter**. In the terminology of the "world of blocks" there is also the generic term for inputs and outputs: **I/O terminal strip**.

If it is an OS property of a symbol, the table will have only one row, since symbols are not structured any further.

Table of WinCC properties

The table contains 12 columns and only part of this table can be displayed in the view window. You can move the visible pane using the horizontal scrollbar (or by moving the mouse pointer horizontally to the right or left, over the edge of the window). The "Parameter" column is always visible. If the table contains more parameters than can be displayed on a single page, a vertical scrollbar will be displayed as well.

Table 5-1 WinCC properties

Header	Content of the column (meaning)	Variable
Parameter	Name of the block I/Os or symbol names	No
PLC data type	Data type of the parameter	No
OS data type	Data type used by WinCC for displaying the parameter	No
Format adjustment	Operations used by WinCC to convert the PLC data type into an OS data type	Yes Enter via the combination box or edit using the keyboard.
Length	Length of the OS data type (in bytes)	No
UL	Upper limit for displays (e.g. bars) and measured values	Yes, if the OS data type is not a text type. Click in the selection box to activate and edit the value.
LL	Lower limit for displays (e.g. bars) and measured values	Yes, if the OS data type is not a text type. Click in the selection box to activate and edit the value.
Starting value	Default selection for the WinCC display	Yes, if the OS data type is not a text type. Click in the selection box to activate and edit the value.
Substitute value	Substitute value. This is used with certain events during operator communication and visualization; in conjunction with "Use substitute value if"	Yes, if the OS data type is not a text type. Click in the selection box to activate and edit the value.
Use substitute value if	<ul style="list-style-type: none"> >UL Upper limit reached <LL Lower limit reached Start as a starting value Error Connection error 	Yes, if the OS data type is not a text type. Click in the selection box to activate Condition: "Substitute value" must have been activated
Generate log entry if	<ul style="list-style-type: none"> UL Upper limit exceeded <LL Lower limit exceeded CONerror Conversion error SAppl Write access to an application Sprocess Write access to a process 	Yes, if the OS data type is not a text type. Click in the selection box to activate Condition if >UL / <LL: UL / LL column has been activated

5.2 Message planning

Blocks capable of signalling	Control system-related block can be made capable of signalling. To do this, the block must always have the OS property.
Create message instance	When a block with messaging characteristics is inserted into the CFC chart, the message server will automatically create a message instance. This block has a message structure with preset properties and message texts, i.e. when an event occurs, the corresponding message will be sent by the PLC without any further configuration. However, the properties and texts can also be edited to suit a specific block with the message planning facility.
Message planning	Message planning is used to create and edit event-independent messages and message types with assigned texts and properties. The message type is created for an FB (see 5.2.1). The messages configured for this message type are used as the template for any blocks instantiated by it. With the instance DB, you can modify the messages that were generated from the message type for specific instances.
Transfer	In connection with message planning, you transfer the generated data to the stock of variables of the OS (see section 5.4).

5.2.1 Create block-related message type

Block capable of signalling	The message type is created for an FB. Requirement: the FB must have been created as a block capable of signalling, i.e. the system properties "S7_server = alarm_archive" and "S7_a_type = <i>alarm block</i> " must have been assigned to the block I/Os concerned (<i>alarm block</i> = alarm_8, alarm_8p, notify, alarm, alarm_s, ar_send). See also section 5.6.2, System properties for a specimen block.
Create message type dialog	<p>Select the FB from the blocks container and call the message planning dialog (Edit -> Special Object Properties -> Message...). You will see that this is a message type because the detailed window for the formal parameters contains no message numbers.</p> <p>In the rest of the dialog, create a general message that can be output, as standard, to all display devices. (For a description of the configuration dialog, (see section 5.2.2)</p>

5.2.2 Create block-related message

Start configuration

To configure the message, double-click on the alarm block to open the "Object Properties" dialog box. In the bottom part of the "General" index, you will see the "Special Object Properties" box with the "Message..." button. Click on "Message..." to open a new dialog box (Figure 5-1).

Alternatively, you can also start the "Message..." function for the selected block with the "Special Object Properties" function from the "Edit" menu.

If the "Message..." button in the "General" card index or the "Message..." command in the menu is greyed out, the selected block is not a block with messaging characteristics.

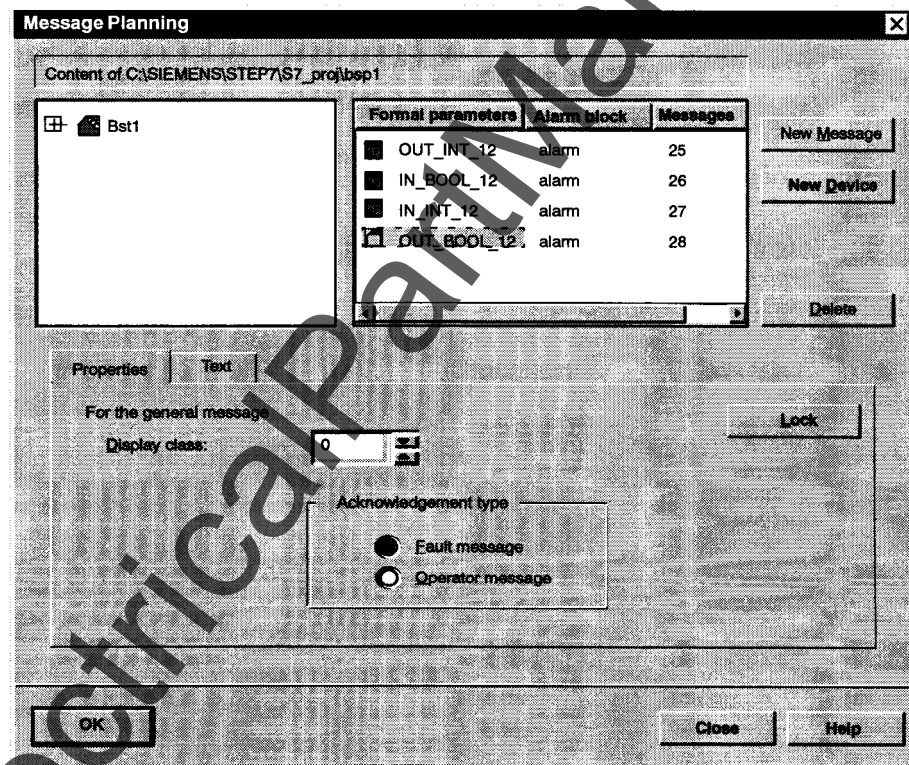


Figure 5-1 "Message planning" dialog box

Dialog for message planning

When a block has been selected from the directory structure (left-hand box), the detailed view (right-hand window) contains the following columns:

- Formal parameter
Name of the block I/O assigned to an alarm block.

- **Alarm block**
Type of alarm block. There are single channel (Alarm, Alarm_s, Notify) and multi-channel (Alarm_8, Alarm_8p) alarm blocks. The designation is the name of the alarm block that was assigned to the block I/O with system property "s7_a_type".
- **Message number**
Number for identifying the alarm or group of messages. The message number is automatically allocated for block-related messages (for DB). A message type (for FB) has no message number.

Configuring without assigning devices:

Select the block I/O to be edited by single clicking on its formal parameters. For single-channel alarm blocks, you can now enter the properties and the message text directly into the "For the general message" box. The properties are display classes 0 to 16 and the acknowledgement type "Fault message" or "Operator message".

For multi-channel blocks, you can enter the properties "For a group of messages" and, once you have opened the directory for this block I/O (click on the + box), you can enter properties and message text "For the general message within a group" for each of the sub-numbers (1 – 8).

Assign device

If you select a block I/O with a single-channel alarm block, then you can click on the "New Device" button to open a dialog box in which you can assign the display device (OP25, OP35, WinCC) and set the device properties. In the case of a block I/O with a multi-channel alarm block, you must first open the directory and then select the sub-number before you can assign a device.

