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SIMATIC

Process Control System PCS 7

Getting Started

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Caution

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Preface

The Process Control System

With **PCS 7**, you have purchased a process control system with which you can automate, control, and monitor the running of a process.

Getting Started Manual and Project

Getting Started consists of a manual explaining the individual steps necessary to create the **COLOR_GS** project and the finished **COLOR_GS** project. You can run the project on an existing SIMATIC station. It may be necessary to adapt the project to your hardware components.

The "Process Control System PCS 7 – - Electronic Manuals" CD also includes this Getting Started manual. You can read and print this using the Acrobat Reader.

When you install PCS 7, the **COLOR_GS** project and this manual are copied to your programming device or PC. You can open the manual when required with "**Start > SIMATIC > S7 Manuals > PCS 7 Getting Started**". You can open the project in the SIMATIC Manager as follows:

1. Select the menu command "**File > Open**".
2. Click the "**Sample Projects**" tab.
3. Select the "**COLOR_GS**" project and click the "**OK**" button.

The **COLOR_GS** project also requires the **COLOR_GL** library containing the model charts. You can open the library as follows:

1. Select the menu command "**File > Open**".
2. Click the "**Libraries**" tab.
3. Select the "**COLOR_GL**" library and click the "**OK**" button.

The "PCS 7 Getting Started" and "PCS 7 Configuration Manual" manuals are on the PCS 7 installation CD in "Manuals\English\" as the pdf files "PCS 7 Getting Started.pdf" and "PCS 7 Configuration Manual.pdf".

This **Getting Started** manual shows you how to create a project and to monitor the process based on an example. Step-by-step, you will learn the procedure for creating a simple solution to the task in hand.

In the individual chapters, you will learn the following:

- Starting the SIMATIC Manager and Setting up a PCS 7 Project
- Inserting CFC Charts in the Project
- Using the Import/Export Assistant
- Inserting SFC Charts in the Project
- Creating Your Process Pictures in the Operator Station
- Transferring OS Configuration Data to the Operator Station
- Controlling and Monitoring your Process from an Operator Station

In the example, the process values are simulated.

In PCS 7 Getting Started, you will find the "COLOR_GS" project in a form that will allow you to create the project in approximately 8 hours.

Getting Started explains the menu commands you require to perform actions. You can also activate the majority of functions with the context-sensitive menu by clicking the right mouse button.

So that you can achieve your aims quickly, the configuration of the "COLOR_GS" project has been deliberately kept simple (a programmable controller and a combined engineering/operator station). For more detailed information on the procedures and points to note in projects with several programmable controllers and several operator stations, refer to the PCS 7 Configuration Manual. You will find the Configuration Manual on the "Process Control System PCS 7 – Electronic Manuals" CD or in "Start > SIMATIC > S7 Manuals" after installing PCS 7.

The Getting Started manual also contains references to videos.



Video

In the HTML online help of Getting Started, you can run a video sequence by clicking the "VIDEO" text that illustrates the procedures for the current stage in configuration.

Configuration Manual

This Getting Started project will allow you to take your first steps in working with the PCS 7 process control system. The topics are dealt with in greater depth in the Configuration Manual. In the **PCS 7 Configuration Manual**, the individual steps required during configuration are explained based on the "**COLOR_PH**" sample plant and you are shown how to structure the process control of a plant from a technological point of view in various phases. You are provided with an overview of the various views (component view and plant view), the individual phases of configuration ranging from structuring projects, creating models, creating an OS, configuring user data for the OS, and transferring the PLC/OS connection data. You can use the Configuration Manual as a reference work.

"SIMATIC PCS 7 Tips and Tricks" Manual

In addition to the Getting Started manual and the Configuration Manual, there is a further manual called "SIMATIC PCS 7 Tips and Tricks". This is a collection of the "Frequently Asked Questions" (FAQs) for PCS 7 taken from the Internet to form a manual. The FAQs provide you with detailed information on various topics gained with hands-on experience. You should also use this manual as a reference work.

Audience

This Getting Started manual is intended for personnel involved in configuring, commissioning, and service.

Basic experience of working with the PC/programming device and working with windows NT are assumed.

Validity

This Getting Started manual applies to the "PCS 7 Engineering Toolset V 5.2".

Guide to the Manual

Step by step you create the "COLOR_GS" example project with the appropriate hardware. You insert a plant hierarchy with "hierarchy folders" and CFC/SFC charts in the project. Using the Import/Export Assistant, you create a model that you can import into the project. You configure a process picture on the operator station in which you can place dynamic objects and transfer the OS configuration data from the engineering system to the OS.

The project contains a functioning sequential control system (SFC) to simulate a dosing operation. It is assumed that you have established communication between the SIMATIC station and the programming device/PC via the MPI interface. You can use a CP 5611, a CP 5412 or other MPI-compliant communications processor (CP) to handle this communication. You can make the necessary settings in the "Set PG/PC Interface" program (see online help) that is available in the Control Panel of Windows NT. Communication using Industrial Ethernet or PROFIBUS networks is, of course, also possible. For more detailed information about installing CPs and making the necessary parameter settings, refer to the PCS 7 Configuration Manual (included on the CD with the electronic manuals for PCS 7) or the online help.

Requirements for Starting the Supplied COLOR_GS Project

If you want to start the supplied COLOR_GS on your computer, you must first make certain settings.

- If you require a link between the ES and PLC, you must activate the required driver in the PG/PC interface (SIMATIC Manager: Options >Set PG/PC Interface). If you require a link via MPI or PROFIBUS, adapt the communication parameters in the PG/PC interface to the communication parameters of the MPI interface or CPU or, for PROFIBUS, to the CP 443-5 and change the driver to MPI or PROFIBUS. You can find the communication parameters in the hardware configuration in the object properties of the CP 443-5 (network settings). If you require a link via Industrial Ethernet, use a CP 1413 or CP 1613 on the PC and a CP 443-1 on the CPU. The settings for the communication parameters can once again be found in the PG/PC interface and in the hardware configuration.
- Transfer the PLC/OS connection data. If you have not already done so, set the transfer options (step 5):
 - Transfer tags
 - Transfer messages
 - Transfer SFC charts
 - "All" with "Clear operator station(s)"
- After you have started the WinCC explorer, you must enter the current computer name in "**Computer > Properties**" in the WinCC Explorer. You will find the current computer name in "**Start > Settings > Control Panel > Network**".

Hardware Components Required for PCS 7:

- Combined ES/OS station (PG or PC)
- PLC consisting of the following:
 - Rack UR2
 - PS 407 10A
 - CPU 416-2, CPU 416-3 or CPU 417-4
- Memory card with at least 1 Mbyte of RAM
- MPI cable

To work through the example, you require a programming device/PC that meets the following requirements:

- At least a Pentium II; ≥ 333 MHz
- ≥ 128 Mbytes of main memory
- > 2 Gbytes of free hard disk space

Note:

This example has been configured with the hardware for "PCS 7" listed above. If you use a different configuration, you must adapt the example to your equipment.

Software Components

To be able to work with Getting Started, you must have the "PLC Engineering" and "OS Engineering" packages installed on your PC:

The packages listed above are on the "PCS 7 Toolset" CD. If you have questions relating to the installation of the PCS 7 Toolset, please read the readme file on the installation CD or contact customer support (see below).

Conventions

All the documentation referred to in this Getting Started can be found on the "Electronic Manuals Process Control System PCS 7" CD.

Further Support

If you have questions about the use of the products described in the manual, and you cannot find the answers here, please contact your Siemens representative in your local Siemens office.

<http://www.ad.siemens.de/partner>

Training Center

To familiarize you with the Process Control System PCS 7, we offer a range of courses. Please contact your regional training center or the main training center in D 90327 Nuremberg.

Phone:: +49 (911) 895-3200..

<http://www.sitrain.com>

SIMATIC Documentation on the Internet / Siemens Intranet

- You can obtain documentation free of charge on the Internet at:

<http://www.ad.siemens.de/support>

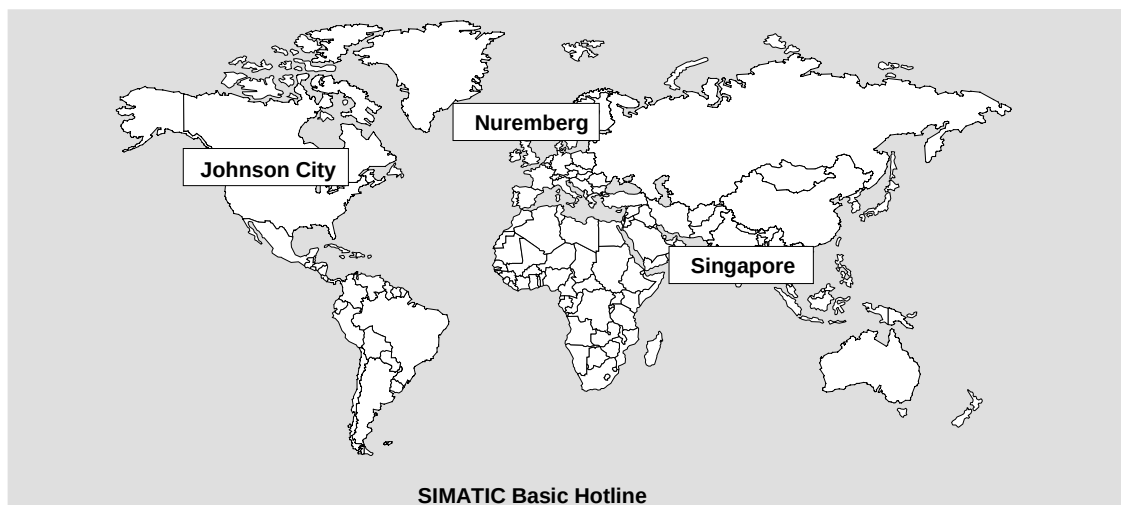
Use the Knowledge Manager to find the documentation you require quickly. If you have questions or suggestions relating to the documentation, a "Documentation" conference is available in the Internet forum.

- Look us up in the Siemens Intranet on the home page of SIMATIC Documentation. Here, you can get information on new products and developments, ask questions about the documentation, and let us know about your personal wishes, suggestions, criticisms or even perhaps a word of praise.

http://intra1.khe.siemens.de/e8_doku/index.htm

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English and German are spoken on all hotlines. On the authorization hotline, French, Italian and Spanish are also spoken.		

Service & Support on the Internet

In addition to our documentation services, you can also make use of all our knowledge on the Internet.

<http://www.ad.siemens.de/support>

Here, you will find:

- Current product information (product news), FAQs (Frequently Asked Questions), Downloads, Tips and Tricks.
- The Newsletter keeps you constantly up to date with the latest information on the products you use.
- The Knowledge Manager will find the documents you need.
- In the Forum, users and specialists exchange information and experience.
- You can find your local contact for Automation & Drives in our contacts database.
- Information on local service, repair, spares and much more is available to you under the rubric "Service".

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1 Introduction

1.1 Description of the Complete Process

General

In this Getting Started project, you will create the raw material tank of a new automated plant for manufacturing paint ("COLOR_GS" project). To help you understand the layout of the entire plant, the individual phases of the process are explained briefly below. If you are not interested in the technological background of the COLOR_GS plant, you can skip to Chapter 1 immediately.

Raw Materials (this unit of the plant is configured in Getting Started)

The liquid raw materials required for the product are stored in two tanks and are pumped from these tanks to the reactors. The solid raw materials are stored in three silos. Three feed screws leading from the silos transport the solid raw materials to a weighing hopper where they are weighed. Once the correct mixture has been obtained, a further feed screw and a blower transport the raw materials to one of the two mixing containers.

Production

The required quantities of liquid material are fed to either reactor 1 or reactor 2 via valves. The solid materials from the mixing containers are transported to the reactors by feed screws and mixed by an agitator. The product is produced in the reactors by agitating, heating and cooling the raw materials along with the additives. The temperature in the reactors is controlled by valves and actuators. When necessary, water can be let in to the reactors flow-controlled from a filtering unit.

Holding Phase

The finished product is then pumped to a holding tank. Here, it is stirred slowly and kept at a constant temperature.

Filling

Following the holding phase, the product is briefly stored in a filling tank from which it can then be filled into tankers or small drums.

Cleaning

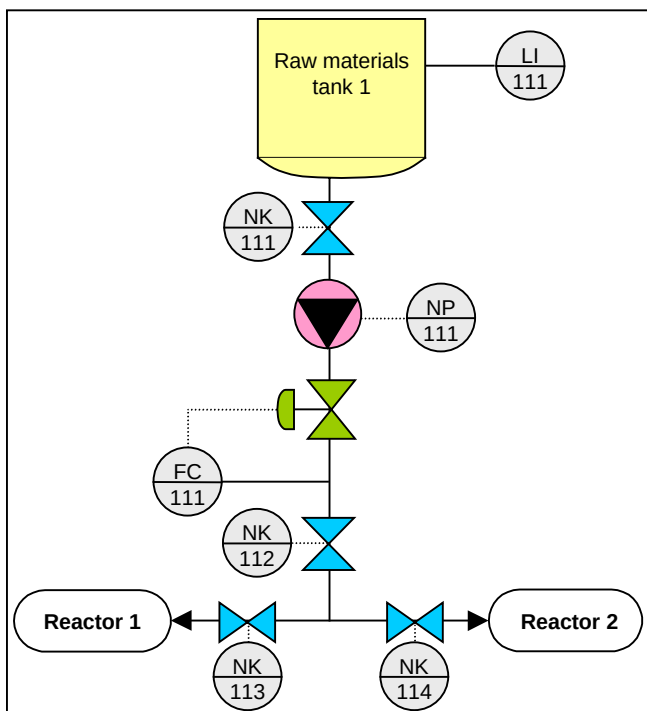
The reactors, piping, valves, actuators, holding tank, and filling tank can then be cleaned by a cleaning system (CIP). The resulting effluent is then collected in a separate effluent tank for disposal.

1.2 The Aim of the Project

Overview

In the course of this Getting Started project, you will configure the tanks along with the relevant actuators and sensors for the liquid raw material store.

Piping and Instrumentation Flow Diagram



Description

The operator is informed of the current level of the raw material tank from the measuring point (tag) LI 111 (LI = level indicate). NK 111 and NK 112 are stop valves that must always be open when dosing raw materials (NK = identifier for valves that can be freely selected by the customer). The NP 111 pump transports the raw material depending on the state of valve NK 113 or NK 114 (only one can ever be open at any one time) to reactor 1 or reactor 2 (NP = identifier for motors freely selected by the customer).

The amount of raw material transported is regulated by the dosing FC 111 using the corresponding actuator (FC = flow control).

The operator has a display of the current statuses of valves NK 111 to NK 114 and pump NP111. The operator can also intervene in the dosing FC 111 from the OS.

1.3 Structure of the Hardware

Note:

It is not absolutely necessary to have the hardware available before creating your project. You can also start by creating your project as described from **1. Creating the Project** onwards.

Wherever hardware is necessary, you will be informed in the text.

Components of the Control System

Below, you can see the structure of the hardware and how the components interact. To implement the example, the following components are used:

- A programmable logic controller (PLC).
The PLC consists of a rack (mounting backplane that handles the connections between the inserted modules), a power supply unit, and a CPU with a memory card inserted.

The program that handles the control of the "COLOR_GS" plant is created in the Engineering System (ES). The SIMATIC Manager provides access to the ES. You create a project that also contains an OS. The CPU processes the loaded program and returns process values to you. The program consists of a basic automation solution created with CFC and the sequential control system created with SFC. To be able to download the program from your PC to the CPU, a connection is established to the CPU via an MPI interface. The connection is established using a cable from the MPI port to the PLC. In the Getting Started project, the MPI interface was selected since this is already available on the CPU and integrated on a PG. You can, of course, select another suitable connection between the ES and PLC via PROFIBUS or Industrial Ethernet (Fast Ethernet).

Caution:

The MPI attachment is used only for test purposes in the laboratory. In normal process operation, PROFIBUS (only up to 9 nodes due to performance restrictions) or Industrial Ethernet (Fast Ethernet) is used.

- An operator station (OS).
The OS is started by opening the OS object. It is displayed on the PC and is used to control and monitor the active process. The connection from the PLC to the OS is via the MPI interface located on both the PC and the CPU.

On the operator station, you will see the plant graphics you have created.