Configuration for WinCC

The properties that can be set for WinCC are the

- **Message class**
(e.g. alarm, warning, tolerance, PLC control system alarm, etc)
- **Message type**
(e.g. fault, error, above, below, etc)
- **Type of acknowledgement**
(Single message, group message)

In the "Text" index, you can edit up to 10 message texts and, in the "Infotext" index, you can add a text as additional information.

Detailed description

A detailed description of the message planning procedure and a description of the objects and planning methods are given in the On-line Help on message planning.

5.3 Visualize SFC on OS

Transfer chart

In order to be able to operate and monitor SFC functions in on-line mode (run-time) from the OS, the necessary data must first be generated and transferred to the OS. See section 5.4.

5.3.1 SFC in the WinCC run-time system

You can visualize the imported SFC charts in the WinCC run-time system. You must have the optional "SFC visualization" package

Call SFC chart

The key set for the user interface has a dedicated key for calling the SFC chart. Press the "SFC" key to call a dialog box for selecting an SFC chart. Once you have selected and confirmed by clicking on "OK", a window will be displayed in the working area of the user interface. Depending on the settings in the Control Center, this will either be the "Overview window" with the entire chart in compact format or the Detail window which shows the chart in detail.

Overview window

The chart elements (steps) are displayed in minimum size and the transitions are not displayed. The size of the overview window is varied to suit the size of the chart. The active steps are identified by colours. The name of the first active step is output above the chart topology.

Detail window

Click with the mouse within the Overview window to open another detail window. This is the "detail window". This displays the (enlarged) area of the chart in which the mouse pointer was positioned. This shows all the chart elements in "normal size". However, you can change the size at any time (down to minimum size).

The detail window contains all the controls required to visualize steps and transitions and for issuing commands, switching modes and the options for using the chart.

More detailed documentation

A more detailed description of the visualization and operator input options can be found in the WinCC On-line Help and the WinCC User Manual for the run-time system /304/.

5.4 Transfer configuration data

Call transfer dialog Select the "Transfer configuration data" function from the SIMATIC Manager "Options" menu to open a dialog box and then select the desired OS the the project from the OS-CPU assignment.

When you select the OS, you can also specify the transfer mode in the dialog box (delta or complete) and set the transfer options (see Figure 5-2).

Comparison Before the transfer, you should compare the addresses, text and names.

Transfer The data will not be transferred to the OS unless you have checked the "Variables and messages" check box.

Click on "OK" to start the generation process, followed by the transfer to the selected OS.

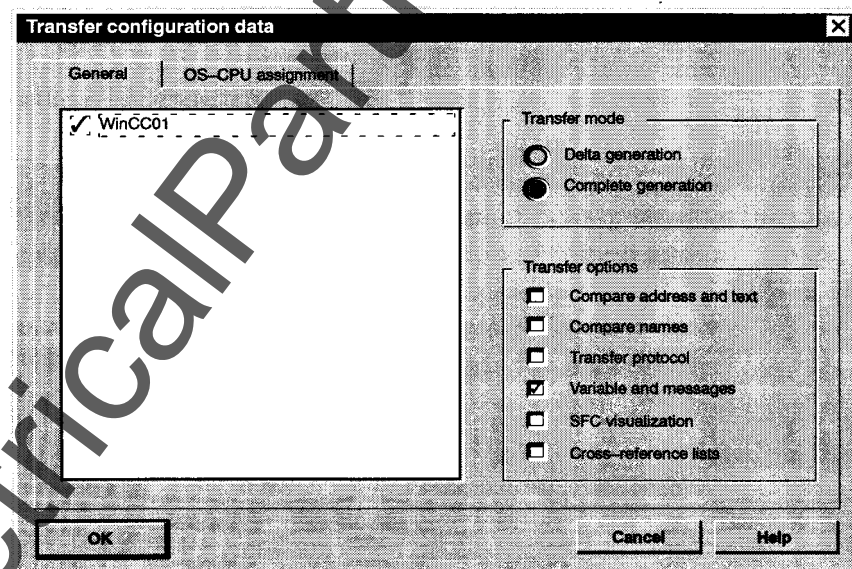


Figure 5-2 "Transfer configuration data" dialog box

This will transfer the configuration data to the stock of variables of the OS.

5.5 Block types for S7

Overview

The block types used in PCS7 can either be purchased in the form of block libraries or you can create them yourself. You can also supplement the existing stock of block types if necessary.

At this point, we particularly recommend using the basic blocks and the Reference Manual /258/, which also provides a detailed description of the block concept (Chapter 2).

You can also make use of the libraries of *technological blocks* and *field device blocks* and their documentation /259/, /260/.

Differentiating between block

We differentiate between

- block types
- freely programmed S7 blocks
- mapping objects

A block type in the context of the type/instance concept is a block whose program code accesses only its own interface and instance data. Direct access to peripheral signals and global data is not permitted. The block types can be instantiated as often as required.

Freely programmed S7 block can directly access peripheral signals and global data. The CFC editor does not prevent multiple instantiation – this is possible under the user's responsibility.

Mapping objects are blocks which occur during SCL code generation for the ES (they can be identified in the detailed view under "Editor: CFC/SFC").

Blocks generated in this way cannot logically be instantiated.

Driver blocks

Driver blocks are required for transferring process data between the I/O peripherals and the processor blocks. These driver block form the interface to the hardware and also perform a testing function.

During CFC planning, information such as subnet, rack and slot number, must be transferred to the driver block via the assigned module. This information can be take from the configuration table created during configuration with HWConfig. (You can call HWConfig and the table by double-clicking on the "Hardware" icon at the SIMATIC station.)

In the case of redundant modules, you must also carry out the parameter assignment for the redundant module.

For more detailed information on assigning parameters to driver blocks, see /258/, Chapter 5.

Transfer of the data

The block interface description (but not the block code) is transferred to the ES database. This involves the following information:

- Block type (FB, FC) and block number
- Block name (from the symbol table)
- Block comment (from the symbol table)
- Block family
- Description of the individual parameters
 - Address
 - Declaration (IN, OUT, etc.)
 - Name
 - Data type (BOOL, INT, etc.)
 - Start value
 - Comment
 - System properties

5.6 Creating block types

STEP 7 tools

S7 block types for the CFC can be created with the appropriate STEP 7 tools, e.g. STL, LAD, SCL editor.
See /232/, /233/, /250/ of the STEP 7 documentation.

Differentiating between FB / FC

When you create the block, you must specify whether you want to create an FB or an FC. Please note the following differences:

- Select FB if you want to use the block for operating and monitoring and if you require a block with a "memory", i.e. if the data is to be available and ready for access over several cycles. A DB is created for each instance.
It is possible to implement the FB with lower-level FBs (multi-instance). When it is instantiated, only an instance DB will be created.
- Select the FC if you want to use functions for which the block does not require a "memory", i.e. if values generated by the block are to be used immediately. This applies to all basic operations, such as AND, NAND, etc. An FC has no default values at the outputs. No instance DB is created.

Subsequent modification

When you create the block type, you should have taken account of what the block type is to record. Modifying block types that have already been used can be a very time-consuming operation.

Note

If block types that have already been used in the CFC are subsequently modified (e.g. in the S7 tool SKA), there will be inconsistencies with the CFC planning.

Inconsistencies can also occur if structural changes are made to Block Types that have already been used in the OS.

The block consists of the I/O terminal strips, the static data and the code for the algorithm. If you modify the block, this means:

- You can modify the algorithm for the block type at any time in the "Blocks" container.
- You can modify the static data, e.g. by adding additional data. However, you must then recompile the CFC chart to ensure that the new instance DBs are created.

- To modify the I/O terminal strips, proceed as follows:
 - Delete all instances of the type and the block type
 - modify the block type in the language in which it was created
 - import back to the CFC
 - reconfigure all the instances

Please note

When you create the block types, the **block name** (as displayed in the "object properties" dialog box) is of no relevance for the CFC since, as with the comment, it is taken from the symbol table. If there are no entries in the symbol table, then the name will be formed from the type and the number, e.g. *FB100*.

The keyword **FAMILY** and a string of characters (<= 8 characters) is used to designate the block family, e.g. *LOGIC*. This block family is the sort criterion in the CFC block catalog (tree view).

For **block I/Os** (block inputs / outputs also known as the block interface), the parameters IN, OUT and IN_OUT must be taken from the declaration table with the parameter name, data type, starting value and comment

Restrictions:

The types STRUCT, ARRAY and BLOCK_SDB may not be used for CFC blocks.

Properties

In addition to the existing block interface description, you can assign other properties to the blocks. These are defined as system properties and are used for FB, FC, SFB, SFC.

The properties can be accessed via the block properties. System properties are:

- Task list
This is used to specify in which tasks the block is to be automatically inserted by the CFC.
- Display type
We differentiate between two display types:
In the **large** display, the block with the parameter names for the inputs and outputs is mapped in the **small** display without parameter names.
- Properties for block I/Os, such as: visible / invisible, can be made dynamic, interconnected, assigned parameters and operated.
- Operating and Monitoring
For block types with usable inputs, you can specify the operating text, which can be individually modified for each instance.

Warning: If this parameter is modified, the instance should be deleted and recreated so that the equivalent structure is created on the OS. The operator message text is transferred to the OS, but is not loaded onto the PLC.
- Signalling
You can pre-specify default message texts for the block types. These can be modified for each instance. The message text is transferred to the OS, but is not loaded onto the PLC.

5.6.1 The system properties

General on the system properties

The number of system properties per block is unlimited.

When you edit the properties, ensure that the keyword:

- starts with the prefix "S7_"
- is written in lower case (key and value. The only exception is the prefix "S7_")
- always has a value. It is not sufficient simply to specify the key.

System properties for multiinstance blocks

When you create an FB with lower-level FBs (multiinstance), only the "parent" is of importance for the system properties, i.e. the system properties of the local instances ("children") are not analyzed and are thus not inherited by the instance DB.

Creating multiinstance blocks: see /250/.

User interface

The system properties are entered via the block properties. The "Properties" dialog box contains several indexes. The "Properties" index contains a table with two columns: the first for the keyword and the second for the value.

Testing the input

The entered properties are tested for correct syntax, length (key: 24 characters, value: 254 characters) and for uniqueness (a property may only be entered once per block I/O).

Default setting

Do not enter the system properties unless you want to modify or add to the default setting.

We shall now describe the system properties that can be used in the CFC.

S7_tasklist

Inset into several tasks

With this property, the CFC can identify whether a **block** is to be inserted into several tasks. The task list is taken from the property.

In S7, you should always use the OB no. as the task name since the symbol for the task can be modified as required. However, if no valid OB no. is found, the task name will be interpreted as the symbolic name.

For all other CFC PLCs (e.g. M7, SIMADYN D), the symbolic name is expected in the S7_tasklist, e.g. 'restart'.

Values:	S7_tasklist:='taskname1,taskname2,...'
Can be modified for each instance:	No
Default:	Block will not be inserted several times

Please note: The block will be inserted into the tasks contained in the task list if they were also present in the chart container at the time of import. Any tasks not present will not be included and no message will be issued.

If you work with the symbolic names for tasks then, during the import, the associated OB will be determined from the symbol name. The block will be inserted into this OB. If the name of the OB is subsequently modified, this will have no effect since it is the OB name at the time of import that is used.

S7_blockview

Displays the block

With this property, the CFC can identify whether a **block** is to be displayed in large or small format.

Values:	S7_blockview:='big' S7_blockview:='small'
Can be modified for each instance:	No
Default:	S7_blockview:='big'

S7_visible

Visible: Yes / No

With this property, the CFC can identify whether the **block I/O** is to be displayed or not.

Values:	S7_visible:='true' S7_visible:='false'
Can be modified for each instance:	Yes
Default:	S7_visible:='true'

S7_param

Can be assigned parameters: Yes / No

This property determines whether the **block I/O** can be assigned parameters in the CFC or not.

Values:	S7_param:= 'true' S7_param:= 'false'
Can be modified for each instance:	No
Default:	S7_param:= 'true'

S7_link

Can be linked: Yes / No

With this property, the CFC can identify whether the **block I/O** can be linked or not.

Values:	S7_link:= 'true' S7_link:= 'false'
Can be modified for each instance:	No
Default:	S7_link:= 'true'

S7_dynamic

Can be made dynamic: Yes / No

With this property, the CFC can identify whether the **block I/O** can be made dynamic during the testing/commissioning functions or not.

Values:	S7_dynamic:= 'true' S7_dynamic:= 'false'
Can be modified for each instance:	Yes
Default:	S7_dynamic:= 'false'

The following properties are used for preparing functions for operating and monitoring. The property values can be used by WinCC or by user-written display driver blocks.

S7_m_c

This property can be used both for the **block** and for the **block I/Os**.

S7_m_c
for
block

Block for operating and monitoring (OS): Yes / No
With the property for the **block**, you can specify whether its instances can be operated and monitored (default behaviour). The property "Operating and Monitoring" can subsequently be modified for the instances (requirement: the block must have at least one block I/O with the property *S7_m_c:=true*).

Values:	S7_m_c:='true' S7_m_c:='false'
Can be modified for each instance:	Yes
Default:	S7_m_c:='false'

S7_m_c
for
block I/O

Block I/O can be operated and monitored: Yes / No
With this property, the CFC identifies which **block I/Os** can be read from or written to the OS. Requirement: For the block I/O to be operated and monitored, the property for the block must be *S7_m_c:='true'*.

Values:	S7_m_c:='true' S7_m_c:='false'
Can be modified for each instance:	No
Default:	S7_m_c:='false'

S7_server

Message planning

With this property, the CFC identifies whether the **block I/O** is to be assigned to a message server. The message / archive number is signalled to the block I/O by the server.

Values:	S7_server:='alarm_archiv'
Can be modified for each instance:	No
Default:	No server call

S7_a_type

Type of message / archive block

Requirement: S7_server:=alarm_archiv

With this property, it is specified for the **block I/O** whether is is a message number input (message type ALARM, ALARM_8, ALARM_8P, ALARM_8S or NOTIFY) or an archive number input (AR_SEND). The message server will identify from this for which type of alarm block or archive block an action is to be initiated (e.g. Instantiate message, Allocate number).

Values:	S7_a_type:='alarm' S7_a_type:='alarm_8' S7_a_type:='alarm_8p' S7_a_type:='alarm_8s' S7_a_type:='notify' S7_a_type:='ar_send'
Can be modified for each instance:	No
Default:	—

S7_shortcut

Identifier for analog values

The 16-character designation for analog values is allocated to the **block I/O** and analysed in the display block and OS operator input listing.

Values: (Examples)	S7_shortcut:='Setpoint value' S7_shortcut:='Manipulated variable' etc.
Can be modified for each instance:	Yes
Default:	Empty string

S7_unit

Unit

Up to 16 characters of text can be specified in order to display the unit of process values in the display block. This text is assigned to the **block I/O** and is analysed in the display block and OS operator input listing.

Values: (Examples)	S7_unit:='Litre' S7_unit:='m' etc.
Can be modified for each instance:	Yes
Default:	Empty string

S7_string_0

Operating text 0 for binary values

Up to 16 characters of text are assigned to the **block I/O** and as the 1st operating text (e.g. for labelling the "OFF" key) in the display block and the OS operator input listing. In the CFC, the property is also used to display the statuses (in plain text).