Installing a Communications Module

You require a communication module installed on your ES/OS to be able to communicate over Industrial Ethernet (Fast Ethernet), PROFIBUS or MPI. If you use a PG or a pre-assembled PCS 7 station (ES or OS), this communications module is already installed. If you use a PC and have installed the PCS 7 software yourself, you must also install the communications module in the "Set PG/PC Interface" program. Follow the steps outlined below:

1. Open the "Set PG/PC Interface" program (**Start in the Windows NT taskbar > Settings > Control Panel > Set PG/PC Interface**).
2. In "**Interfaces**" click the "**Select**" button.
3. In the "Installing/Uninstalling Interfaces" dialog, select the required communications module (for example CP 5412 A2) in the left window "**Selection**" and click the "**Install**" button.
4. Enter the required module parameters (for example with the CP 5412 A2, the required memory area, the I/O area and the interrupt).

The module is now installed.

5. Close the "Installing/Uninstalling Interfaces" dialog.

With some modules, you must also specify the interface parameter assignment. The CP 5412 A2 can, for example, communicate both on MPI as well as on PROFIBUS. For the "COLOR_GS" project, you could select the "CP5412A2(MPI)" and establish communication between the PLC and ES/OS via an MPI cable.

2 Creating the Project

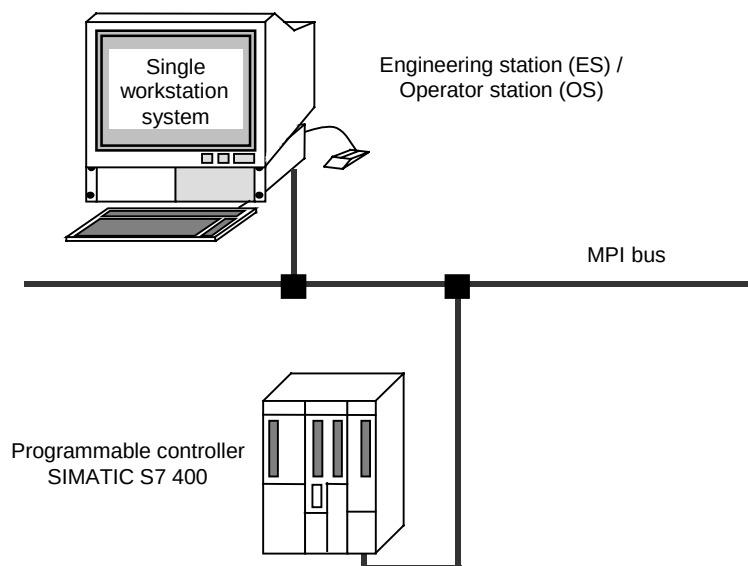
2.1 Creating the Project

What is a Project?

A project contains all the objects of an automation solution (for example blocks, charts, ...) regardless of the number of stations, modules and how they are networked.

Structure of the "COLOR_GS" Project

The "COLOR_GS" project involves a small unit of a plant with one programmable controller and a combined engineering/operator station. The operator station is designed as a single workstation system. The following figure illustrates the topology of the setup.



2.2 Creating a Project with the SIMATIC Manager

Introduction

The project is created with the Engineering System (ES). Among other things, the ES includes the SIMATIC Manager.

The SIMATIC Manager provides graphic access to all applications that you require for creating this PCS 7 sample project. You start to create your project in the SIMATIC Manager.

In this section you will learn how to start the SIMATIC Manager and how to create a new project. At the end of this section you will have created the structure for your project.

Starting the SIMATIC Manager

- Start the SIMATIC Manager by double-clicking the **STEP 7** icon on your desktop.



As an alternative, you can also start the SIMATIC Manager in the Windows taskbar by selecting:

- **Start > SIMATIC > SIMATIC Manager.**

The SIMATIC Manager is now started.

Creating a New Project

When you start the SIMATIC Manager, the "New Project" PCS 7 assistant is started if this option is set in the dialog of the assistant (default setting). Otherwise, you can start the assistant with the menu command

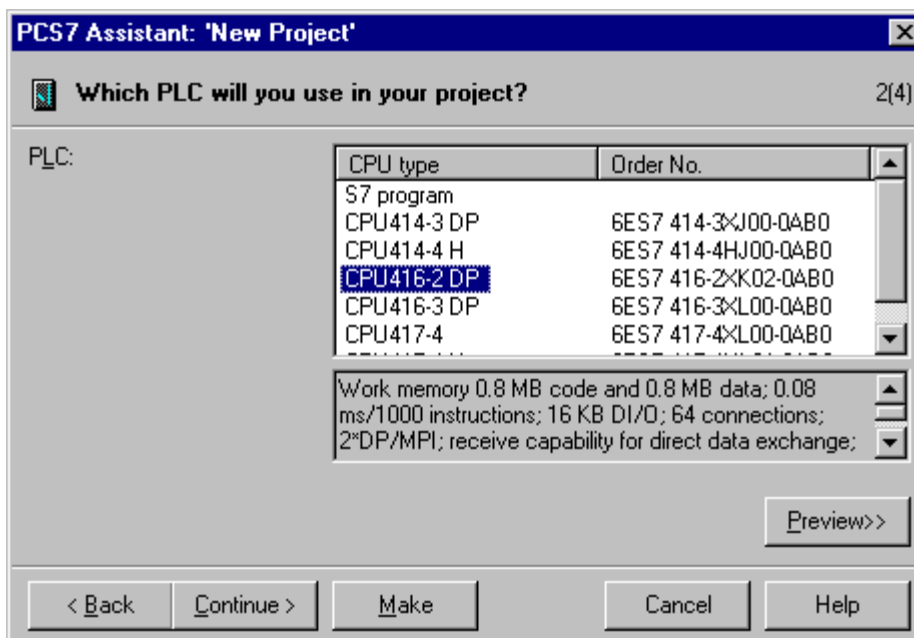
File > 'New Project' Wizard. The PCS 7 "New Project" assistant supports you when you create a new project. It creates the required hardware, the plant hierarchy, and, as default, one CFC and one SFC chart in the project.

To create the project, follow the steps outlined below:

1. In the first dialog of the assistant, click the **"Continue"** button.
2. In the second dialog **"Which CPU will you use in your project ?"** select the CPU type you are using (for example the CPU 416-2). When you select the CPU, compare the type number and the order number on the front of your CPU with the type number and order number displayed in the list.

Note:

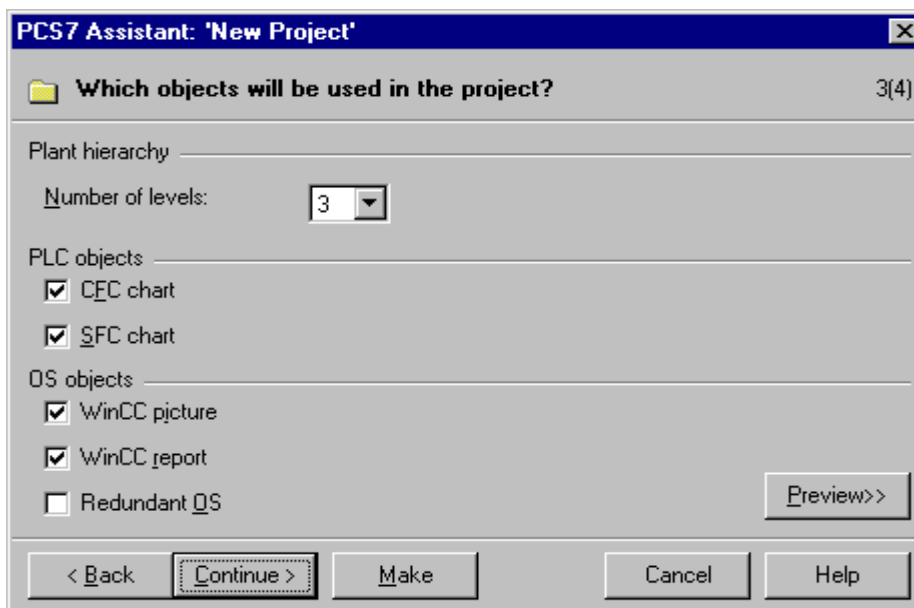
You can also configure the user software in an S7 program without reference to a specific CPU. At a later stage, you then assign specific sections of the program to the CPUs. For more detailed information, refer to the online help of the SIMATIC Manager.



With the **Preview >>** button, you can toggle the display of the Plant View and the Component View on and off. In the preview, you can see the current status of the configuration.

Click the **"Continue"** button.

3. In the third dialog **"Which objects will be used in the project ?"**, accept the default settings.



Click the **"Continue"** button.

4. In the fourth dialog, enter "**COLOR_GS**" as the project name and click the "**Make**" button.

The project is now created with these settings.

In the SIMATIC Manager, the windows of the component view (physical memory location of the charts) and the plant view (technological arrangement of the charts) are displayed automatically. From now on you will continue working in the plant view. You can change the view in the SIMATIC Manager with the "**View > Plant View**" or "**View > Component View**" menu commands.

Note:

How to include input and output modules, selecting the relevant drivers, creating the symbolic names, and using the driver wizard is explained in the configuration manual based on the COLOR_PH example.



Video

2.3 Structuring in the Plant View

In the plant view, you can structure a project according to technological aspects; in other words, you structure automation and operator control and monitoring functions to suit your application (for example, hierarchically). This structuring, provides greater clarity and allows you to handle technological objects (plants, units, process control points, ...) as one entity.

In the plant view window, you can see the icon of a folder at the top left. This folder represents your project and is labeled with the name of your project "**COLOR_GS**". Below this you can see the hierarchy folder "**Plant**". This is the highest hierarchy level of the project. Below this folder, you can see the folder "**Unit**" and also the hierarchy folder "**Function**".

Before you extend the plant hierarchy, you should make the settings for the plant hierarchy. Select the "**Plant**" in the plant view and then select the menu command:

Options > Plant Hierarchy > Customize

In the dialog box, you enter the value 3 in the "**Number of hierarchy levels**" box. This means that a maximum of 3 hierarchy levels are permitted.

The number of hierarchy levels depends on the requirements of the project. If you have several SIMATIC stations in a project, units are processed in the individual stations. This means that it is advisable to create a hierarchy folder at the top level per station. The further technological division within a SIMATIC station is then implemented with the second level.

The next stage is to decide which level names are included in the higher level designation (naming scheme). If a level is included in the naming scheme, this means that the names are entered in the origin of the message (OS) and in the tags on the OS (measuring point).

As an example, level 1 and level 2 (plant and unit) should be included in the naming scheme. Select **"Include in designation"** for **level 1** and **level 2** (click check box). As shown in the following figure, set **8 characters** per level in the "Max. number of characters" column (assigning short meaningful names).

Select the **"Base picture hierarchy on the plant hierarchy"** check box. This means that the OS picture hierarchy is derived completely from the configured data of the PH. When you later transfer to the OS, any picture hierarchy configured on the operator station using the Picture Tree Manager will be deleted and overwritten by the data created in the SIMATIC Manager. Select the **second level** as the relevant level (OS area) on which the OS picture hierarchy will be based.

When you have made the settings, the dialog box appears as shown below:

Level	Max. number of characters	Include in designation	With separator	OS area
1:	8	☒	☒	☐
2:	8	☒	☒	☒
3:	8	☐	☒	☐
4:	24	☐	☒	☐
5:	24	☐	☒	☐

Preview: 11111111\22222222\

☒ Update PLC-OS connections
☒ Base picture hierarchy on the plant hierarchy
☐ Base BATCH flexible configuration on the plant hierarchy

OK Cancel Help

Close the dialog by clicking **OK**, the message "You have changed the include in designation property. Do you also want the changes to apply to existing hierarchy folders?" appears and you should confirm with **Yes**. The settings that you have made for the selected "Plant" hierarchy folder are then also applied to the "Unit" and "Function" hierarchy folders.



Video

Now create the plant hierarchy you require for the "COLOR_GS" project. To do this, follow the steps outlined below:

5. Right-click the "**Plant**" hierarchy folder, select **Object Properties** and enter the name "**Plant1**".

After you click the **OK** button, the name of the hierarchy folder is changed to "**Plant1**".

6. Right-click the "**Unit**" hierarchy folder, select **Object Properties** and select the "**Control and Monitoring Attributes**" tab.

There must be no check mark in the "**No modification when renaming the hierarchy folder**" check box. If you change the name of the hierarchy folder, the OS area identifier for the area-oriented filtering of messages is automatically changed as well and transferred to the OS when you transfer the PLC-OS connection data.

7. Select the "General" tab in the displayed object properties and change the name "**Unit**" to "**RMT1**".

After you have clicked OK, the name of the hierarchy folder is changed after a brief wait.

8. As described in point 2, change the name of the "**Function**" folder to "**FC111**".

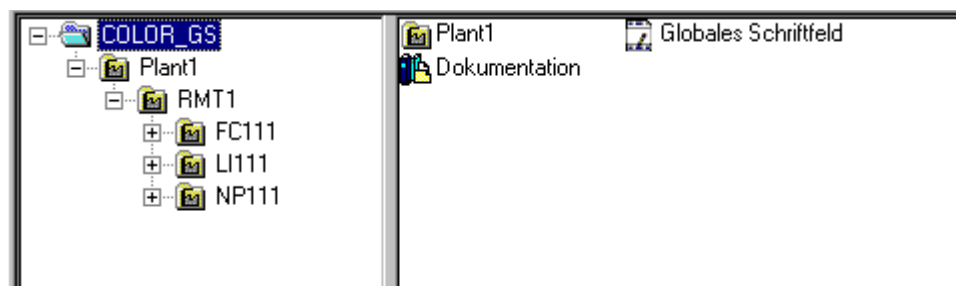
9. Right-click to select the RMT1 folder (if it is not already selected) and select "**Insert New Object > Hierarchy Folder**" in the context-sensitive menu.

The hierarchy folder is created and you can change the default name of the folder.

10. Change the name to "**LI111**".

11. Now insert the hierarchy folder "**NP111**". Follow the same procedure as described in points 5 and 6.

12. The following figure shows the folders of the technological hierarchy required for the "COLOR_GS" project.





Video

The following plant components are disguised by the hierarchy folders:

Hierarchy Folder	Technological assignment
Plant1	Process Plant
RMT1	Raw material Tank 1
FC 111	Flow control (dosing)
LI 111	Level indicator
NP 111	Pump control

In the plant view, each technological area has its own hierarchy folder that can then be further subdivided by nesting hierarchy folders within it (tree structure).

The basic structure of the project now exists.

Result

In this tutorial, you have created your project in the SIMATIC Manager and laid the foundations of your project. You have inserted new hierarchy folders in the plant view and therefore mapped the technological structure of the plant. The hierarchy folders were automatically assigned to the PLC and OS in the project. You can check the assignment by right-clicking the "Plant1" hierarchy folder and selecting "Object Properties" in the context-sensitive menu and then selecting the "PLC-OS Assignment" tab. With this assignment, the charts you create later will be stored on the SIMATIC station and the pictures you will create will be stored on the OS.

3 Working with the CFC Editor

3.1 Working with the CFC Editor

What is CFC?

CFC stands for Continuous Function Chart and is used for the convenient description of continuous processes by means of graphic interconnection and assignment of parameters to standard blocks.

Introduction

In this tutorial, you will learn how to include CFC charts and blocks in your program and how to assign parameters to these blocks and interconnect them. You will take standard, "off the peg" blocks from a library. For many components in a process engineering plant (valves, motors etc.) there are standard blocks available in PCS 7 (valve blocks, motor blocks, etc.) that can be used for control of the process.

You will create the charts CFC_LI111 and CFC_FC111 and the blocks they contain yourself. You will copy all the other charts required for the raw material tank (for example CFC_NP111) from the "PCS7_CFC_Templates" library in the plant view. This library contains ready-made charts (model charts) for technological functions in process control. After copying the charts, you can adapt them to meet your requirements.

Later, you will copy the raw material tank RMT1 and all the charts it contains and insert it in the "COLOR_GS" project as raw material tank RMT2. These functions allow you to duplicate similar complex parts of a plant conveniently and saving a considerable amount of time.

Note

In the COLOR_GS project, the names of the hierarchy folders (for example NP111) and the names of the charts are based on the tag of the corresponding measuring point. To allow you to distinguish the charts more easily, the CFC charts have had the CFC identifier added (for example CFC_NP111).

3.2 Creating CFC Charts

You will create your CFC charts in the "**COLOR_GS**" project using the SIMATIC Manager. The "New Project" PCS 7 assistant has already created the CFC charts "**CFC1**" in the "**FC111**" hierarchy folder.

1. Click this chart with the right mouse button and select **Object Properties**.
2. Give this chart the name "**CFC_FC111**" and click **OK**. You will insert the blocks of CFC_FC 111 later.

For this project, you require several CFC charts that will be given the names of the corresponding hierarchy folder for this example. In real projects, the name of the chart already relates to an identification system as required by the customer for the measuring points (tags).