Values: (Examples)	S7_string_0:='OFF' S7_string_0:='ON' etc.
Can be modified for each instance:	Yes
Default:	Empty string

S7_string_1

Operating text 1 for binary values

Up to 16 characters of text are assigned to the **block I/O** and as the 2nd operating text (e.g. for labelling the "CLOSE" key) in the display block and the OS operator input listing. In the CFC, the property is also used to display the statuses (in plain text).

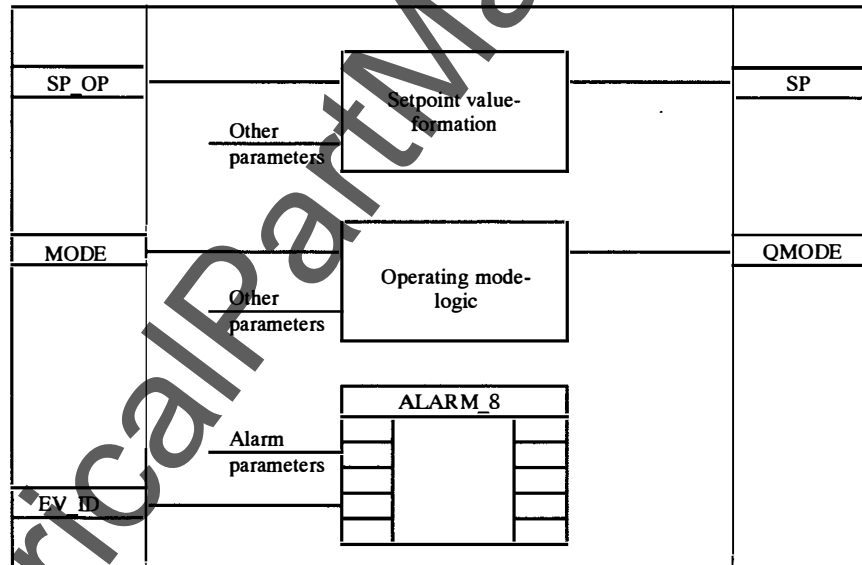
Values: (Examples)	S7_string_1:='ON' S7_string_1:='OF' etc.
Can be modified for each instance	Yes
Default:	Empty string

5.6.2 System properties for a specimen block

Task

To create a block that can be operated and monitored and can also send messages. The block for this example should contain:

- useable analog value (setpoint value SP_OP)
- useable binary value (for switching between operating modes MODE)
- monitorable analog value (effective setpoint value SP)
- monitorable binary value (effective operating mode QMODE)
- signalling behaviour with ALARM_8P (message number EV_ID)



System properties

We shall now describe, for this specimen block, which system properties are used for the *block* and the *block I/Os*.

Property for block

The following property is to be set for the block:

S7_m_c:='true'

In the CFC, each instance of this block type will be enabled for operating and monitoring. This object property can subsequently be deselected for specific instances.

**Properties for
block I/Os**

The following properties are to be set at the block I/Os:

1. Analog input *Setpoint value SP_OP*

S7_m_c:=true'

The input is now enabled for operating and monitoring.

S7_shortcut:=W=

S7_unit:=rpm'

This will create variables in the WinCC stock of variables with the text for the analog value abbreviation (W=) and for the unit (rpm).

2. Binary input *Switch between operating modes MODE*

S7_m_c:=true'

The input is now enabled for operating and monitoring.

S7_string_0:=Manual'

S7_string_1:=Automatic'

This will create variables in the WinCC stock of variables with the operating text for the operating modes (Manual, Automatic).

3. Analog output *Effective setpoint value SP*

S7_m_c:=true'

The output is now enabled for operating and monitoring.

S7_shortcut:=WW'

S7_unit:=rpm'

This will create variables in the WinCC stock of variables with the text for the analog value abbreviation (WW=) and for the unit (rpm).

4. Binary output *Effective operating mode QMODE*

S7_m_c:=true'

The output is now enabled for operating and monitoring.

S7_string_0:=Manual'

S7_string_1:=Automatic'

This will create variables in the WinCC stock of variables with the operating text for the operating modes (Manual, Automatic).

5. Input *EV_ID* for *Alarm_8P* block**S7_server:='alarm_archive'****S7_a_type:='alarm_8P'**

This will ensure that a message object can be created for the block and a message number will automatically be allocated when it is instantiated (assignment of the alarm in the OS). The default message texts for the block type will be configured at the message object. These can then be individually modified at each instance in the CFC.

S7_link:='false'**S7_param:='false'**

This will prevent the message number input being assigned parameters or linked in the CFC.

Please note: We recommend that you always enter the properties (S7_link:='false' and S7_param:='false') for EV_ID.

General notes

The message text available at the block type and the texts that can be assigned via properties (shortcut, unit, string_0, string_1) are default values which can be modified in the CFC for each instance. The corresponding dialog will be offered to the user if the block type can be operated/monitored and can send messages.

When transferred to WinCC, the operating and display texts are entered into all the foreign language columns in the text library, where they can be modified using WinCC tools.

In addition, several alarm blocks can be used in a block type. Consequently, each EV_ID parameter must be passed to the block's inputs and assigned properties. The message object will then automatically receive the same number of message texts.

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Documentation

Overview

This chapter describes how to generate and use lists to document your planning structure (reference data).

In this Chapter

This chapter deals with the following topics:

Section	Topic	Page
6.1	Introduction	6-2
6.2	Operation	6-3
6.3	Cross References	6-4
6.3.1	"Cross References for Addresses" list	6-5
6.3.2	"Cross References for CFC I/Os" list	6-6
6.3.3	"Cross References for Runtime Groups" list	6-6
6.3.4	"Cross References for SFCs" list	6-7
6.3.5	"Cross References for Block Types" list	6-7
6.3.6	"S7 Resource Assignment" list	6-8
6.4	Tree structure of the "Run Sequence"	6-9

6.1 Introduction

Overview

The "Reference data" function is used to display and print cross-reference lists, the S7 Resource Assignment list and the Run Sequence:

In this way, you can check your planning structure. For example, you can use the "Cross References of Addresses" list to check which memory markers are used how often and whether the write accesses are synchronized.

You do not have to close the window containing the reference data if you want to continue working in the CFC. This means that you can view the generated lists while you are working in the CFC.

Different versions

Once a list has been generated, it will not be updated by the system again. Each list provides information on the project status at the time the list was generated. This has the advantage that you can document the different versions of a project. You can open several lists with different versions in parallel.

Different projects

You can not only generate lists of the project you are currently working on in the CFC. You can also access all the other CFC projects. This will enable you to compare several projects. Lists for several projects can be opened in parallel.

Documentation

Together with the printed charts, with the reference data, you will also obtain complete documentation of your planning structure.

6.2 Operation

Calling and leaving the Editor

Call the "Reference data" application from the current chart:

Select "Options: Reference data" or click on the Reference data on the Toolbar.

This will open the "Reference data" application. The last list to be started will appear on screen (e.g. "Cross References for Addresses") for the current chart.

Handling windows

The "Window" menu contains various options for opening, arranging and closing windows. You can open several lists with different versions and for different projects in parallel. The window title will contain the logical path name for the chart container concerned.

Create list

When you call the application, the last list to be started will be generated and displayed. Select the menu "View" or the appropriate icon from the Toolbar to switch to the individual cross-reference lists, to the S7 Resource Assignment or to the Run Sequence. The list will be generated as soon as you switch over.

Set Column Width

In the lists, you can individually set the width of each column by positioning the mouse over the boundary between two column headers, holding down the mouse button and pulling the boundary to the left or right.

Search

Select "Edit: Search" to search for terms (strings of text) within the active window. The system will always search in every column. When a term is found, the position is displayed and highlighted.

Go to place of use

From the current list, you can double-click on the name in the first column or select "Edit: Go to Place of Use" to open the chart containing the place of use. The block or chart element concerned will be highlighted.

Print

The printing functions in the "Reference data" application are contained in the "Reference data" menu. They are used in the same way as the printing functions of the CFC editor. It is always the list in the active window which is printed.

6.3 Cross References

List of Cross References

The following lists of reference data can be displayed and printed:

- **Cross References for Addresses**
The list contains all the global addresses and their accesses used in the project.
- **Cross References for CFC I/Os (with SFC only)**
The list contains the accesses to the CFC block I/Os from any SFC charts.
- **Cross References for Runtime Groups**
The list contains the accesses for all runtime groups from any CFC and SFC charts.
- **Cross References for SFC (with SFC only)**
The list contains the available accesses from any SFC charts for all SFC charts.
- **Cross References for Block Types**
The list contains the block types used and the points (CFC chart) at which they are used.
- **S7 Resource Assignment**
The list contains the assignment between CFC planning objects and S7 resources.

Please note

The list of "Cross References for CFCs" contains no cross references from CFC to CFC, since this corresponds to the interconnections between CFC charts and can be seen from the CFC documentation.

Abbreviations in the lists

Table 6-1 shows the abbreviations used in the cross-reference lists and their meaning.

Table 6-1 Abbreviation for access types, actions and addresses

Abbreviation	Meaning
L	Access type: read
S	Access type: write
–	Access: real (in the "Virtual" column)
x	Access: virtual (in the "Virtual" column)
I	Action: Initialize
B	Action: Execute
E	Action: Terminate
L	Left-hand operand (of the assignment)
R	Right-hand operand (of the assignment)

6.3.1 "Cross References for Addresses" list

List structure

This is a list of the global addresses used in the project and their accesses. Figure 6-1 shows the Reference data window with the list of cross references. Table 6-2 lists the meaning of the individual columns.

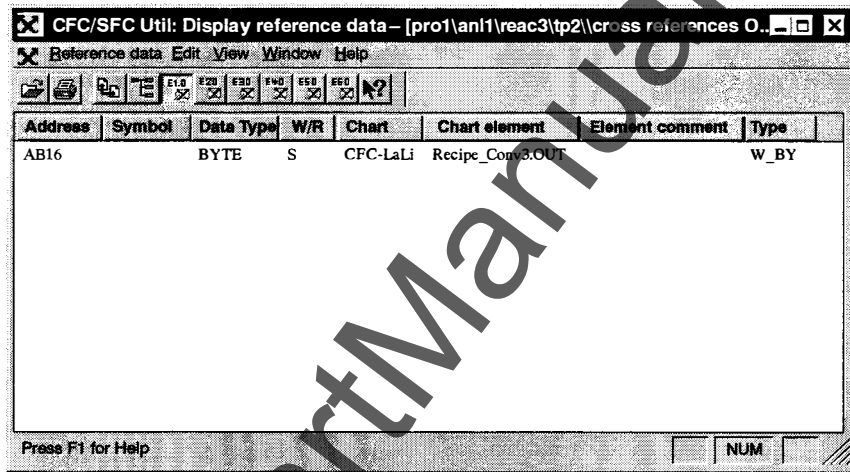


Figure 6-1 Reference Data: Address cross references

Table 6-2 "Cross References for Addresses" list

Column header	Meaning
Address	Absolute address of the operand
Symbol	Symbolic address of the operand (entry in the symbol table)
Data Type	Keyword for the data type used
R/W	Read (R) or write (S) access
Chart	Path and name of the chart from which the address is accessed
Chart element	Name of the linked block and I/O or SFC element, action and number of the assignment
Element comment	Comment on the block / SFC element
Type	Type of chart element (block type in CFC (e.g. "PID") or element type in the SFC (e.g. "Step"))

6.3.2 "Cross References for CFC I/Os" list

The list contains the accesses to block I/Os from any SFC charts (steps and transitions) for all CFC charts.

Table 6-3 "Cross References for CFC I/Os" list

Column header	Meaning
CFC	Path and name of the CFC chart which is accessed
I/O	Block and I/O name
Type	Block type (e.g. MUX8_R)
Virtual	x = SFC access to a CFC block which is not really present – = real access
R/W	Read (R) or write (S) access
SFC	Path and name of the SFC chart from which the address is accessed
Zoom element	Name of the linked SFC element, action and number of the assignment (e.g. step.B.005)
Type	Type of chart element (step or transition)

6.3.3 "Cross References for Runtime Groups" list

The list contains, for all runtime group, the accesses available (switching the runtime group on/off, status query) from any CFC charts (block I/Os) and SFC charts (steps and transitions).

Table 6-4 "Cross References for Runtime Groups" list

Column header	Meaning
Runtime group	Name of the group
Virtual	x = virtual access – = real access
R/W	Read (R) or write (S) access
Chart	Path and name of the CFC or SFC chart
Chart element	Name of the linked block and I/O or SFC element, action and number of the assignment
Element comment	Comment on the block / SFC element
Type	Type of chart element (block type in CFC (e.g. "PID") or element type in the SFC (e.g. "Step"))

6.3.4 "Cross References for SFC's" list

The list contains, for all SFC charts, the accesses available (switching the chart on/off, status query) from any SFC charts (steps and transitions).

Table 6-5 Cross references for SFC charts

Column header	Meaning
SFC	Path and name of the SFC chart which is accessed
Virtual	x = SFC access to a CFC block which is not yet really present (– = real access)
R/W	Read (R) or write (S) access
SFC	Path and name of the SFC chart from which the address is accessed
Zoom element	Name of the linked SFC element, action and number of the assignment (e.g. step.B.005)
Type	Type of chart element (step or transition)

6.3.5 "Cross References for Block Types" list

The list of block types shows where these block types are used. This can be useful for management of blocks if, for example, before you delete a block type which you think is unused, you can check the Cross Reference list to identify whether this block type is used or not.

Table 6-6 "Cross References for Block Types"

Column header	Meaning
Block type	Block type name (e.g. CTU)
Chart	Path and name of the CFC chart in which the block is used
Block	Name of the instance block (e.g. counter)
Block comment	Comment on the block (e.g. loop counter)
Virtual	x = SFC access to a CFC block which is not yet really present (– = real access)

6.3.6 "S7 Resource Assignment" list

The list contains the assignments between the configuration data and the S7 resources, sorted by ES configuration object.

Table 6-7 Cross References for S7 resources

Column header	Meaning
Configuration object	Path and name of the object (e.g. CFC/SFC chart, group, OB)
Element	Block name and block I/O (e.g. COUNTER.END) Step, action, assignment no. and address (e.g. START.B.002.R) Transition, condition no. and address (e.g. TIMER.01.R) Runtime groups enabled or disabled (e.g. EN or –)
Type	Type of chart element (block type, SFC, step, transition, runtime group, task)
S7 resource	Name of the DB (even with OFFSET), FC, OB (e.g. DB 27 OFFSET 3.5, DB 17, FC 9, OB 1)
Resource type	(e.g. instance DB, sequence DB, pool element, transition FC, action FC, task FC)

6.4 Tree structure of the "Run Sequence"

List structure

Figure 6-2 shows the run sequence of a CPU (tasks, runtime groups and blocks).