3. Right-click the "**LI111**" hierarchy folder and select **Insert New Object > CFC**.

The SIMATIC Manager creates a CFC chart in the "**LI111**" hierarchy folder and displays its name as being selected.

4. Change the name to "**CFC_LI111**"

Note

The technological significance of the charts within the "COLOR_GS" project is explained in *Interconnecting Blocks*.



Video

3.3 Inserting Blocks

The automation functions of the "COLOR_GS" project are implemented with the function blocks from the PCS 7 libraries. To be able to place blocks in your CFC charts, you must now open one of the charts you have just created.

1. Select the **LI111** hierarchy folder.
2. Open the "**CFC_LI111**" CFC chart by double-clicking it.

The CFC editor is started and the "**CFC_LI111**" CFC chart is opened.

Layout of the Chart

The chart is divided into six sheets that can all be seen at the same time in the overview (with the appropriate zoom setting). You can also create chart partitions in a chart (refer to the online help in CFC). This means that a chart can consist of a maximum of 26 chart partitions each with six sheets.

You can toggle between the sheet and overview levels using two buttons .

In the status line below the block catalog, you can see the currently displayed chart and whether you are in the overview or on a single sheet (for example sheet 1). To jump to a particular sheet,

- select the menu command Edit > Go To > Sheet; by clicking one of the buttons 1 to 6, you then jump to the required sheet.

As an alternative, you can double-click a free area on the sheet at the overview level to change to the sheet view of this sheet.



Video

Fetching Blocks from a Library

To visualize the level on the OS and to monitor the level, you use the **MEAS_MON** block. Insert the block in the chart.

Note

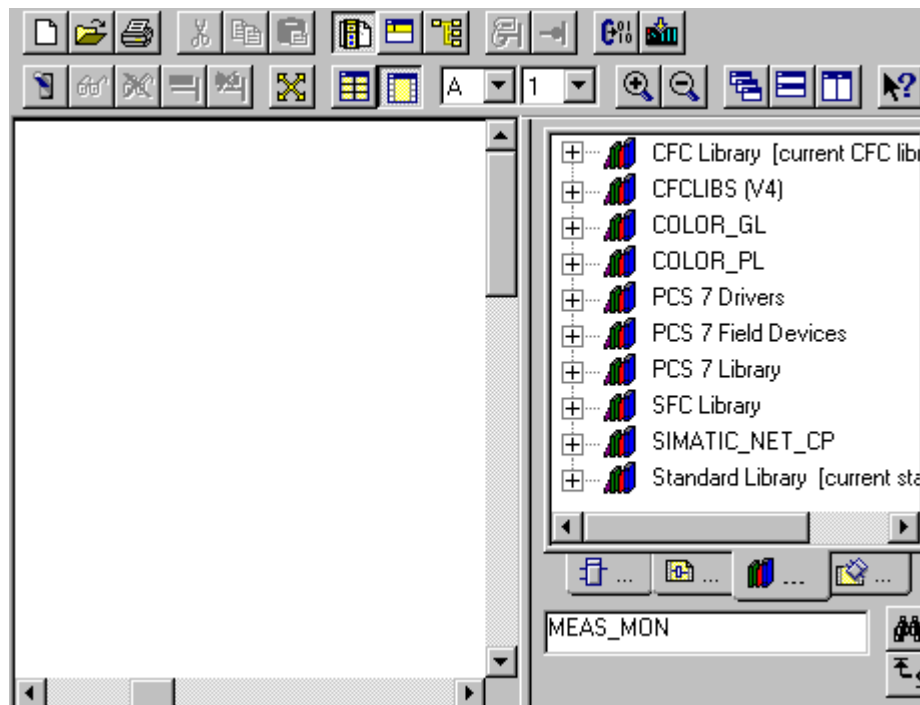
If you require further information about this or other blocks, for example, which inputs of the block have which function, select the corresponding block and then press the **F1** key. The online help provides you with further information about the block and its inputs and outputs.

- If it is not already open, open the block catalog by clicking the  "Catalog" button.
- Select the "**Libraries**" tab in the block catalog (refer to the figure below).

- You will find the block in the libraries by entering the MEAS_MON name in the search field and clicking the button with the binoculars (refer to the figure below). The block that has been found is displayed as being selected in the opened library "**PCS 7 Library > Technological Blocks**".

Note

The number of displayed libraries in the figure below (right-hand window) varies depending on the type and number of libraries created on the computer.



To include this block in your chart, follow the steps outlined below:

1. Drag the block to the chart (Sheet 1).
2. Move the **MEAS_MON** block to the right-hand side of your sheet.
3. Double-click the header of the block.
4. This opens the **Properties - Block – CFC_LI111/1** dialog box in which you enter the name "**LIA**" and then close the dialog with **OK**. The name of a tag is made up of the plant hierarchy, the CFC chart name, and the block name on the OS. You will find the name "LIA" you have entered as part of a tag name on the OS. This provides you with a reference to your PLC blocks on the OS.

5. Now drag the **INT_P** block to your chart and position it to the left beside the MEAS_MON block. (You require this block to simulate the level of the raw material tank.)
6. Give the block the name **INT_P** (as described above).



Video

The name of the MEAS_MON block as well as the names of the folders in the plant view are based on standards commonly used in process engineering.

Note

The MEAS_MON already has message texts that it passes on to the OS, for example, whenever measured values are exceeded. You can change these messages by right-clicking the block, selecting the "**Object Properties**" command in the context-sensitive menu, and then clicking the "**Messages**" button in the "**General**" tab and making the changes there. You can, of course, also use this function to simply review the messages which can be retained for this particular project.

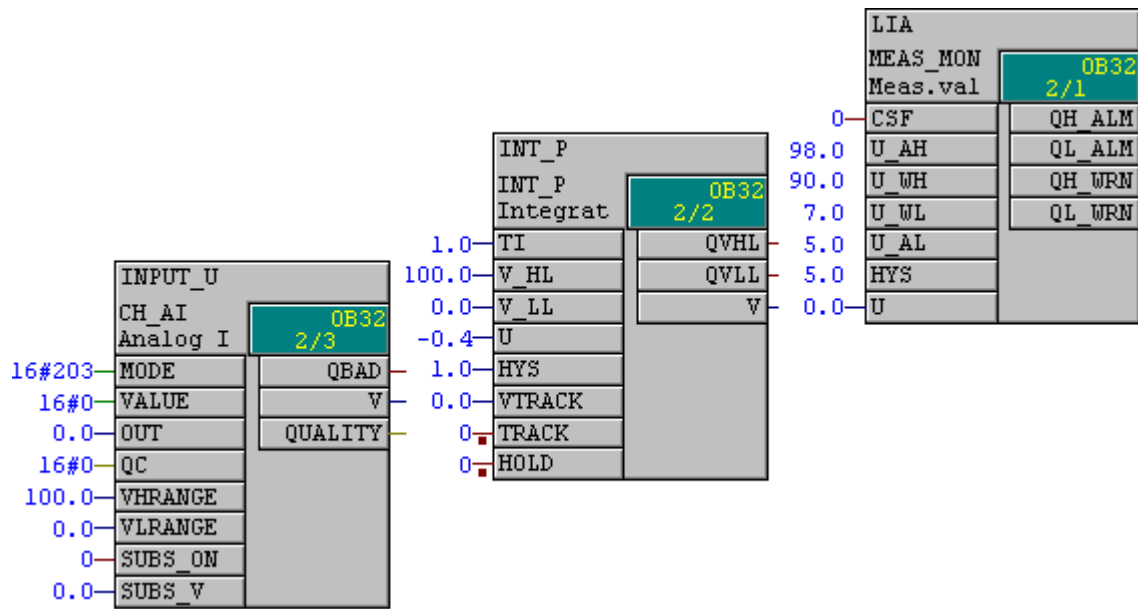
Installing Driver Blocks

The next step is to insert the "**CH_AI**" driver block. The "**CH_AI**" driver blocks is required to read in a process value from an input module and to make the value available for further processing in CFC.

Note

The "**PCS 7 Drivers > PCS 7 Drivers/Blocks**" library contains driver blocks that implement the interface to the hardware including test functions (for example module failure). The driver blocks access the process image input table (PII) and the process image output table (PIQ).

- Drag the "**CH_AI**" block from the **PCS 7 Drivers > PCS 7 Drivers/Blocks** library (drag the slider up in the block catalog and open the library) to the open chart "**CFC_LI111**" to the left of the INT_P block and name it "**INPUT_U**" (see Figure below).



You have now created all the blocks for this chart.

Creating Run-Time Groups

Per CFC chart, you should create a separate run-time group and install all the blocks of a chart in the run-time group. This procedure speeds up the compilation of changes to the CFC charts. Follow the steps below for the COLOR_GS project:

1. With the chart open, select **Edit > Run Sequence**.
2. Select the required execution cycle (for example OB32; in the object properties of the CPU (HW Config) the default is that OB32 is called once every second).
3. Right-click on the OB and select **Insert Run-Time Group**
4. In the **Insert Run-Time Group** dialog, enter the name you require (for example the name of the CFC chart whose blocks are located in the run-time group; here CFC_LI111).
5. Leave all the other parameters unchanged and complete editing of the run-time group with OK.
6. Click the "+" in front of **OB32**. You can now see the contents of OB32.
7. Click on **OB35** (this is the default OB where CFC installs blocks, executed every 100 milliseconds) and in the right-hand window (content of ...) select all blocks that belong in OB32 (LIA, INT_P, INPUT_U).

8. Now drag these blocks to the run-time group inserted in OB32 in point 4 (see above) (the contents of OB32 must be visible in the left-hand window) and click **"Yes"** in answer to the question **"Do you want to install within the group?"**.
9. If you want to insert further blocks in this run-time group, right-click on a block within the run-time group and select "Predecessor for Installation" in the context-sensitive menu. All the blocks that you then insert in the CFC chart will be inserted after this block in the run-time group.
10. Close the run sequence with **"Edit > Run Sequence"**.

PCS 7 Model Chart MOTOR (CFC_NP111)

The next step shows you how to copy the "MOTOR" model chart to the plant hierarchy from the "PCS 7 Library > Templates" library. The CFC templates are ready-made model charts for technological functions in process control. You can copy these charts and adapt them to your own requirements.

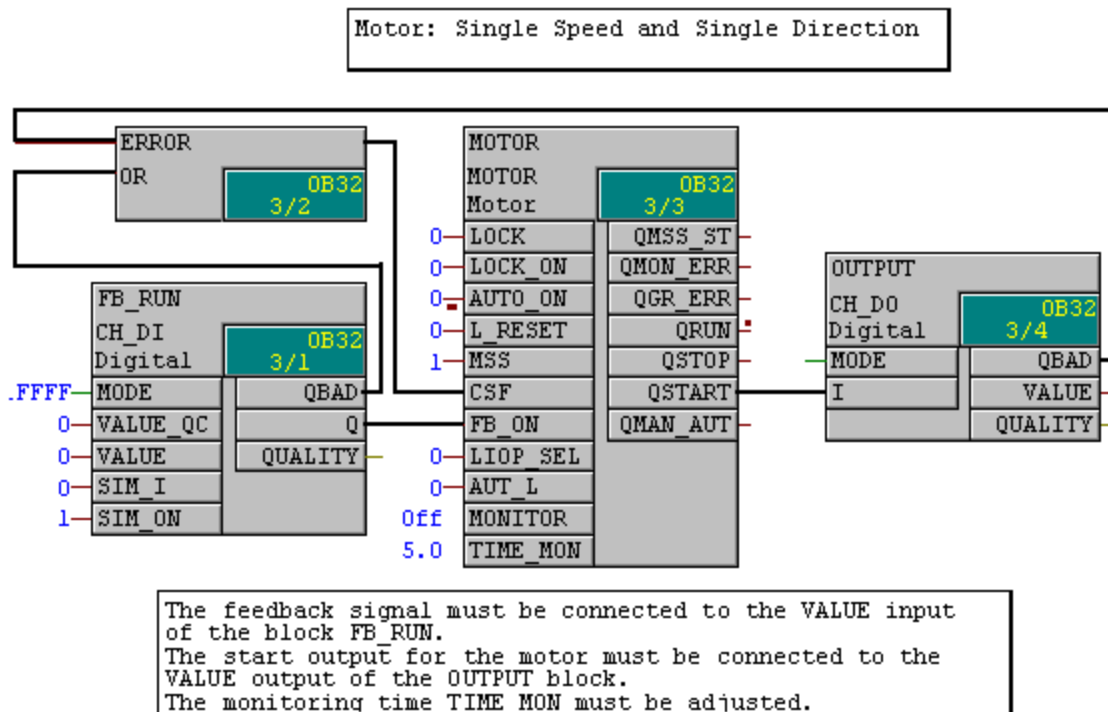
Follow the steps outlined below:

1. Close the CFC editor (**Chart > Exit**). All modifications made in charts are saved automatically so that you do not need to save explicitly.
2. Open the "PCS7_CFC_Templates" library in the SIMATIC Manager (**File > Open > Library > PCS 7 Library > OK**).
3. Double-click "Templates" in the library (component view) and then double-click the **"Charts"** folder.
4. Right-click on the **"MOTOR"** model chart and select **"Copy"**.
5. Open the **Plant View** of the **"COLOR_GS"** project with the **"Window"** menu command.
6. Right-click the **"NP111"** hierarchy folder and select **"Paste"**. The "MOTOR" template is inserted in the "NP111" hierarchy folder.
7. Change the name of the model chart from **"MOTOR"** to **"CFC_NP111"**.

The "CFC_NP111" chart is now completely configured (refer to the figure below).



Video

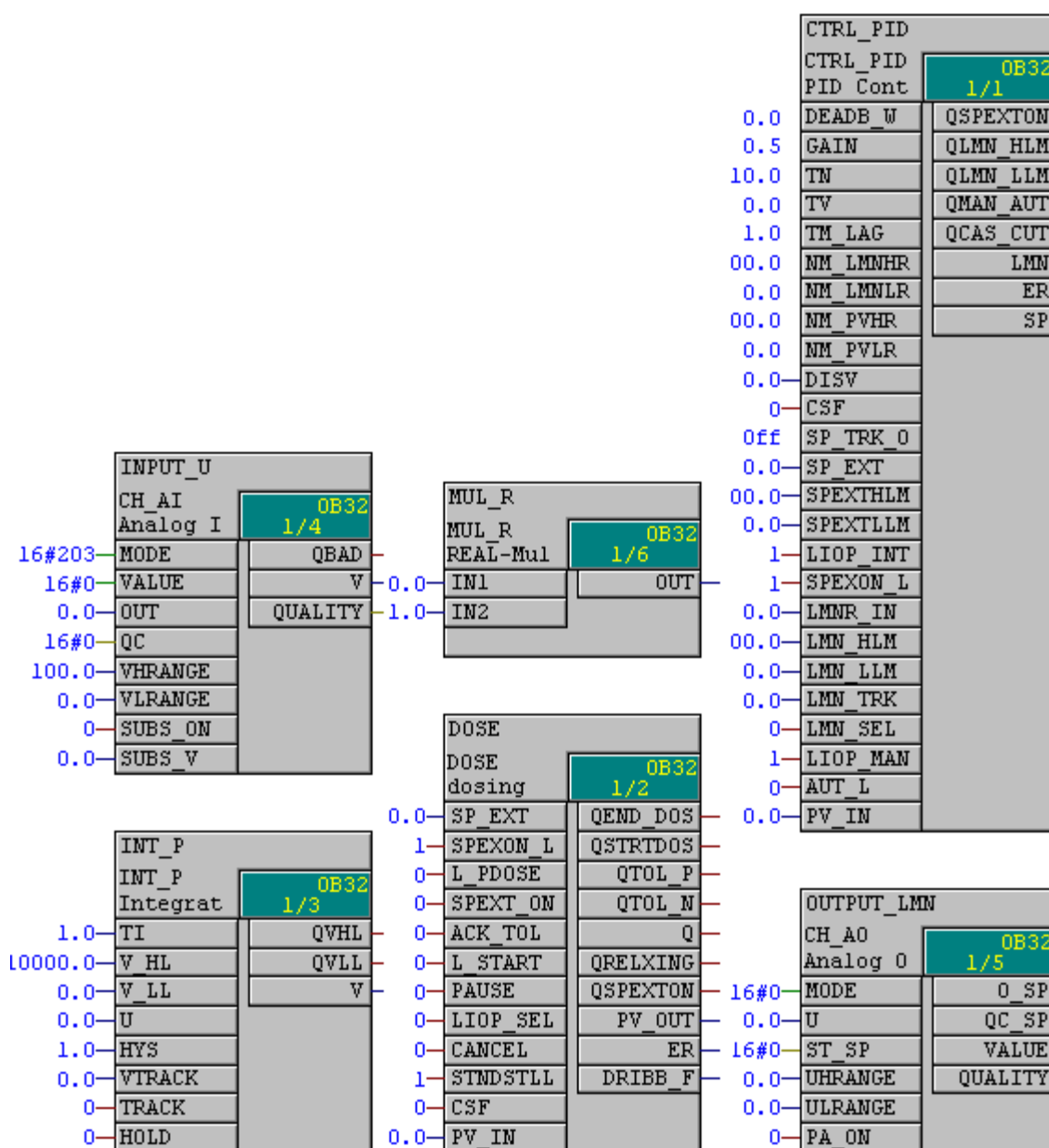


Creating the "CFC_FC111" Chart

The next step is to edit the "CFC_FC111" CFC chart. No suitable template is available. For this reason, you will configure the chart using blocks from the PCS 7 library.

This chart will contain the control for dosing speed and dosing of the amount of raw material from the tank.

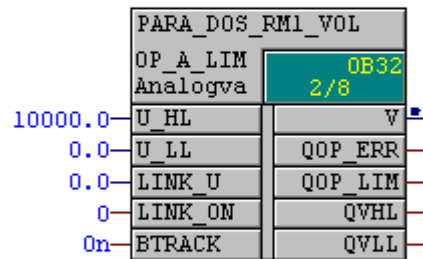
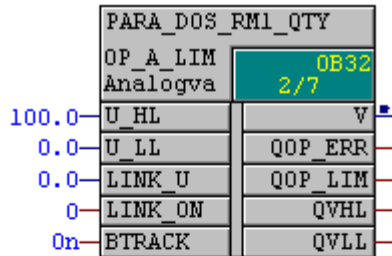
Open the chart CFC_FC111 (in hierarchy folder FC111) you renamed in Creating CFC Charts and insert the following blocks in the open chart "CFC_FC111" as described above: a "CTRL_PID" (controller block; PCS 7 Library > Technological Blocks) with the name "CTRL_PID", a "DOSE" (dosing block; PCS 7 Library > Technological Blocks) with the name "DOSE", a "INT_P" (integrator block; PCS 7 Library > Technological Blocks) with the name "INT_P", a "MUL_R" (multiplier; CFCLIBS/Elementa) with the name "MUL_R", a "CH_AI" (analog input; PCS 7 Library > Driver Blocks) with the name "INPUT_U" and a "CH_AO" (analog output driver; PCS 7 Library > Driver Blocks) with the name "OUTPUT_LMN". (refer to the figure below)



The operator must be able to control the dosing from the OS. The setpoint for the dosing volume, the dosing speed, and the target reactor must be specified by the operator.

The quantity of material is stored in an analog operating block "OP_A_LIM" with the name "PARA_DOS_RM1_QTY" and the dosing speed is stored in an OP_A_LIM block with the name "PARA_DOS_RM1_VOL". The raw material can be fed to reactor 1 or reactor 2. Which reactor is to be used is set in a binary operating block "OP_D" with the name "PARA_DOS_RM1_SEL". The blocks are located in the **PCS 7 Library > Technological Blocks** library.

- Position these blocks on sheet 2 (**Edit > Go To > Sheet 2**) of the "CFC_FC111" chart and enter the names shown above (refer to the figure below).



Installing Blocks in a Run-Time Group

Now move all the blocks of the CFC_FC111 chart to a run-time group "CFC_FC111" to be created new (procedure, as described in this section in "Creating Run-Time Groups" for the CFC_LI111 chart).

3.4 Setting Block Parameters

The blocks now require correct parameter settings; in other words, the inputs that have not yet been interconnected must be assigned the values required for the process to run.

"CFC_LI111" Chart

1. Open the "CFC_LI111" chart (if this is not already the active chart in the window) by double-clicking it in the plant view.

First, change the values of the block "LIA". With this change, you set the switching thresholds at which messages are sent to the operator station. These messages are process messages and appear on the OS as the message class "Warning" or "Alarm".

2. Go to Sheet 1 in the sheet view (top left).
3. Double-click the header of the **MEAS_MON** block with the name "LIA" to open the Object Properties.
4. Change to the **Inputs/Outputs** tab.

You can assign parameters for all I/Os in the **Inputs/Outputs** tab (visible and invisible in CFC). The column with the title "Name" displays the names of all inputs and outputs of this block.

5. Change the value of the **U_WH** input (upper warning limit) in the "Value" column to "90". This means that a process value at input U higher than 90 results in a warning "Too High" on the operator station.
6. Change the values listed in the following table as described above.



Video

Block Name	Parameter	Value	Meaning
LIA	MO_PVHR*	100	Upper limit of the process value in the container 100 m ³
	U_AH	98	Upper alarm limit 98 m ³
	U_WL	7	Lower warning limit 7 m ³
	U_AL	5	Upper alarm limit 5 m ³
INT_P	U	-0.4	Simulation of the raw material tank level
INPUT_U	SIM_ON*	1	Simulation value active
	SIM_V*	78	Raw material tank level 78%
	VHRANGE	100	Upper measuring range
	MODE	16#0203	Measuring range 4 to 20 mA

* Invisible in CFC (refer to the note below)

Note

In the properties of a block, you have the option of switching parameters "Displayed" or "Not Displayed" (select the block in the CFC chart > select "Object Properties" in the context-sensitive menu > select "Inputs/Outputs" tab > select the required option in the "Not displayed" column. All invisible parameters are displayed only in the block properties and not in the blocks displayed in CFC.

"CFC_NP111" Chart

The properties of the **CH_DI** block in the "**CFC_NP111**" chart need to be modified. With the **SIM_ON** input, you activate the simulation of a measured value at the driver block. You require this simulation for your sequential control system.

1. Open the "**CFC_NP111**" chart.
2. Assign the parameters for the inputs according to the following table:

Block Name	Parameter	Value	Meaning
FB_RUN	SIM_ON	1	Simulation activated
MOTOR	MONITOR	Monitoring =Off	Monitoring deactivated
MOTOR	AUT_ON_OP*	AUTO	Activate the automatic mode

* invisible in CFC.

"CFC_FC111" Chart

The next settings to be made are in the "**CFC_FC111**" chart.

1. Change to the "**CFC_FC111**" chart

Assign the parameters for the inputs of the blocks according to the following table:

Block Name	Parameter	Value	Meaning
MUL_R	IN2	1	Parameters for optional adaptation of the flow rate value
INT_P	V_HL	10000	Upper limit quantity summation 10000 Liters
DOSE	SP_HLM*	10000	Upper limit of the setpoint for the dosing volume
	MO_PVHR*	10000	Upper limit of the process value for the dosing volume
	SPEXON_L	1	Interconnection for the internal/external switchover active
INPUT_U	SIM_ON*	1	Simulation activated
	MODE	16#0203	Measuring range 4 to 20 mA

Block Name	Parameter	Value	Meaning
	VHRANGE	100	Upper measuring range
CTRL_PID	LIOP_MAN_SEL	1	Interconnection automatic/manual active
	LIOP_INT_SEL	1	Interconnection for the internal/external switchover active
	SPEXON_L	1	Switch controller to external setpoint
	GAIN	0.5	Set the gain of the controller to 0.5
PARA_DOS_RM1_QTY (sheet 2)	U*	50	Setpoint for flow control 50 liters/min
PARA_DOS_RM1_VOL (sheet 2)	U*	5000	Setpoint for dosing 5000 liters
	U_HL	10000	Limit value of the entry for the U parameter
PARA_DOS_RM1_SEL (sheet 2)	IO*	ON	The material is fed to reactor 1

* invisible in CFC.

3.5 Interconnecting Blocks

Now make the required interconnections in the charts (connections between outputs and inputs). To make an interconnection, click first the output and then the input you want to connect to it.

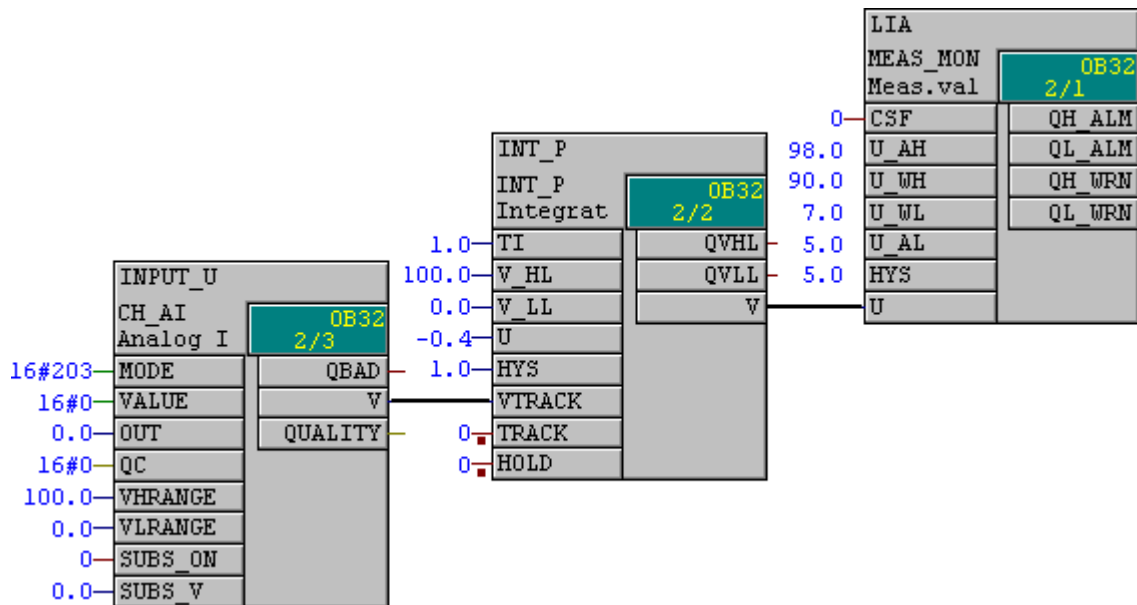
Interconnections in the "CFC_LI111" Chart

Technological Significance of the CFC_LI111 Chart:

The CH_AI block reads in the process value (fill level of the raw material tank) and outputs the current value at output "V". As default, this output is connected to the input "U" of the MEAS_MON block and then passed on by the MEAS_MON block for display on the OS. The INT_P block included here is used to simulate the fill level.

Interconnect the blocks as follows:

1. Change to the CFC chart "**CFC_LI111**".
2. Click on the output "**V**" of the block "**INPUT_U**" and then on the input "**VTRACK**" of the block "**INT_P**".
3. Click on the "**V**" output of the "**INT_P**" block and then click on the "**U**" input of "**LIA**" (refer to the figure below).



Video

Note

When you interconnect I/Os, the connecting lines are automatically drawn in the most suitable position (autorouter function). The position of the lines has no effect whatsoever on the function of the interconnection.

If you make an incorrect interconnection:

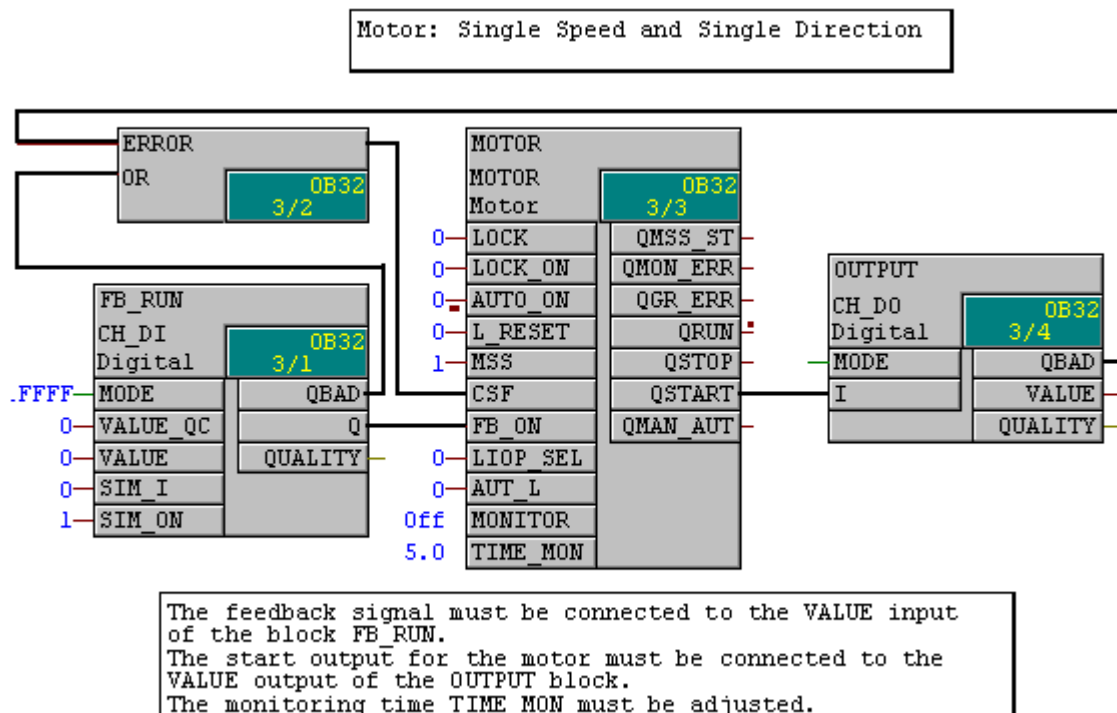
- Right-click on the incorrectly connected output or input and select **Delete Interconnection**.

Interconnections in the "CFC_NP111" Chart

Technological Significance of the CFC_NP111 Chart:

The CH_DI block supplies the current state of the pump (on or off) at output "Q". This value is connected to the "FB_ON" input (feedback ON) of the MOTOR block where it is evaluated. The operator or a higher level controller controls the MOTOR block. The CH_DO block takes the control command from the "QSTART" output of the MOTOR block and outputs this to the pump in the process.

- Since the CFC_NP111 chart is a ready-made model chart, all the required interconnections have already been made.



Interconnections in the "CFC_FC111" Chart

Technological Significance of the CFC_FC111 Chart:

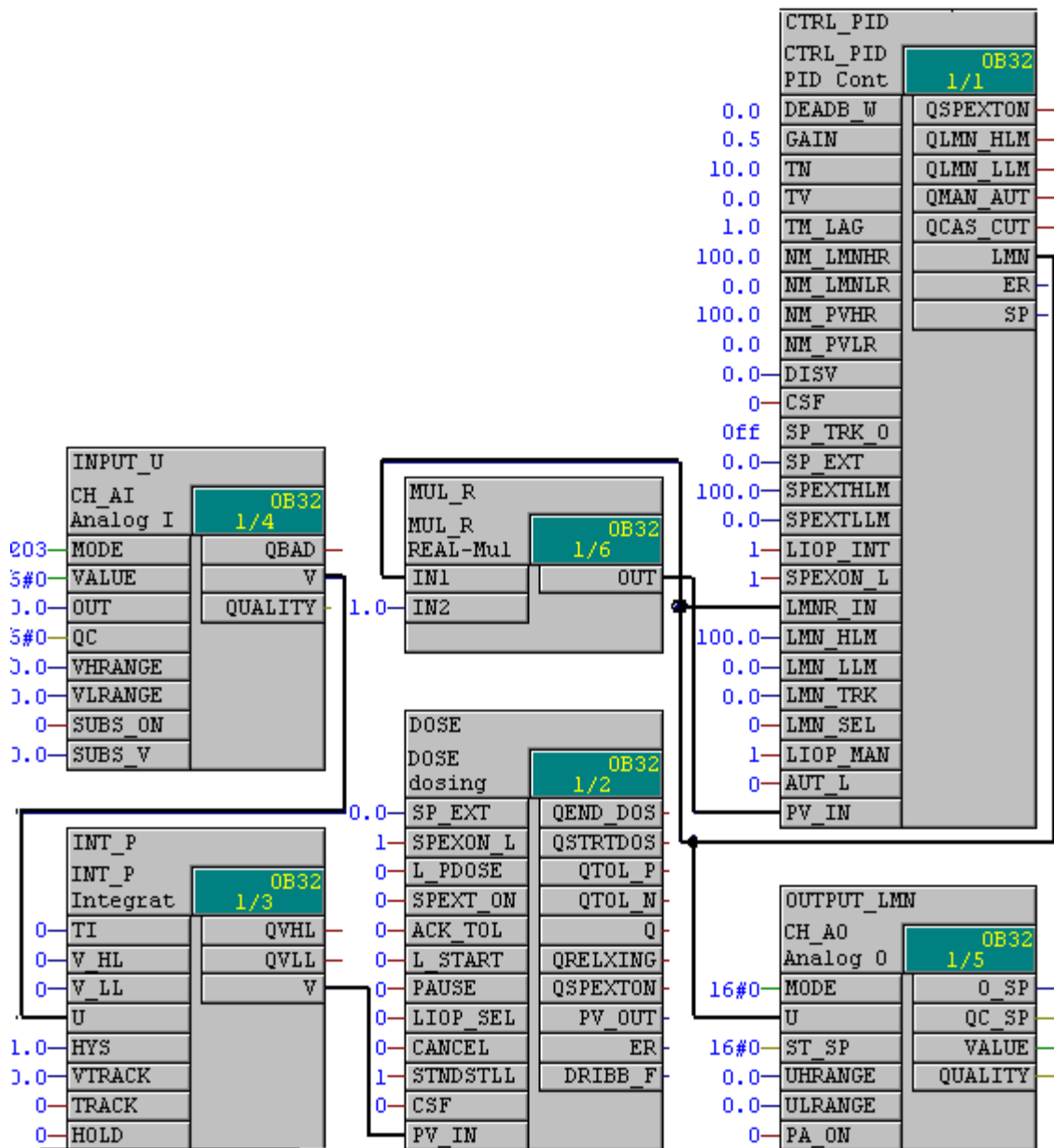
The CH_AI block provides the currently dosed volume at the "V" output and transfers this measured value to the "PV_IN" (process value) input of the DOSE block. The INT_P block is used in this case for simulation of the dosed volume.