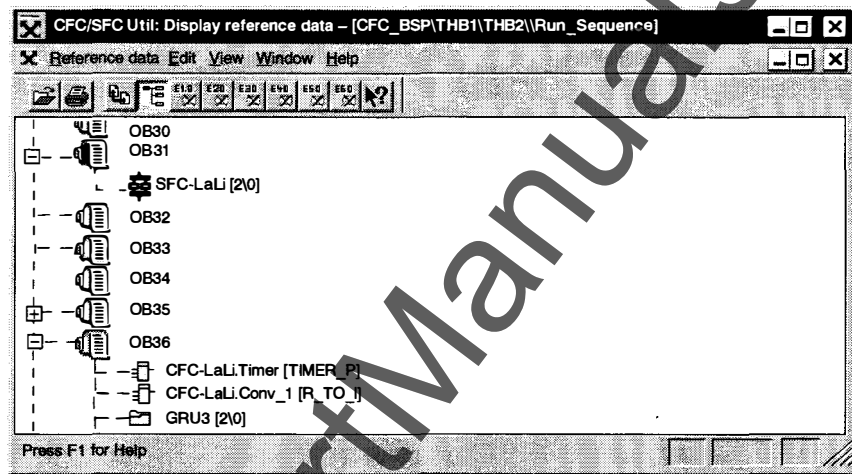






Figure 6-2 Reference Data: Sequence

The designation of the objects means:

-  OB33
Task name
-  SFC-LaLi [2\0]
SFC chart name [Scan rate \ Phase offset]
-  CFC-LaLi.Timer [TIMER_P]
Chart_name.Block_name [block type Name]
-  GRU3 [2\0]
Group_name [Scan rate \ Phase offset]

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Technical Data

In Appendix A

Appendix A deals with the following topics:

Section	Topic	Page
A.1	Data Types	A-2

A.1 Data Types

Table A-1 Data types for the SIMATIC S7 system

Abbr.	Keyword	Designation	Bits
A	ANY	Pointer to data element	80
BO	BOOL	Logical value	1
BY	BYTE	8-bit sequence	8
C	CHAR	Individual character	8
CR	COUNTER	Number of an S7 counter	16
D	DATE	Date	16
DB	BLOCK_DB	Number of a DB	16
DI	DINT	Double integer	32
DT	DATE_AND_TIME or DT	Date and time	64
DW	DWORD	32-bit sequence	32
FB	BLOCK_FB	Number of an FB	16
FC	BLOCK_FC	Number of an FC	16
I	INT	Integer	16
P	POINTER	Pointer to memory area	48
R	REAL	Floating-point number	32
S	STRING	ASCII string	254 bytes
SD	BLOCK_SDB	Number of an SDB	16
SN	STRING[n]	String of up to n characters, $1 \leq n \leq 253$	n bytes
T	TIME_OF_DAY or TOD	Time	32
TI	TIME	Duration	32
TR	TIMER	Number of an S7 timer	16
T5	S5TIME	Duration in S5 format	16
W	WORD	Sequence of 16 bits	16

List of abbreviations

C / C++	High-level language for programming computers
CFC	Continuous Function Chart
COM	Setup /Commissioning
CPU	Central Processing Unit
CS	Control System
CSV	Comma-Separated Values (file format)
DB	Data Block
ES	Engineering System
FB	Function Block
FC	Function Code (function block without memory)
IEA	Import/Export Assistant
LAD	Ladder Diagram

MS	Microsoft
OB	Organization Block
OP	Operator Panel
O&M	Operating and Monitoring (WinCC)
OS	Operator Station
PC	Personal Computer
PG	Programming device
PH	Plant hierarchy
PICS	Process Instrumentation and Control System
PLC	Programmable Logic Control / Automation System
SFB	System Function Block
SFC	Sequential Function Chart
SFC	System Function Call
SINEC	Siemens NEtwork ArChitecture
STEP 7	Software development environment for SIMATIC S7 / M7
STL	STatement List

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- /140/ Manual: *ET 200M Distributed I/O Device*
- /141/ Manual: *ET 200L Distributed I/O Device*
- /231/ User Manual: *Standard Software for S7 and M7, STEP 7*
- /232/ Manual: *Statement List (STL) for S7-300 and S7-400, Programming*
- /233/ Manual: *Ladder Logic (LAD) for S7-300 and S7-400, Programming*
- /234/ Programming Manual: *System Software for S7-300 and S7-400, Program Design*
- /235/ Reference Manual: *System Software for S7-300 and S7-400, System and Standard Functions*
- /236/ Manual: *Function Block Diagram (FBD) for S7-300 and S7-400, Programming*
- /250/ Manual: *Structured Control Language (SCL) for S7-300 and S7-400, Programming*
- /254/ Manual: *CFC Programming Continuous Function Charts*
- /255/ Manual: *Process Control System PCS 7, System Function Charts (SFC)*
- /256/ Manual: *Process Control System PCS 7, Engineering System (ES)*
- /257/ Manual: *Process Control System PCS 7, Batch flexible Automating Batch Processes*

- /258/** Reference Manual: *Library of Standard Blocks*
- /259/** Reference Manual: *Library of Technological Blocks*
- /260/** Reference Manual: *Library of Field Device Blocks*
- /261/** Manual: *Process Control System PCS 7,*
System Overview
- /501/** Manual: *SIMATIC NET,*
NCM S7 for PROFIBUS

Glossary

A

Access	Operands, charts, block I/Os and runtime groups can be accessed from chart elements or block I/Os. It is also important to differentiate between read and write access.
Action	(SFC) actions are used to activate or deactivate runtime groups and main SFCs and to modify blocks and global resources by assigning to their input parameters. The actions are formulated by means of formatted dialog in zoom-in mode.
Address	An address is the designation of a certain operand or range of operands. Examples include: Input I 12.1; flag word MW25; data block DB3. An address may be declared as absolute or symbolic.
Addressing, absolute	With absolute addressing, the operand contains the memory address of the value to be used by the operation. Example Address A 4.0 designates bit 0 in byte 4 of the process image output table (PIO).
Addressing, symbolic	With symbolic addressing, the operand to be used is given a symbol (rather than an address). The symbols and addresses are assigned to one another via the symbol table.
Alternative branch	(SFC) structure element consisting of at least two transition sequences, only one of which is executed by the PLC when its first transition condition is fulfilled.

Automation system

An automation system is a programmable logic controller (PLC) for a SIMATIC S7, a high-performance device (PLC with integrated operator panel) SIMATIC C7, or an automation computer SIMATIC M7.

Autorouter

(CFC) program segment for automatically creating connecting lines, connectors and marginal entries.

B

Basic element

(SFC) The basic elements of a chart are the "step" and the "transition". To guarantee identification, the name of each element must be unique within the chart.

Basic operation

Basic operations are objects which can exist at any time within the system and contain simple calculation functions such as AND, OR, etc.

Bit memory (M)

Memory area in the system memory of a SIMATIC S7 CPU. It allows both read and write access (by bits, bytes, words and double words). The bit memory address area can be used by the user to store interim results.

Block

Blocks are discrete segments of the user program delimited by their function, structure or application.
The CFC works with predefined block types which are positioned in (inserted into) control system flowcharts. When a block type is inserted, an instance of this block type is generated. These instances and their graphical representations are blocks for the purposes of CFC.

Block header

The top part of the block in the CFC display. It contains, for example, the names and task assignment (runtime properties).

Block input

A block I/O which can be linked to a block output and operands of the same data type or assigned values.

Block I/O

A block input or output

Block output	A block I/O which can be linked to block inputs and operands of the same data type.
Block type	Block types are predefined program sections which can be inserted into a CFC chart, generating instances in the process. Any number of instances can be created from a block type. For an S7 PLC, the block types are created with LAD, STL or SCL.
C	
CFC	Continuous Function Chart. A control system flowchart with graphically-linked plant-related functions (blocks).
CFC editor	A configuration tool enabling continuous processes to be described in a user-friendly manner. The editor is used to create control system flowcharts in which blocks can be assigned parameters and linked.
Chain	(SFC) A chain is a sequence of chart elements (a vertical path within the chart topology). A parallel or alternative branch consists for example of 2 to n parallel chains, each with 1 to n basic elements.
Chart	A special graphics unit created with the CFC or SFC configuration tool. A chart has an implicit type, but no interface. This means that it cannot be interconnected. A chart with <ul style="list-style-type: none">– graphically linked plant-related functions (CFC),– graphical display of a plant-related sequential control system (SFC)
Chart container	Container in the project structure, contains the charts of a user program.
Chart element	(SFC) Chart elements are divided into two groups: basic elements (step, transition, text) and structure elements (sequence, parallel branch, alternative branch, loop).
Chart topology	(SFC) In the chart topology, the chart elements are displayed in accordance with fixed syntax rules (e. g. distances between, spread and alignment of the elements). The syntax rules are observed automatically by the editor when the chart creates the chart topology.