The speed of the dosing is controlled by a flow control with the CTRL_PID block.

The block receives the setpoints via the step control in conjunction with the OP_A_LIM block PARA_DOS_RM1_VOL.

The manipulated variable for the valve is output at the "LMN" output and is fed directly to the CTRL_PID block at input "LMNR_IN" in the absence of feedback from the process. The CH_AO block outputs the manipulated variable to the valve.

- Open the "**CFC_FC111**" chart and make the interconnections as shown in the figure below:



The operating blocks on Sheet 2 of the "CFC_FC111" chart do not require interconnections. These blocks are simply used to store the input made by the operator.

You have now made all the interconnections necessary for the "COLOR_GS" project.

Result

In this tutorial, you have created CFC charts in your project. Within these charts, you have placed blocks, assigned parameters to them and interconnected them.

4 Working with the Import/Export Assistant

4.1 Working with the Import/Export Assistant

Introduction

In this example, you will learn how to create models, create replicas of these models by importing, work in the project, and export the results.

What is the Import/Export Assistant (IEA)?

You use the import/export assistant when you require one or more models regularly in a project (processing mass data; for example placing 100 drives in a project) and require a convenient means of adapting the parameter descriptions of the blocks.

What is a Model?

A model consists of a hierarchy folder with CFC/SFC charts, pictures, reports, and additional documents and an assigned IEA file with the information for parameters, signals, and messages. Using the IEA assistant, you can create any number of replicas.

4.2 Creating Models

Introduction

In this section, you will create the "**VALVE**" model chart directly in a new library and import the required number into the "Liquid Raw Materials Store" unit. By assigning an IEA file to the hierarchy folder of the model chart, a model chart becomes a model. To create the IEA file and to assign it to the hierarchy folder, you use the IEA assistant. In this section, you will perform the following activities:

- Create a library with model charts
- Select the import/export I/Os
- Link the import/export file with the import/export I/Os
- Edit the import/export file
- Assign the IEA file parameters to the model data
- Import the models into the project

General

You can create model charts in the project or in a library. The advantage of the library is that you only manage the objects in a project that will actually be downloaded to the CPU at a later point in time. You can then import (duplicate) the charts from the library using the Import/Export Assistant.

Creating a New Library

To create a new library, follow the steps outlined below:

1. Select the menu command "**File > New**" in the SIMATIC Manager
2. In the displayed dialog, select the "**Libraries**" tab, enter the name "**COLOR_LIG**" and click the **OK** button.

The new library is displayed in the "Component View".



Video

Placing a Model Chart in the Library

The next step is to insert an S7 program in the library and to create the model chart "VALVE" in it. Follow the steps outlined below:

1. Select the "COLOR_LIG" folder in the library.
2. Select the folder and then right-click > **Insert New Object > S7 Program**.

The S7 program is created.



Video

3. Select the plant view of the library (**View > Plant View**).
4. Insert a hierarchy folder in the library and give the folder the name "PLANT1" (the procedure is the same as described in Chapter 2).
5. Right-click the hierarchy folder "PLANT1" and open the "Customize Plant Hierarchy" dialog box (**context-sensitive menu > Plant Hierarchy > Customize**).
6. Make the settings for the plant hierarchy as follows:

Level	Max. number of characters	Include in designation	With separator	OS area
1:	8	☒	☒	☐
2:	8	☒	☒	☒
3:	8	☐	☒	☐
4:	24	☐	☒	☐
5:	24	☐	☒	☐

Preview: 11111111\22222222\

☒ Update PLC-OS connections
☒ Base picture hierarchy on the plant hierarchy
☐ Base BATCH flexible configuration on the plant hierarchy

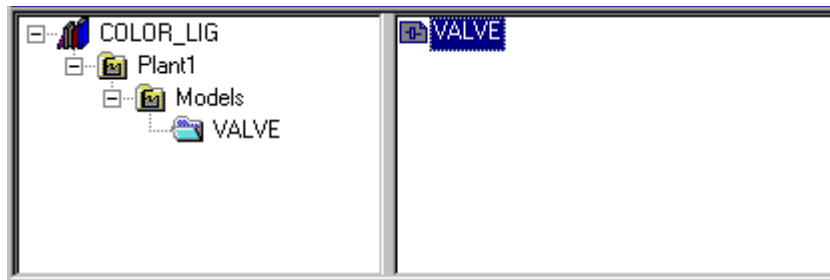
OK Cancel Help

Close the dialog box with OK and acknowledge the prompt that follows with **Yes**.



Video

7. Insert a further hierarchy folder with the name "**Models**" in the "**Plant1**" folder. You will create all the models you require in this folder.
8. Insert the "**VALVE**" hierarchy folder in the "**Models**" folder for the model chart of a valve.
9. Insert the CFC model chart "**VALVE**" from the "PCS 7 Library > Templates" in the "**VALVE**" folder (procedure as described in Chapter 2, Section "PCS 7 Model Chart MOTOR (CFC_NP111)"). You have now set up the plant hierarchy and it should appear as shown in the following figure.

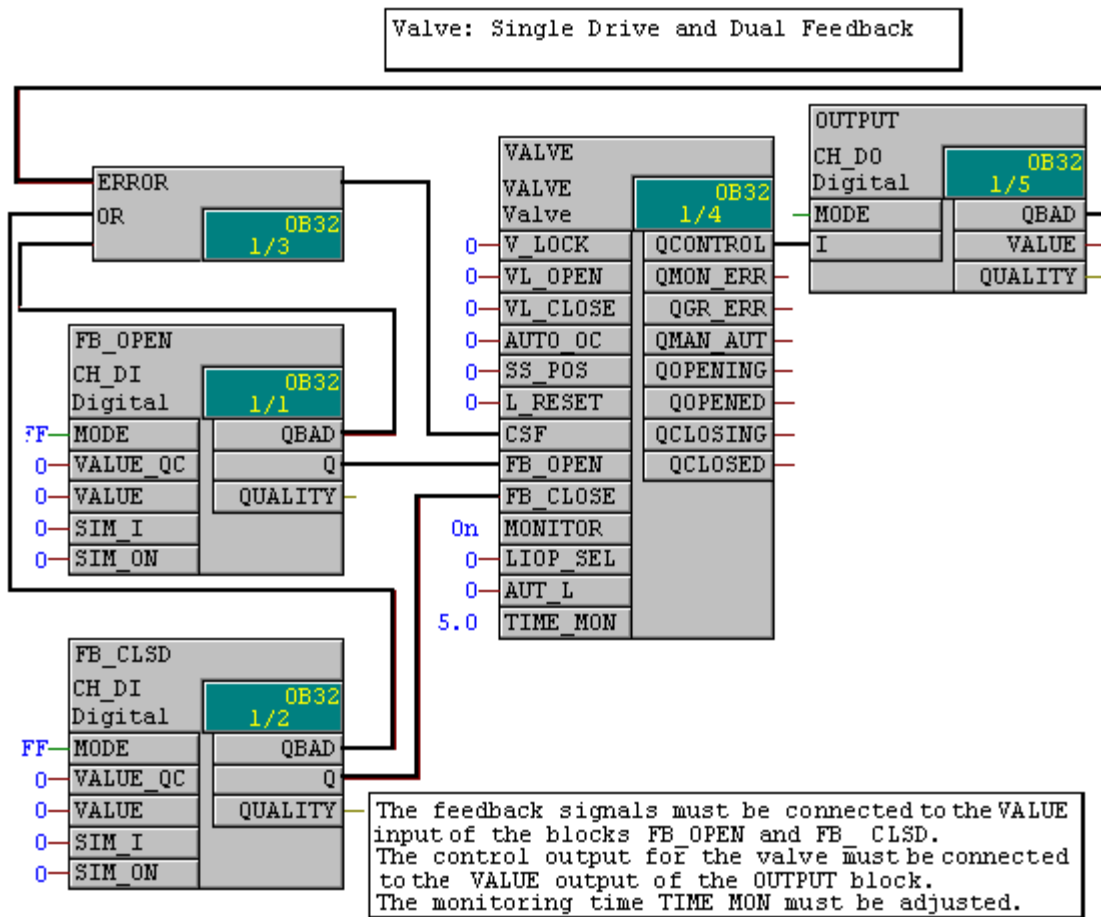


Video

"VALVE" Model Chart

Technological significance

The CH_DI blocks provide the return message (open and closed) of the valve to the value control block "VALVE". The operator or a higher level controller switches this valve using its block and the control command is sent from the output "QCONTROL" via the output driver "CH_DO" to the valve in the process. Any fault messages from the input or output modules are ORed (OR block) and passed on to the operator station by the valve control block so that they can be displayed to the operator.



4.3 Selecting Import/Export Flagged I/Os

To be able to make parameter assignments and interconnections for some of the I/Os by importing, you must select the I/Os in the model. Follow the steps outlined below:

1. Select the "VALVE" hierarchy folder in the "Models" folder in "COLOR_LIG" in the plant view.
2. Select the menu command **Options > Import/Export Assistant > Create/Modify Model**.
3. Work through the assistant and select the parameters to which you want to assign values or signal addresses for chart/block I/Os in step 2.

Set the I/Os shown in the table below for the "COLOR_GS" project:

Block Name	I/O Parameter	Block type	Remarks
IEA parameter			
VALVE	START_SS*	VALVE	Select the valve default state (open/closed)
VALVE	MONITOR	VALVE	Disable monitoring of feedback from the process for the example
VALVE	AUTO_ON_OP	VALVE	Switch the valve to the automatic mode

* Note: This parameter is switched invisible in CFC.

Hierarchy	Cha	Block	Block comm	I/O name	I/O comment	IEA par	IEA i	I/O	Typ	Block
Plant1\Mod.	VA..	VALVE	Single drive..	AUTO_OC	AUTO Mode:1=Open,...			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	SS_POS	Safe Position. 1=Open..			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	START_SS	1=Start withSafe Stat...	X		IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	FAULT_SS	1=In Case of Fault:Sa...			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	L_RESET	Linkable Input RESET			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	CSF	Control System Fault 1			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	FB_OPEN	Feedback: 1=OPEN			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	FB_CLOSE	Feedback: 1=CLOSE			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	NO_FB_OP	1=No Feedback OPEN.			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	NO_FB_CL	1=No Feedback CLOS.			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	MONITOR	Select: 1=Monitoring O.	X		IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	NOMON_OP	1=No Monitoring OPEN			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	NOMON_CL	1=No Monitoring CLOS			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	OP_OP_EN	Enable 1=Operator ma.			IN	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	CL_OP_EN	Enable 1=Operator m.			IN	B...	VALVE
:	:	:	:	:	:	:	:	:	:	:
Plant1\Mod.	VA..	VALVE	Single drive..	RUNUPCYC	Lag: Number of Run U..			IN	INT	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	RESET	Operator Input Error R..			I...	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	MAN_OC	Operator Input: 1=OPE.			I...	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	AUT_ON_OP	Operator Input Mode 1..	X		I...	B...	VALVE
Plant1\Mod.	VA..	VALVE	Single drive..	AUX_PR04	Auxiliary Value 4			I...	A...	VALVE

Click the **"Next"** button.

4. In step 3, you can select the blocks you want to assign message texts using the IEA assistant. For the "COLOR_GS" project, use the default message texts of the blocks. This means that you do not need to import message texts.

Click the **"Next"** button.

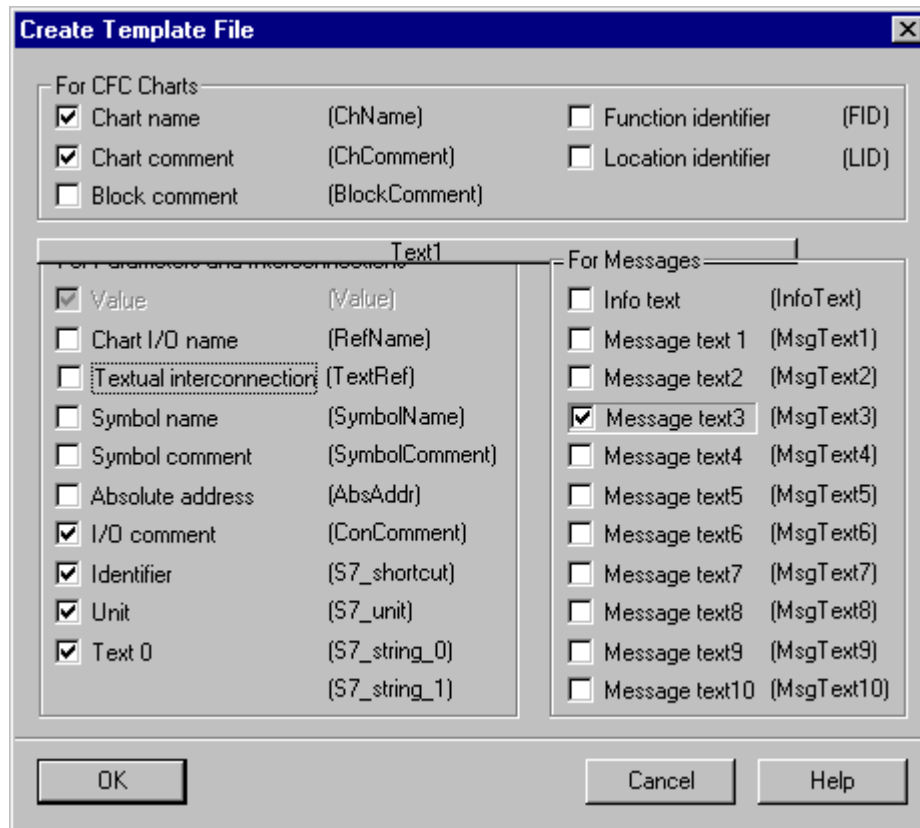


Video

Linking Import/Export I/Os with the Import/Export File

In the IEA file, you insert the values that will be assigned automatically to the I/Os selected above when the replicas are created during import (refer to figure following point 4).

1. In step 4, you make the assignment to the IEA file. Since you have not yet created an IEA file, select the **"Create Template File"** button (refer to the figure below point 6).
2. Select a **file name** (or enter the default name "VALVE_00.IEA") for the import file that will be generated.
3. In the dialog box displayed, select the following columns. Each selection in "For CFC Charts" creates a further column in the current IEA file, each selection in "For Parameters and Interconnections" creates a column in the IEA file for each selected parameter (see figure above) and each selection in "For Messages" creates a column in the IEA file for each message of the relevant block.



The "Create Template File" dialog box is shown with the following settings:

For CFC Charts		For Messages	
☒ Chart name	(ChName)	☐ Function identifier	(FID)
☒ Chart comment	(ChComment)	☐ Location identifier	(LID)
☐ Block comment	(BlockComment)		

Below these sections, there are two tabs: "Text1" (selected) and "For Parameters and Interconnections".

Text1 Tab:

☒ Value	(Value)
☐ Chart I/O name	(RefName)
☐ Textual interconnection	(TextRef)
☐ Symbol name	(SymbolName)
☐ Symbol comment	(SymbolComment)
☐ Absolute address	(AbsAddr)
☒ I/O comment	(ConComment)
☒ Identifier	(S7_shortcut)
☒ Unit	(S7_unit)
☒ Text 0	(S7_string_0)
	(S7_string_1)

For Messages Tab:

☐ Info text	(InfoText)
☐ Message text 1	(MsgText1)
☐ Message text 2	(MsgText2)
☒ Message text 3	(MsgText3)
☐ Message text 4	(MsgText4)
☐ Message text 5	(MsgText5)
☐ Message text 6	(MsgText6)
☐ Message text 7	(MsgText7)
☐ Message text 8	(MsgText8)
☐ Message text 9	(MsgText9)
☐ Message text 10	(MsgText10)

Buttons at the bottom: OK, Cancel, Help.