Chart overview	The overview of a CFC chart with its six sheets.
Code block	<p>In SIMATIC S7, a code block is a block containing part of the STEP 7 user program. In contrast a data block only contains data. The following code blocks exist:</p> <ul style="list-style-type: none">• Organisation blocks (OB)• Function blocks (FB)• Functions (FC)• System function blocks (SFB)• System functions (SFC)
Code generation	Compilation of the graphical CFC to create an application program (SCL for S7 or C for M7).
Commissioning (COM)	Testing functions are incorporated CFC/SFC editor to support commissioning and to monitor, change and, if necessary, to adjust setpoint values as the programs run on the PLC.
Compilation	Creates an executable user program from a source.
Connector	(CFC) Point of connection on the block with a reference to the I/O to be linked. Connectors are used if no further connecting lines can be drawn on a sheet because it is too full. The connectors also enable complex CFC structures (covering more than one sheet) to be displayed in full.
Consistency check	Checks that the block types, shared operands, etc of the chart container are consistent.
Counter (C)	Counters are part of the system memory of the CPU. The contents of this counter can be changed by STEP 7 statements (for example count up, down).
Create mode	<p>(Alternative to test mode)</p> <p>Enables blocks to be inserted, deleted, renamed, assigned parameters or linked in the CFC.</p> <p>In SFC, it is used to create a sequential control system. Chart elements can be inserted, deleted, moved, renamed and assigned parameters in the zoom view.</p>

D

Data block (DB) Data blocks are data areas in the user program which contain user data. There are shared data blocks which can be accessed by all code blocks, and instance data blocks which are assigned to certain FB calls. In contrast to all other blocks, they do not contain statements.

Data type A data type defines how the value of a variable or constant can be used at a block I/O. For example, "BOOL" defines a binary variable and "INT" defines a 16-bit fixed-point variable.

Diagnostic buffer Backed-up memory area in the CPU in which all the diagnostic events are saved in their sequence of occurrence.

Display property (CFC) An attribute at the block I/O which determines whether the block I/O is displayed (visible) in the CFC or not. I/Os which have been linked are no longer visible.

DM variable Data manager variable in WinCC

Dynamization Dynamization means that input or initial values of a block from the CPU are updated in the CFC chart running in test mode.

E

Enable attribute The enable attribute is an execute property. It switches a runtime group on or off. As long as it is deactivated, the group is not executed, irrespective of all other conditions.
The enable attribute can be set dynamically. The initial value of a CFC block then determines whether the group is switched on or off.

F

Function (FC)

(FUNCTION) Functions are code blocks without a memory as defined in IEC 1131-3. A function offers the possibility of transferring parameters in the user program. Functions are therefore suitable for programming complex functions occurring repetitively, such as calculations. Important! Since a memory does not exist, the calculated values must be used immediately after the FC call.

Function block (FB)

(FUNCTION BLOCK) A function block is a code block with static data as defined in IEC 1131-3. A function block offers the possibility of transferring parameters in the user program. This makes function blocks suitable for programming complex functions recurring repetitively such as controls, mode selection. Since an FB has a memory (instance data block), its parameters (for example outputs) can be accessed at any time at any point in the user program.

G

Generic block

(CFC) A block, the number of inputs of which can be modified by parameter assignment.

Generic property

(CFC) A block with the generic property has a variable number of inputs, i. e. in the CFC, the user can increase the number of inputs or reduce it to the original number.

H

Higher level designation (HID)

Formed from the path of the plant hierarchy.

HOLD mode

HOLD mode is activated from RUN mode by a request from the programming device. Special test functions can be used in this operating mode.

I**Import/-Export Assistant (IEA)**

This is a software block in the ES for handling templates and their instances (PICS units)

Instance

A block type which has been selected and inserted into a chart becomes an instance. When it is inserted runtime properties are assigned to the instance and a name which is unique within the chart is assigned.

Interconnection

(CFC) Linking a block output or block input to another element. The value of the linked input will be fetched from the other end of the connection at runtime. The following interconnections are possible:

Block output	→	Block input
Block output	→	Shared operand
Block output	→	Runtime group
Shared operand	→	Block input

Interrupt stack

In the case of an alarm or error, the address of the interrupt location with the current display is entered by the CPU in the interrupt stack (I stack) of the system memory of the CPU.

L**Ladder Logic (LAD)**

Graphical representation of the automation task with symbols from the DIN 19239 circuit diagram.

Library

A container for reusable projects and objects.

Load-related change

A change to the CFC/SFC chart is load-related if it causes the CPU user program to change (e. g. interconnection changed). Non load-related changes concern, for example, block positions and comments in the CFC.

Local data

Local data is the data assigned to a code block and listed in its declaration section or its variable declaration.

Loop

(SFC) Structure element consisting of a sequence (S sequence) and a return branch enclosing the S sequence, and containing precisely one transition.

M

Margin (CFC) Box on the left and right edges of a sheet. The margins contain
a) references to linked objects (block, BOP, run-time group) not on the current sheet;
b) the number of the connector reference if the autorouter could draw the line right to the margin because the chart was too full.

Memory reset During a memory reset the following memories of the CPU are deleted:

- Working memory
- Read-/Write-area of the load memory
- System memory with the exception of the MPI parameters and the diagnostic buffer

Message class The message class determines the property of the message. SIMATIC PCS 7 has the following message classes: alarm, warning, tolerance, PLC and OS status message, process message, operator request and operator message.

Message planning Creating messages with their attributes and texts. Messages can be planned from the CFC/SFC.

MPI address In an MPI network, each programmed module must be assigned a separate MPI address.

Multi Point Interface (MPI) interface for connecting up to 32 devices (PC, PG, programmable controller, PLC).

O

Operating mode The SIMATIC S7 process logic controls have the following operating modes: STOP, STARTUP, RUN and HOLD.

Operating mode The mode selector of the central processor is used to set the following operating modes:

- RUN with the option of accessing the STEP 7 user program from the programming device, for example ("RUN-P").
- RUN with access protection ("RUN"),
- STOP and
- Memory reset ("MRES").

Operating system	Comprehensive term for all functions which, in conjunction with the hardware, control and monitor the execution of user programs, the allocation of system resources to individual user programs and maintenance of the operating mode (for example (the MS WINDOWS standard operating system, M7 RMOS32 real-time operating system).
On-line/off-line	In on-line mode a data connection exists between the programmable logic controller and the programming device, in off-line mode it does not.
Operand	An operand is part of an STEP 7 instruction and defines what the processor is to use to do something. It can be addressed in absolute form or symbolically. In the SFC, an operand is part of an assignment (step) or condition (transition).
Organization block (OB)	In an S7 organization blocks form the interface between the operating system of the CPU and the user program. The execution sequence of the user program is defined in the organization blocks. An organization block corresponds to a task.
Overflow page	(CFC) An overflow page is automatically created if so many marginal entries have been created that there is no space remaining. An overflow page consists only of the margins and contains no other objects.
P	
Parameter	A parameter is <ol style="list-style-type: none">1. a variable of an S7 code block (actual parameter, formal parameter)2. a variable for defining the behaviour of a module. Every module for which parameters can be assigned is delivered with a meaningful basic setting that can be changed using STEP 7.
Phase offset	The phase offset moves the point at which the runtime group or chart is activated, within a task, by a pre-defined value compared to the basic cycle. This ensures even load distribution within the CPU.
Plant hierarchy (TH)	A structure divided up hierarchically on the basis of the equipment contained in it.