After clicking the "OK" button, the assignment of the IEA file to your model chart "VALVE" is completed.



Video

- Click the "Open File" button and enter the information shown in the following table in the IEA file.

Note:

In the IEA file editor, you can duplicate lines (**Edit > Duplicate Row**).

You want to create four replicas (CFC_NK111 to CFC_NK114) of your "VALVE" model. As a result, the corresponding IEA file has four rows containing the destination path for saving the replicas in the "Hierarchy" column. The "ChName" column contains the names of the CFC charts (replicas) to be created. For each parameter, there is a further column with the "Value" to be specified and depending on the parameter, the operator input string (string for operation with 0 and a further string for operation with 1).

Hierarchy	ChName	ChComment	Value	ConComment	V.	S7_stri..	S7_st.	V.	S7_string0	S
	Chart		VALVE.START_SS.IN		VALVE.MONITOR.IN		VALVE.AUT_ON_OP.I			
H\	C\		P\		P\			P\		
Plant1\RMT1\NK111\	CFC_NK111	stop valve1	0	1=Start with Sa.	0	Monitori.	Monito	1	Mode=Man..	M
Plant1\RMT1\NK112\	CFC_NK112	stop valve2	0	1=Start with Sa.	0	Monitori.	Monito	1	Mode=Man..	M
Plant1\RMT1\NK113\	CFC_NK113	stop valve3	1	1=Start with Sa.	0	Monitori.	Monito	1	Mode=Man..	M
Plant1\RMT1\NK114\	CFC_NK114	stop valve4	1	1=Start with Sa.	0	Monitori.	Monito	1	Mode=Man..	M

- If required, you can adapt the column titles to your requirements. Save the file in the "COLOR_GS" project (**File > Save As**; folder: "**Siemens \Step7\I7proj\COLOR_GS**"). The advantage of this is that all the data are saved with a backup of the project and you will find it easier to assign the import file during importing in a later dialog. Close the file.
- The parameters of the IEA file are already assigned automatically to the model data. Close the dialog with the "**Finish**" button.



Video

D:\Siemens\STEP7\I7proj\Color_gs\Valve_00.iea								
Model data:								
*	Param/Inter/Mess	Hierarchy	Chart	Block	I/O	I/O comment	I/O	Type
P	VALVE.START_SS.IN	Plant1\Model	VALVE	VALVE	START_SS	1=Start with Safe Stat...	IN	BOOL
P	VALVE.MONITOR.IN	Plant1\Model	VALVE	VALVE	MONITOR	Select: 1=Monitoring O.	IN	BOOL
P	VALVE.AUT_ON_OP.IN	Plant1\Model	VALVE	VALVE	AUT_ON_OP	Operator Input Mode 1	INOUT	BOOL

- To create the charts, select the menu command **Options > Import/Export Assistant > Import** in the SIMATIC Manager with the "**VALVE**" hierarchy folder selected.

Note:

Since you have selected a model in a library, this must first be copied to the target project and is then imported (refer to the steps below).

- In step 1, click the "**Next**" button.
- In step 2, select the "**Find Target Project**" button and select the "**COLOR_GS**" project. Confirm your selection with "**OK**". This step is necessary to be able to copy the model to the target project. Click the "**Next**" button.
- Acknowledge the message "**Find Import Files**" with the **OK** button.

11. Click the **"Other File"** button in step 3 and select the import file **"VALVE_00.IEA"** you created. The import file is then assigned to the model in the project. Select the **"Next"** button.
12. In step 4, click the **"Finish"** button.
The import is started.
13. After importing is completed, click the **"Exit"** button.

Note:

If, during the import, a dialog box is displayed with the message "The hierarchy folder is not yet assigned to a chart folder, do you want to make the assignment now?", click the "Yes" button in the dialog box and make the assignment to your chart folder (SIMATIC 400(1)\CPU416-2\S7 Program(1)\Charts).

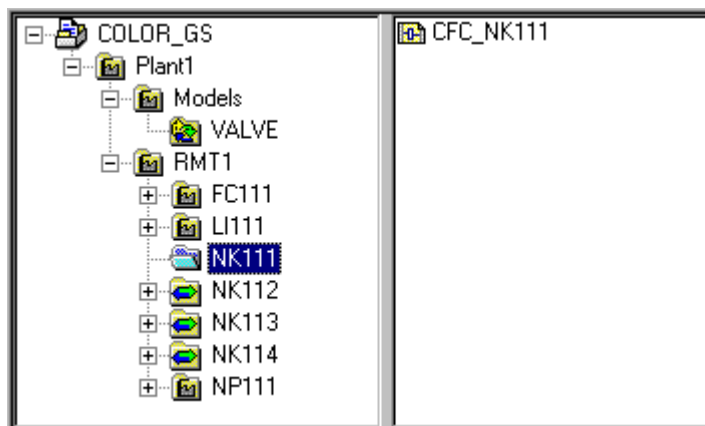


Video

When the import is completed, the "VALVE" hierarchy folder is displayed in the plant view of the library with the icon of the model.



Four new hierarchy folders with the names "NK111" to "NK114" have now been created in the **"RMT1"** hierarchy folder of the **"COLOR_GS"** project and are shown as replicas of a model.



Result

In this tutorial, you have got to know the import/export assistant. You have specified chart I/Os and created an IEA file. During import, you have created new folders each with a CFC chart as a copy of the top chart "VALVE" with the selected parameters and interconnections in the area RMT1.

5 Working with the SFC Editor

5.1 Working with the SFC Editor

What is SFC?

SFC (Sequential Function Chart) is a sequential control system partitioned to ensure step-by-step execution with control passing from one state to the next state dependent on conditions.

Introduction

In this tutorial, you will learn how to create and insert an SFC chart in your project and to assign values to the blocks you created in CFC so that they can be used in a sequential control system.

5.2 Technological Structure of the Sequential Control System

The following section (sequence) provides you with an overview of the technological sequence of the individual steps and transitions in the sequential control system. The sections following this explain how to configure this sequential control system.

Processing Sequence

The SFC chart is executed in the following sequence:

START	Initial settings: - change the dosing controller to manual - switch the dosing controller to external - set units to automatic mode - stop dosing etc.
DOSE_REA1 DOSE_REA2	Query: - which reactor will be used (reactor 1 or 2)?
INIT_LINE1 INIT_LINE2	Controls: - open valves of the relevant chain - turn on pump - switch dosing controller to external setpoint
INIT_1_OK INIT_2_OK	Query: - is the pump turned on? - Is the controller set to "External Setpoint"?
INIT_DOSE	Controls: - specify setpoint of dosing rate - set dosing controller to automatic - specify setpoint of dosing volume - start dosing
INIT_OK	Query: - dosing started? - dosing volume (setpoint - actual value) < 500 Liters?
SLOW_DOWN	Control: - reduction of the dosing rate shortly before reaching the required dosing volume
END_DOSE	Query: - dosing completed?
CLOSE_LINE	Controls: - close all valves - turn off pump - switch dosing controller to manual - set dosing rate to 0 - stop dosing
CLOSE_OK	Query: - is the pump turned off?
END	Reset: - switch dosing controller to internal - close valves - turn off motor

The chart you have created can be started, controlled and monitored on an operator station.

5.3 Renaming an SFC Chart

The "**SFC1**" SFC chart was created by the PCS 7 new project assistant in the "FC111" hierarchy folder. You will now give the chart a new name.

1. Select the "**FC111**" hierarchy folder in the SIMATIC Manager (plant view) "**FC111**".
2. Right-click the "**SFC1**" chart and select **Object Properties**.
3. Change the name to "**SFC_RMT1**" and click **OK**.

5.4 Structure of the Sequential Control System

Using the SFC editor, you create the entire chart topology graphically.

- Open the "**SFC_RMT1**" chart by double-clicking it.

The SFC editor is started and the "**SFC_RMT1**" chart is opened.

Since this chart is new, it has only two steps (START and END) and one transition. The step is the control instance for processing the assigned actions on the PLC. It is executed until the following transition (condition) is satisfied.

In this chart, the sequence is first established graphically.

Topology

In the element bar (on the left-hand side) you can see seven buttons the highest of which "**Select**"  is activated.

1. Click "Insert Step + Transition". 

Your mouse pointer changes to a small crosshair and a circle with a bar across. As soon as you move the crosshair to a point in the chart at which it is possible to insert a step + transition, the circle changes to a symbol for "Step with Transition". At the same time, a green line indicates where the "Step with Transition" will be inserted.

2. Insert a "Step + Transition" directly below transition "**1**" by moving the small crosshair directly below the transition and pressing the left mouse button.
Step "**3**" and transition "**2**" are inserted in the chart.

3. Now click the "**Insert Alternative Sequence**"  button.

4. Move the small crosshair directly under step **START**" and click the left mouse button.

An alternative sequence is inserted directly below the step "**START**". At the same time, transitions "**3**" and "**4**" are positioned parallel to each other with step "**4**" directly below.

You will now insert further steps and transitions required for the "**COLOR_GS**" project.

5. Select the "Insert Step + Transition" button.
6. Insert a Step + Transition pair directly below transition "3" and below transition "4".

The steps **5** and **6** and the transitions **5** and **6** are inserted.

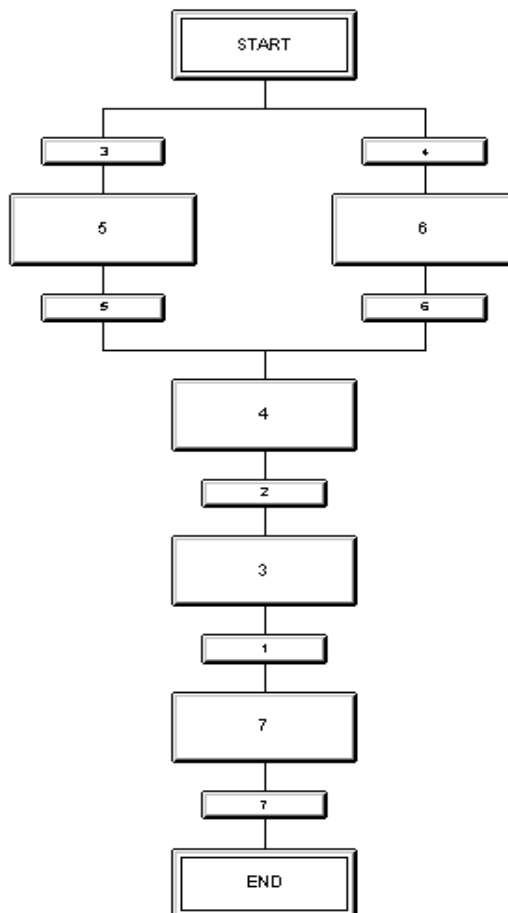
7. Insert the next **Step + Transition** directly below transition **2** (before the **"END"** step).

Step **7** and transition **7** appear at this point.



Video

You can check the structure of your SFC chart based on the following figure.



5.5 Naming Steps and Transitions

The steps are now given a name suitable for the plant.

1. Click the **"Select"** button.
2. Double-click transition **"3"**.
3. In the **General** tab of the **Object Properties**, the **Name** box is already selected and you can enter the name **"DOSE_REA1"**.
4. Click **Apply**.
5. To move to the next transition below this transition, click the **Down Arrow**



You have now moved to the next transition, transition **"5"**. In this way, you can move from transition to transition through the entire chart. Name the transitions as shown in the following table.



Video

Default Name	New Name
3	DOSE_REA1
5	INIT_1_OK
1	INIT_OK
2	END_DOSE
7	CLOSE_OK
4	DOSE_REA2
6	INIT_2_OK

6. Close the **Object Properties** dialog box with **Close**.

You change the names of the steps in exactly the same as the names of the transitions.

7. Double-click step **"5"**.

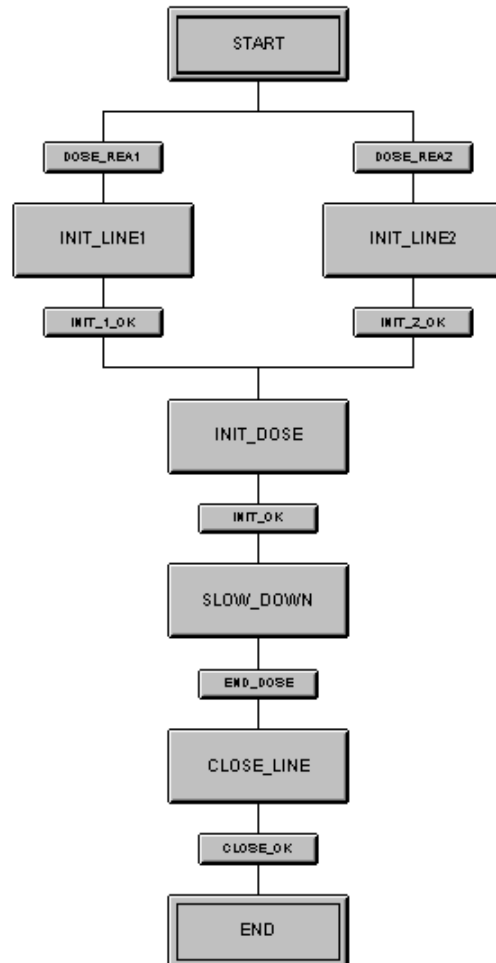
In the **General** tab of the **Object Properties**, change the names of the steps according to the following table.

Default Name	New Name
5	INIT_LINE1
4	INIT_DOSE
3	SLOW_DOWN
7	CLOSE_LINE
6	INIT_LINE2

8. Close **Object Properties**.

You have now completed naming the steps and transitions.

The sequential control system appears as shown in the figure below.



5.6 Defining Steps

Working within SFC, you can now assign values to your CFC block inputs. With the first step (START), you make the settings for the sequence of the dosing process.

1. Double-click the "**START**" step.
2. In **Object Properties**, select the **Initialization** tab.

You will now see an empty list with processing steps. The cursor is flashing in row 1.

3. Click **Browse**.

A dialog box is opened in which you can create a link.

The CFC charts tab is open. The list contains all the CFC charts belonging to this project.

4. Click the "**FC111**" CFC chart.

A second list is now opened containing all the available blocks in the "**FC111**" CFC chart.

5. Click the "**CTRL_PID**" block in this list.

The list with the I/Os of this block is opened.

6. Double-click the input "**AUT_L**" (you may need to widen the column with the parameter names using the left mouse button).

The **Browse** dialog box goes into the background and the path you have selected is entered as the first address in row 1. The cursor now flashes after the assignment character (operator) in the next column.

7. Here, enter a "**0**" and move the cursor to the second line.



Video

The following structure can only be seen in the **Initialization** tab:

Step	Assignment
1	T1\FC111\WCFC_FC111\CTRL_PID.AUT_L := FALSE
2	
3	
4	
5	
6	
7	
8	
9	
10	

8. Click **Apply**.

The first assignment in the "**Start**" step is now complete. Make the following assignments in the same way. You insert all the other assignments required in the "**START**" step, click "Apply" and can then move from step to step with the **Down Arrow** or select the steps by double-clicking them.

If you want to close a step or move to the next step without clicking "**Apply**" following a modification, SFC will ask you whether or not you want to save the changed step. Answer the prompt with **Yes**.

The following table shows you the contents of the actions. The order of the addresses (operands) in the steps and transitions of the project may differ from the order shown in the table.

To save cycle time, all the commands of the actions in the initialization branch ("Initialization" tab in the open action) can be executed.

The "Initialization" of the current step is executed only once. In contrast, the "Processing" of a current step is executed cyclically until the next transition is satisfied. The "Termination" is then executed once.

Note

To improve the clarity, the first level of the plant hierarchy (Plant1) has not been written explicitly in the following tables.

Tip: When entering the addresses (operands), check whether you have selected the required step based on the title bar of the dialog box.