PLC	The programmable logic controller or a component of it on which the user program runs. PLCs are for example the SIMATIC S7 and M7.
Process image	Reserved areas in the CPU RAM. The signal states of the input and output modules are stored in it.
Process variable	This is a resource-neutral object. It is used to link the PLC programming environment (STEP 7, CFC, etc.) to the OS programming environment (WinCC). It contains information on the location at which it exists at runtime (e. g. the network address in the PLC) and information on specific OS-related properties.
Processing phase	(SFC) A step is divided into three processing phases: Initialization, (cyclic) processing and termination. Each processing phase corresponds to an action with assignments.
Program	Generic term for S7 and M7 programs.
Programming device	Portable personal computer with a special robust and compact design. A programming device is equipped completely to program SIMATIC programmable logic controllers.
Project	A container for all the objects of an automation solution irrespective of the number of stations, modules and their networking.
R	
Reference data	Reference data are data which are available to the user in the form of lists in addition to the graphical data display, for example a list of the accesses to the shared addresses.
Resources	Resources are sets of objects (FB, FC, DB, OB, flags, counters, timers, etc) which can be accessed when configuring and assigning parameters to a CFC/SFC chart.
RUN mode	In RUN mode, the user program runs and the process image is cyclically updated. All the digital outputs are enabled.
Runtime attribute	Each runtime group has runtime attributes which control its activation. The group passes on these properties to all the blocks contained in it.

Runtime group	Runtime groups are used to structure and classify tasks. The blocks are installed sequentially in the runtime groups. Runtime groups can be activated and deactivated separately. When a runtime group is deactivated, all the blocks contained in it are deactivated as well.
Runtime properties	The runtime properties of a block defines how this block fits into the running order within the overall structure of the PLC. These properties determine the behaviour of the PLC with respect to response times, down times or the stability of time-critical systems, e. g. closed-loop control circuits.
S	
S7 program	A container for blocks, sources and charts for programmable S7 modules.
Scan rate	The scan rate is a runtime property. It determines whether a chart or a runtime group is to be processed whenever the task is passed through or only on the nth pass.
Scan time	The scan time is the time required by the CPU to execute the user program once.
SCL	A Pascal-like high-level language conforming to IEC 1131-3 for programming complex tasks in a PLC, e. g. algorithms, data processing system.
Sequence	(SFC) A structure element containing a series of steps (S) and transitions (T). There are four different types of sequences which are characterized by the first and last type of the chart element: S, T, ST and TS sequences
SFC	An SFC represents a sequential control system which is executed as an autonomous control system in the programmable logic controller.
Shared address	Shared addresses are objects which can be accessed by every code block (FC, FB, OB). Shared addresses are bit memories (M), inputs (I), outputs (Q), timers (T), counters (Z) and elements of data blocks (DBs). Shared addresses can be accessed either absolutely or symbolically.

Shared data block	<p>This is a block which can be accessed by all the blocks in the program. Every CFC block instance can read the shared data from such a block or write data to the block.</p> <p>Shared data blocks are created using the LAD or STL Editor.</p>
Sheet	<p>(CFC) Part of a chart. A workspace with margins on which the blocks can be positioned and linked.</p>
SIMATIC Manager	<p>Graphical user interface for SIMATIC users under Windows 95. The SIMATIC Manager is used for example to create projects and to access libraries.</p>
Source	<p>Segment of a program which is created with a graphical or text editor and from which the executable S7 user program is created by compiling.</p>
STARTUP	<p>Startup is an operating mode through which the CPU passes during the transition from STOP to RUN mode. STARTUP is triggered when the mode selector on the CPU is selected, after power-on or by operation on the programming device.</p>
STARTUP mode	<p>The CPU passes through startup mode when it switches from STOP mode to RUN mode. It can be triggered with the mode selector, by switching the power on from the programming device. On the S7-300, this means a cold restart. On the S7-400, it can be either a cold restart or a warm restart, depending on the position of the mode selector.</p>
Statement list (STL)	<p>The statement list is a low-level, text-based programming language. The representation form for STL is the STEP 5 and STEP 7 assembly language. When a program is programmed in STL, then the individual statements correspond to the steps with which the CPU runs the program.</p>
Step	<p>(SFC) A step consists of a basic element and the control instance for processing the actions assigned to it. Each step consists of three actions: Initialization, (cyclic) processing and termination.</p>

Step control	<p>(SFC) Operating mode with the following switching modes:</p> <ul style="list-style-type: none">• SWA (Stepping with acknowledgment) Sequential control is operator-controlled.• SCT (step control with transition) The sequential control system is controlled by the process.• SCTOC (step control with transition or confirmation) The sequential control system is controlled by the process or by the operator.• SCTAC (step control with transition and confirmation) The sequential control system is controlled by the process and by the operator.
Step group control (SGC)	<p>(SFC) Operating mode with switching mode "SGC". For steps without an SGC flag, the sequential group control is controlled by the process (as with SCT) and for steps with an SGC flag, it is controlled by the operator (as with SCTAC)</p>
Step types	<p>(SFC) The SFC supports different step types:</p> <ul style="list-style-type: none">• Starting step• Normal step• End step
Step zoom-in	<p>(SFC) See zoom in</p>
STOP mode	<p>STOP mode is initiated by:</p> <ul style="list-style-type: none">• switching the mode selector• an internal error on the central processing unit• operator input on the PC/programming device <p>The user program is not executed in STOP mode. All the modules are switched to a secure state. Certain programming functions such as operator communication, visualization and monitoring functions can also be used.</p>
Structure element	<p>(SFC) Structure elements consist of an arrangement of basic elements. The following are structure elements: "Sequence", "parallel branch", "alternative branch" and "loop".</p>

Symbol A symbol is a name defined by the user under observation of certain syntax rules. This name can be used for programming as well as for operating, visualization and control after you have defined its use (for example variable, data type, jump label, block).
Example Address: I 5.0, Data type: BOOL, Symbol: Emergency stop pushbutton.

Symbol table Table used to assign symbols (=name) to addresses for shared data and blocks.
Examples: Emergency stop (symbol),
I 1.7 (address),
Controller (symbol),
SFB 24 (block)

T

Task Tasks are the interface between the CPU's operating system, and the user program. The Order in which the user program is executed is defined in the task. A task corresponds to an OB (S7).

Test mode (Alternative to Create mode) CFC/SFC operating mode for testing and optimising the user program running online on the CPU.

Timer (C) Timers are part of the system memory of the CPU. The contents of these timers are updated by the operating system asynchronously to the user program. STEP 7 statements are used to define the exact function of the timer (for example on-delay and to trigger their execution (start).

Transition (SFC) A transition is a basic element containing the conditions under which a sequential control system is allowed to move on from one step to the following step.

Transition zoom-in (SFC) See zoom-in

U

Updating cycle In test mode, this defines the intervals at which the monitored block I/Os are updated.

User program The user program contains all the instructions, declarations and data required to process signals in order to control a plant or process. It is assigned to a programmable module (for example CPU, FM) and can be structured in smaller units.

V

Variable A variable defines a data item with variable contents which can be used in the STEP 7 user program. A variable consists of an address (for example M 3.1) and a data type (for example BOOL) and can be characterized by a symbol (for example BELT_ON).

W

Warm restart (S7) When a central processing unit starts up (for example when the mode selector has been switched from STOP to RUN or when the supply voltage is switched ON), cyclic program scanning (OB1) first executes either the organization block OB 100 (cold restart) or the organization block (OB101) (warm restart, only for S7-400). When the system is restarted, the process input image is uploaded and processing of the STEP 7 user program is continued from the point at which it ended at the last interruption (STOP, power off).

Z

Zoom (SFC) In the zoom display, the steps and transitions of the sequential control system still run (actions and conditions are created).

Zoom in (SFC) see: zoom-in view

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