Action	Address 1	Operator	Address 2	Meaning
START	RMT1\FC111\CTRL_PID.AUT_L	:=	FALSE	Controller manual mode
	RMT1\FC111\CTRL_PID.SP_EXT	:=	RMT1\FC111\PARA_DOS_RM1_QTY.V	Setpoint for flow control
	RMT1\FC111\CTRL_PID.LMN_SEL	:=	FALSE	No setpoint correction
	RMT1\FC111\DOSE.L_START	:=	FALSE	Dosing stopped
	RMT1\FC111\INT_P.TRACK	:=	TRUE	Track integrator
	RMT1\FC111\DOSE.SPEXT_ON	:=	TRUE	Setpoint external
	RMT1\LI111\INT_P.TRACK	:=	TRUE	Track integrator
	RMT1\NK111\VALVE.AUT_ON_OP	:=	Auto	Valve in automatic mode
	RMT1\NK112\VALVE.AUT_ON_OP	:=	Auto	Valve in automatic mode
	RMT1\NK113\VALVE.AUT_ON_OP	:=	Auto	Valve in automatic mode
	RMT1\NK114\VALVE.AUT_ON_OP	:=	Auto	Valve in automatic mode
	RMT1\NP111\MOTOR.AUT_ON_OP	:=	Auto	Motor in automatic mode
	RMT1\LI111\INT_P.HOLD	:=	FALSE	Hold output value
INIT_LINE_1	RMT1\NK111\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NK112\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NK113\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NP111\MOTOR.AUTO_ON	:=	TRUE	Turn on motor
INIT_LINE_2	RMT1\NK111\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NK112\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NK114\VALVE.AUTO_OC	:=	TRUE	Open valve
	RMT1\NP111\MOTOR.AUTO_ON	:=	TRUE	Turn on motor
INIT_DOSE	RMT1\FC111\CTRL_PID.SP_EXT	:=	RMT1\FC111\PARA_DOS_RM1_QTY.V	Active setpoint for flow control
	RMT1\FC111\CTRL_PID.AUT_L	:=	TRUE	Controller automatic mode
	RMT1\FC111\DOSE.SP_EXT	:=	RMT1\FC111\PARA_DOS_RM1_VOL.V	Active setpoint for dosing volume
	RMT1\FC111\DOSE.L_START	:=	TRUE	Start dosing
	RMT1\FC111\INT_P.TRACK	:=	FALSE	Integrator after setpoint correction
	RMT1\FC111\INPUT_U.SIM_V	:=	50.0	Simulation: Flow 50 liters/min simulated!
	RMT1\LI111\INT_P.TRACK	:=	FALSE	No correction for integrator
Set the minimum run time of this step to "8s" (Properties/General)				

Action/ Transition	Address 1	Operator	Address 2	Meaning
SLOW_DOWN	RMT1\FC111\CTRL_PID.SP_EXT	:=	10.0	Reduction of the flow setpoint
	RMT1\FC111\INPUT_U.SIM_V	:=	10.0	Simulation: Flow 10 liters/min simulated!
CLOSE_LINE	RMT1\NK111\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK112\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK113\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK114\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NP111\MOTOR.AUTO_ON	:=	FALSE	Turn off motor
	RMT1\FC111\CTRL_PID.LMN_SEL	:=	TRUE	Correct manipulated variable to 0 (close valve)
	RMT1\FC111\CTRL_PID.SP_EXT	:=	0.0	Active setpoint for flow control
	RMT1\FC111\CTRL_PID.AUT_L	:=	FALSE	Controller manual mode
	RMT1\FC111\DOSE.L_START	:=	FALSE	Dosing stopped
	RMT1\FC111\INPUT_U.SIM_V	:=	0.0	Simulation: Flow 0 liters/ min simulated!
	RMT1\LI111\INT_P.HOLD	:=	TRUE	Track integrator
END ¹⁾	RMT1\FC111\CTRL_PID.AUT_L	:=	FALSE	Reset input
	RMT1\FC111\CTRL_PID.LMN_SEL	:=	FALSE	No correction of manipulated variable
	RMT1\NK111\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK112\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK113\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NK114\VALVE.AUTO_OC	:=	FALSE	Close valve
	RMT1\NP111\MOTOR.AUTO_ON	:=	FALSE	Turn off motor

¹⁾If the sequential control system aborts, the "END" action is always executed. For this reason, the block inputs modified by the sequential control system are reset again in the "END" action.

The steps of the SFC chart now have the required parameters set. Each step containing an assignment changes its color from dark gray to light gray. With this color scheme, you can see whether or not a step has had parameters assigned without needing to open the step.

5.7 Defining Transitions

A transition contains the conditions according to which a sequential control system passes control from one step to the next. You assign the parameters for transitions in much the same way as for steps.

1. Double-click the transition "**DOSE_REA1**".
2. Select the **Condition** tab.

The tab is opened and contains lines with empty conditions. The first line is selected and the cursor is flashing in it.

3. Click **Browse**.

Once again the browse dialog box comes to the foreground.

4. In the **CFC Charts** tab, click the "**FC111**" chart.
5. Click the block name "**PARA_DOS_RM1_SEL**".
6. Double-click the output "**Q0**".

Note

If output "Q0" is not displayed, click the "Filter" button and select the "Suitable I/Os only" check box.

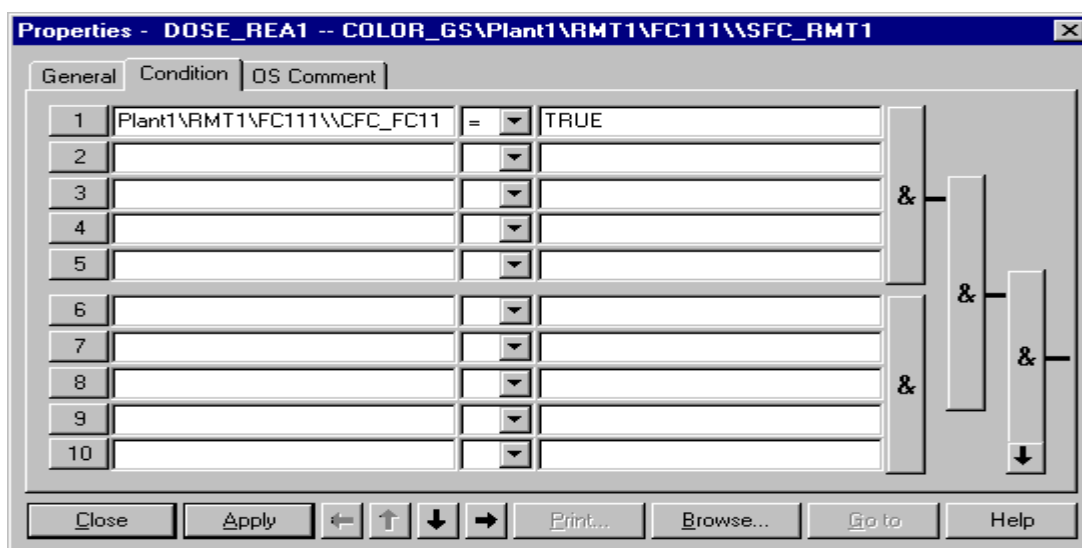
The output is inserted in the current line of the transition.

7. Enter "**1**" as the second operand and press the tab key.
8. Click **Apply**.



Video

The transition appears as shown below:



Enter the other conditions for the "DOSE_REA1" transition and the conditions for all other transitions. The following table shows you the values to be entered. The individual lines of the transitions are logically ANDed.

Transition	Address 1	Operator	Address 2	Meaning
DOSE_REA1	RMT1\FC111\PARA_DOS_RM1_SEL.Q0	=	TRUE	Dosing reactor 1 ?
	RMT1\FC111\PARA_DOS_RM1_VOL.V	>	0.0	Dosing volume higher than 0 ?
INIT_1_OK	RMT1\NP111\MOTOR.QRUN	=	TRUE	Is motor on?
	RMT1\FC111\CTRL_PID.QSPEXTON	=	TRUE	Is controller switched to external setpoint
DOSE_REA2	RMT1\FC111\PARA_DOS_RM1_SEL.Q0	=	FALSE	Dosing reactor 2 ?
	RMT1\FC111\PARA_DOS_RM1_VOL.V	>	0.0	Dosing volume higher than 0 ?
INIT_2_OK	RMT1\NP111\MOTOR.QRUN	=	TRUE	Is motor on?
	RMT1\FC111\CTRL_PID.QSPEXTON	=	TRUE	Is controller switched to external setpoint
INIT_OK	RMT1\FC111\DOSE.QSTRTDOS	=	TRUE	Dosing started ?
	RMT1\FC111\DOSE.ER	<	500.0	Dosing volume: setpoint – actual value < 500 liters?
END_DOSE	RMT1\FC111\DOSE.QEND_DOS	=	TRUE	Dosing ended ?
CLOSE-OK	RMT1\NP111\MOTOR.QRUN	=	FALSE	Is motor off?

You have now created your SFC chart. Result

In tutorial 4, you have renamed an SFC chart and created a graphic sequential control system. With the steps and transitions, you have assigned values to the blocks of the CFC charts so that the sequential control system can operate with the blocks.

6 Compiling, Downloading and Testing

6.1 Compiling, Downloading and Testing

Introduction

This tutorial explains how you compile the program you have created with CFC and SFC, download it to the CPU and run it in the test mode. This gives you the opportunity of checking the correct functionality.

6.2 Compiling and Downloading

Note:

From this point onwards, you should have set up the hardware as described in the tutorial **Creating the Hardware** (refer to the introduction at the start of Getting Started).

You download in two steps; first you download the hardware configuration, and then after compiling, the programs of the CFC/SFC charts.

The hardware configuration was created automatically by the PCS 7 new project assistant.

Creating the Network Connection

To simplify matters, the connection between the PLC and OS is implemented in this example using the MPI interface (the restricted performance is acceptable for an example). To establish this connection, follow the steps outlined below:

1. Go to the component view in the SIMATIC Manager and select the **SIMATIC 400**.
2. Start **HW Config** by double-clicking **Hardware** in the right-hand window.

The station configuration displays the hardware configuration of a station. Here you specify how your PLC is structured.

You must specify the connection via which the SIMATIC station is connected to the operator station.

3. Double-click on the CPU you are using.

Note:

With certain CPUs, the MPI/DP interface can be recognized explicitly as a line in HW Config. In this case, do not select the properties of the CPU but rather the properties of the MPI/DP interface.

4. In the **General** tab, click the **Properties** button.
 5. In the **Parameters** tab, select the **MPI(1)** network in the **Subnet** box.
 6. Close both dialogs with **OK** and save the configuration (**Station > Save and Compile**).
-

Note:

Make sure that the highest station number in the object properties of the CPU (HW Config > Object Properties of the CPU > General Tab > Properties Button > Parameters Tab > MPI(1) > Properties Button > Network Settings Tab > Highest MPI Address) matches the highest address specified in the set PG/PC interface program (SIMATIC Manager > Options > Set PG/PC Interface > Properties > MPI Tab > Highest Station Address).

Downloading the Hardware Configuration (HW Config)

To download the hardware configuration, follow the steps outlined below:

1. Click the "**Download to Module**" button 
2. Close the "**Select Target Module**" dialog box with **OK**.
With the target module, you select the module in your rack to which you want to download the configuration.
3. Close the "**Select Node Address**" dialog box with **OK**.
The node address specifies the CPU (the node) on the existing bus to which you want to download the configuration.
4. If the CPU is in the RUN mode, a dialog box is displayed telling you that the CPU must first be stopped. **You can only download a hardware configuration when the CPU is in the STOP mode.** Click the "**OK**" button.

The hardware configuration is downloaded.

If the CPU was in the RUN mode before the download, a further dialog is displayed in which you are asked whether or not you want to restart the CPU (caution if actuators are connected).

5. Select the "**YES**" button.
Your CPU is started and the green "**RUN**" LED is lit on the front panel of the CPU.
6. Close hardware configuration with the menu command "**Station > Exit**".



Video

You have now downloaded your hardware configuration. You now start the second phase.

Compiling the Programs

The program you have created must now be compiled into a language that can be executed on an S7 CPU. Follow the steps outlined below:

1. With the SFC editor open, click "**Compile**" 
2. Click the "Generate Module Drivers" option.

To detect and signal errors on the I/O modules, you require additional module drivers. These module drivers are created automatically by the "Generate Module Drivers" function and stored in the charts generated by CFC (@...).

Caution:

In addition to the module drivers, an instance of the "OB_BEGIN", "OB_END" and "PO_UPDAT" blocks is created.

The "OB_BEGIN" block must exist once in your project and in conjunction with CFC creates all the acyclic OBs you require (for example OB80, OB81 etc.). "OB_END" resets the stack pointer of "OB_BEGIN".

The "PO_UPDAT" block is responsible for the functions "Hold last value" and "Use substitute value" on the output modules when a CPU goes through a warm restart (OB100).

By using the "Generate Module Drivers" function, several instances of the "OB_DIAG" block are also installed automatically. This block is required for defective DP slaves.

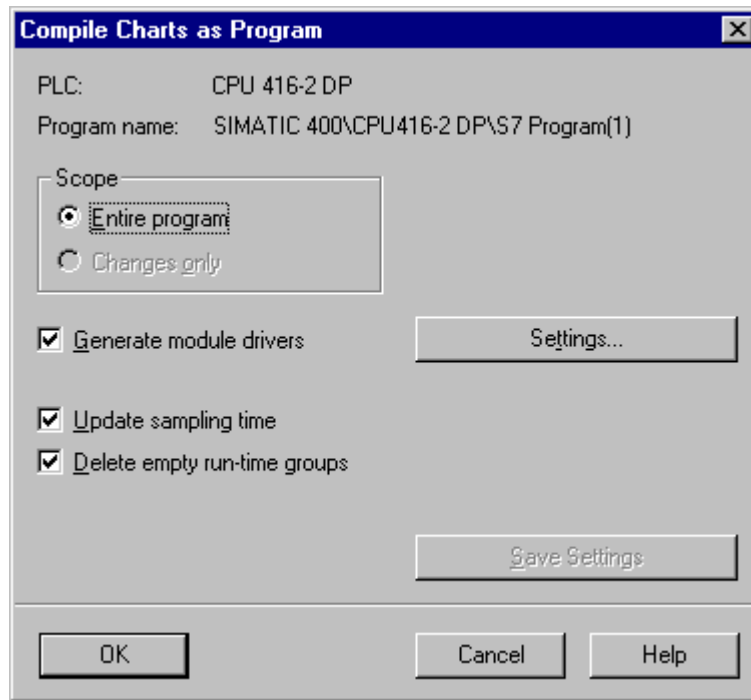
For more information on the assistant and the module drivers, refer to Chapter 1 of the Configuration Manual or to the online help of the blocks listed above.

3. Click the "Update the sampling time" option.

By setting this option, the system checks to find out which OB the block is installed in prior to compilation and makes the appropriate entry at the "SAMPLE_T" input. "SAMPLE_T" corresponds to the sampling time of the block in seconds.

4. Click the "Delete empty run-time groups" option.

By setting this option, all empty run-time groups in the S7 program are deleted.



5. When you click the OK button, the compiler is started.

The compiler starts to compile the program (all CFC/SFC charts of the current S7 program).

If compilation is completed and error-free, the following message is displayed:

Code generation: 0 error(s) and 0 warning(s) found

6. Confirm this message with the **OK button**.

You have compiled the program and you must now download it to the CPU before you can run it in the test mode.

Note

A consistency display  on the chart folder within the component view of the SIMATIC Manager (SIMATIC 400 > CPU xx > S7 program) indicates whether download-relevant charts (modified charts that must be downloaded to the CPU again) exist in the S7 program.

You can also compile and download in one action by simply selecting download (PLC Download). A dialog box is then opened - "The program was modified and must first be compiled. Do you want to compile it now and then download it?" If you click the "Yes" button, the program is first compiled and then downloaded to the CPU.

Downloading the Programs

A program can only be downloaded to the CPU when the keyswitch on the CPU is set to **STOP** or **RUN-P**. To make sure that no blocks of an old program are located on the CPU when you download the "Entire Program", the CPU is set to STOP and all user blocks deleted prior to the download.

1. Set your CPU to **RUN-P** (if this is not already set).
2. Change to the "**SFC_RMT1**" chart via the Windows NT taskbar (if it is not already displayed on the monitor).

3. Click "**Download**" 

You open the **S7 Download** dialog box. In the "Download" box, the "Entire program" option is set.

4. Select **OK**

The following dialog box is opened:



This dialog box informs you that you can only download the entire program to the CPU when the CPU is in the **STOP** mode and that all blocks will be deleted on the CPU before the download. If the CPU is already in the STOP mode, the dialog box simply informs you that all blocks will be deleted.

5. Click the **YES** button.

The program is downloaded to the CPU.

After the download, you will see a further dialog box asking you whether or not you want to start the CPU.

6. Click the **YES** button.



Video

Caution:

If you make modifications in CFC/SFC charts (for example installing new blocks, inserting new interconnections), you can reduce the compilation and download times considerably by selecting the "Changes Only" setting and not the "Entire Program" setting. In this case, only the modified parts of the program are compiled and downloaded to the PLC. The download can then be made while the PLC is in the RUN mode.

6.3 Changing to the Test Mode

Testing in SFC

You will now change to the test mode to check how the simulated values behave and whether they behave correctly.

1. Click the "**Test Mode On/Off**"  button in the SFC editor.

An extra bar is then displayed. In this bar, you can control the test. Below the chart, there are four new options of which "**Command Output**" is already activated.

2. Switch the sequential control system to "**CONTINUE**" (menu command **Debug > Start/Resume**).

The SFC chart is activated. The steps that are currently being executed are displayed in bright green and a small green arrow at the side of the step points down.

Transitions that are not yet satisfied are shown on a brown background.

During the test, you can monitor all the steps and transitions. Double-click the transition that is currently being executed to see how the values of the production system change.



Video

Testing in CFC

During the test, you can also view the blocks in the CFC charts. Follow the steps outlined below:

1. Change to the SIMATIC Manager using the task bar of Windows NT and open the CFC chart "**CFC_FC111**".

The CFC editor is started and the "**SFC_FC111**" chart is opened.

2. Click the "**Test Mode On/Off**"  button in the CFC editor.

In the sheet view of the corresponding blocks, you can see the current values of various dosing functions at the outputs, for example on the **CTRL_PID** or **Dose** block.

Note:

With Windows NT, you can display several windows one beside the other. This allows you to watch CFC and SFC at the same time in the test mode.

With a multi-VGA graphics card (refer to the PCS 7 catalog), you can connect up to four monitors to a PC and display the CFC chart on one monitor and the SFC chart on another and follow them at the same time.

To exit the test mode again, follow the steps outlined below:

3. Deactivate the "Test Mode On/Off"  button.
4. Close the CFC editor.
5. Change to the SFC editor.
6. Deactivate the "Test Mode On/Off"  button.
7. Close the SFC editor.

Result

In this tutorial, you have compiled your program and downloaded it to the PLC. You have seen how your program runs in the test mode and how the values of the blocks change.

7 Working with the Operator Station

7.1 Working with the Operator Station

Introduction

From the operator station, you control and monitor the process. The PLC handles the open and closed loop control of the process. On the OS, you can see the process values as fill levels in the tanks configured in this tutorial. Any warnings and alarms you configured on the PLC that occur during the running of the process are displayed on your OS and can be acknowledged.

7.2 Creating OS Base Data

In the operator station, PCS 7 provides you with standardized and practice-oriented defaults. You create the base data using two wizards in "**Base Data**". In the **Split Screen Wizard**, you select the resolution and layout of the screen and PCS 7 system pictures are created. In the **Alarm Logging Wizard**, you make the settings for the message system.

1. In the component view in the SIMATIC Manager, right-click on the **OS (SIMATIC PC Station > WinCC Application > OS)**.
2. Select **Open Object** (right mouse button).
3. Select the **Base Data** folder in the project navigation window.
4. Click on the **Split Screen Wizard** with the right mouse button and select **Open**.
5. Select the screen resolution "**SIMATIC Standard 1280 x 1024**" and click the "**Next**" button.

Caution:

The screen resolution depends on the maximum possible resolution of the monitor and must match the resolution set in the "**Settings**" tab in "**Start > Settings > Control Panel > Display**".

6. Accept the default monitor configuration (one monitor) and click the **Next** button.
7. You obtain an overview of the settings you have made. Click the **Finish** button.

A second window is opened with the **Split Screen Wizard - Generation**. The actions are logged with a gray check mark as they are completed. Once all the check marks are present, the following message appears:

"The display data has been completely created/updated"

8. Close both dialog boxes by clicking **OK**.
9. Right-click on the **Alarm Logging Wizard** and then select **Open>F 6>**.
10. Accept the default values of the Alarm Logging Wizard by clicking the **Next** button twice.

A message box with the message "During area-specific filtering, some messages might not be displayed due to inconsistent configuration data" is displayed.

Close this window with the OK button.

This message once again indicates that messages may not be displayed if you modify the area IDs of the hierarchy folders in the plant hierarchy and do not base the areas in the OS on the plant hierarchy. In the "COLOR_GS" project, this is not the case.

11. Click the **Finish** button.

A second window is opened with the **Message Wizard - Generation**. The actions are logged with a gray check mark as they are completed. Once all the check marks are present, the following message appears:

"Generation completed. All steps executed error-free"

12. Close the dialog boxes by clicking **OK**.

The base data (screen layout, message window, alarms etc.) have now been created on the operator station for the PCS 7 project.

7.3 Creating New Users

You can permit or prevent various users from controlling and monitoring the process on this OS (for example operators, system technicians, configuration engineers) by setting various access options. As the leader of this project, you have access to all options. You must, however, first enter yourself as a new user.

1. Select the **User Administrator** in the project navigation window and then **Open** with the right mouse button.
2. Select **Administrator Group** with the right mouse button and then select **Add User**.

In the dialog box that is then opened, you are requested to enter a login and password.

3. Enter a login and a password and then verify the password.
4. Close the dialog box with **OK**.

After you have logged in as a new user, enable the required options. An operator, for example, might be given the permission for "process control" (for example changing a setpoint) and a further permission for "higher-ranking process control" (for example changing a control parameter). You can include every operator with the operator's name in the USER administrator so that every operator has their own specific profile.

5. Double-click the boxes in the **Authorization** column for all functions. This means that you are authorized to execute all functions in run-time.
6. Close the User Administrator (**File > Exit**).



Video

7.4 Creating Process Pictures

Overview

Process pictures represent the plant equipment for the operator. Here, the operator can enter commands and display plant statuses.

You insert new process pictures in a hierarchy folder in the plant view. By assigning the folder to an OS (object properties of the hierarchy folder), the picture is automatically created in the corresponding OS. The technological relationship is simulated using the plant view.

A double-click opens the picture and you can insert the required static and dynamic elements. The Graphics Designer with the required tools is opened automatically.

Procedure

1. Change to the SIMATIC Manager using the Windows NT taskbar.
2. Change to the plant view of the project.
3. Select the "**RMT1**" folder and insert a new process picture if no process picture already exists (**Right Mouse Button > Insert New Object > Picture**).
4. Change the name of the picture to "**RMT1**" (you can select any name but it should reflect the technological purpose in the plant).
5. Double-click the newly created picture.

The Graphics Designer is started and the picture is opened.



Video

Caution:

If you base the picture hierarchy in the OS on the plant hierarchy as illustrated in this Getting Started, there must only be one picture in a hierarchy folder.

7.5 Taking Objects from the Library

1. Insert the static picture elements listed in the table from the library by dragging them to your picture (**View > Library**).

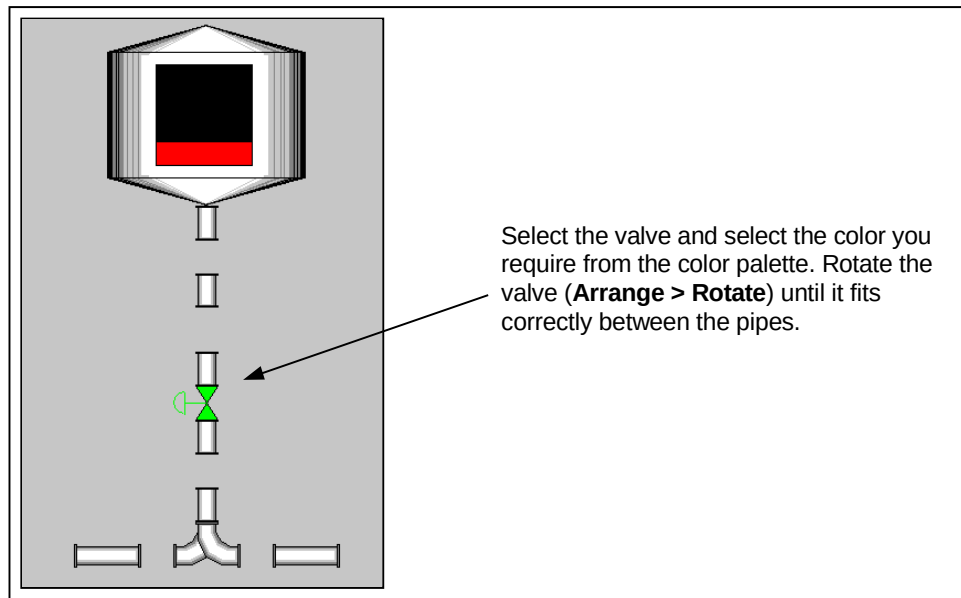


Video

Tip: You can display a preview of the picture elements by clicking the button with the pair of glasses in the toolbar (in the upper part of the library).

Element	Path in the Library
Tank	Global Library/Plant Elements/Tanks/Tank 4
Pipe	Global Library/PlantElements/Pipes - Smart Objects/3D Pipe Horizontal
Pipe	Global Library/PlantElements/Pipes - Smart Objects/3D Pipe Vertical
Pipe	Global Library/PlantElements/Pipes - Smart Objects/3D Pipe Elbow 2
Pipe	Global Library/PlantElements/Pipes - Smart Objects/3D Pipe Elbow 3
Valves	Global Library/Symbols/Valves/30

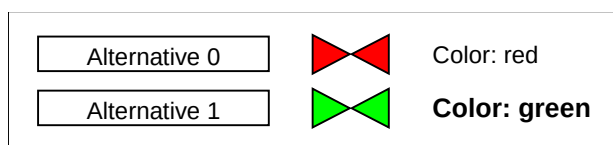
2. Close the library.
3. Adapt the size and position of the objects so that they resemble the figure shown below.



7.6 Creating Status Displays for the Valves

Introduction

The following status displays with two alternatives will be created and then later (in the RMT1 picture) connected to the parameter "QOPENED" of a valve block:



You create a status display in two parts. In the first phase, you create the symbols for the alternatives in a separate picture and then in the second phase you configure the status display in the RMT1 picture. Follow the steps outlined below:

Creating the Symbols for the Alternatives

1. Create a new picture in the graphics designer (**File > New**) and give the picture the name **Status.PDL** (**File > Save As**).

This picture does not need to be created within the plant hierarchy since it only contains the templates for the status displays and is not displayed by the operator.
2. Create the static element for alternative 0 using the **Polygon** from the object palette (refer to the figure above). Select the polygon in the object palette, and draw the valve by clicking at each corner and double-clicking when you return to the starting point. Click the object you have just created and color it red using the color palette.
3. Copy alternative 0 (**Edit > Duplicate**) and color the copy green from the color palette.
4. Draw a lasso around alternative 0 and export (**File > Export**) the alternative in emf format to the file "**valve_v1_h_0**" (valve, version 1, position horizontal, alternative 0).
5. Draw a lasso around alternative 1 and export the alternative in the emf format to the file "**valve_v1_h_1**".
6. You require both a horizontal and vertical valve in the RMT1 picture. To create the vertical alternatives, duplicate alternative 0 by drawing a lasso around it and selecting the menu command **Edit > Duplicate**.
7. Rotate alternative 0 through 90 degrees (menu command: **Arrange > Rotate**).
8. Repeat the same procedure with alternative 1.
9. Export the alternatives using the names "**valve_v1_v_0**" (valve, Version 1, vertical, alternative 0) and "**valve_v1_v_1**".

10. Save the "Status.PDL" picture.



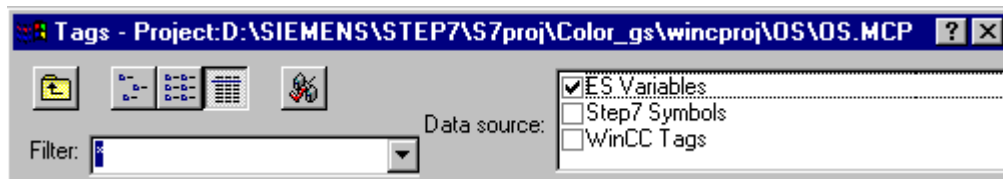
Video

Note:

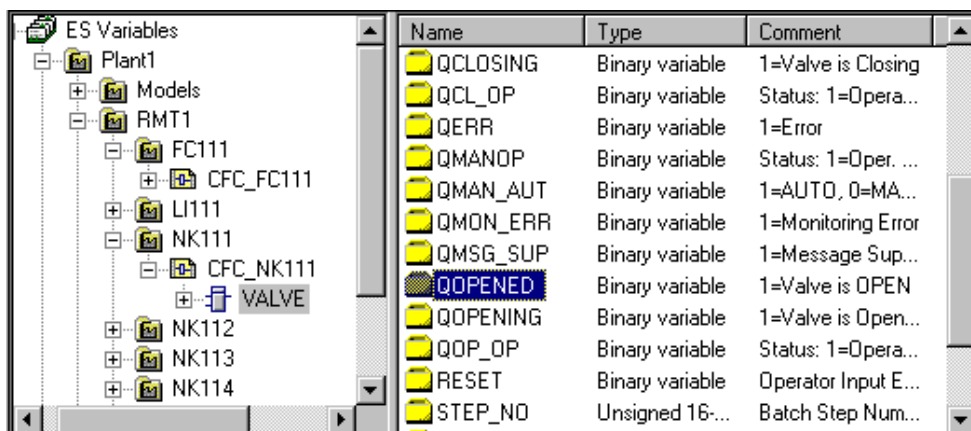
For one status display X, you create the alternatives only once (template). You can then use them as often as required in any pictures. If you require a different status display Y (other form, other color etc.), you should create the required alternatives once etc.

Configuring the Status Display

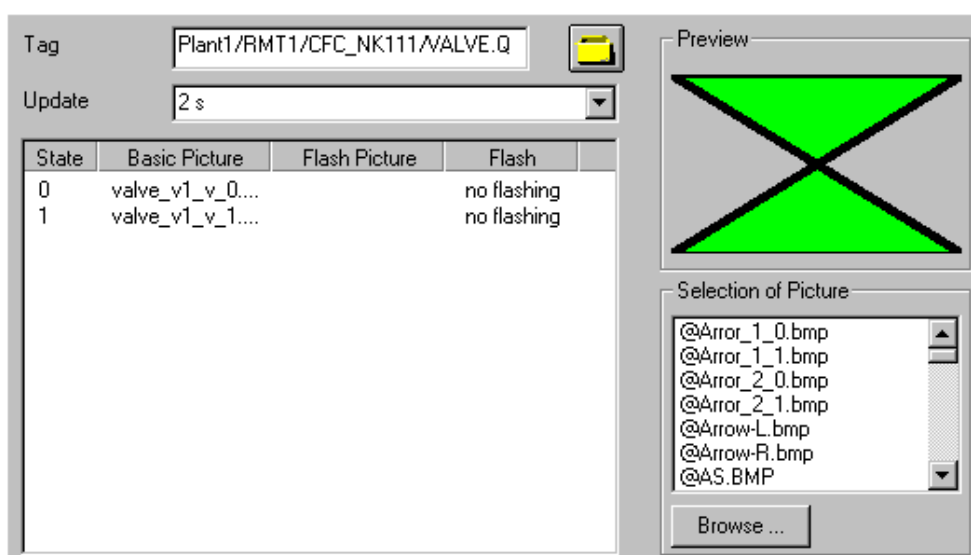
1. Select the RMT1.PDL process picture (menu command **Window**) and select the "**Status Display**" object (**Object Palette/Smart Objects**).
2. Drag the status display to the required size in the picture RMT1.
3. In the "Status Display Configuration" window that is then opened, click the tag browser button 
4. In the tag browser, click the "**ES**" check box and press the "Update Button" (refer to the figure below). If the update button does not appear, deselect the "WinCC Tags" check box.



5. Now connect the status display with the "QOPENED" parameter of the valve block in the "**CFC_NK111**" chart (Plant1 > RMT1 > NK111 > CFC_NK111 > VALVE).



6. Add the State 1 to the status display (click the "Add" button in the "Status Display Configuration" dialog box).
7. Assign the file "valve_v1_h_0" to the basic picture of Status 0 and the file "valve_v1_h_1" to the basic picture of Status 1.
(Drag it from the picture selection window to the "Basic Picture" column).



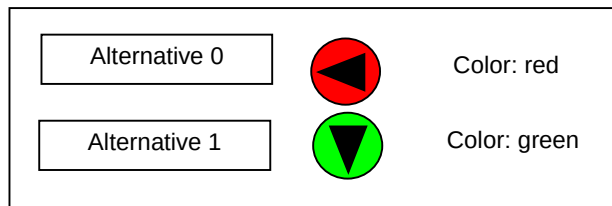
8. Close the configuration of the status display with the **OK** button.
9. Position the valve in the gap below the first pipe of the container (see also the figure in Inserting a Text Field).
10. Duplicate this status display (**Edit > Duplicate**), click the duplicated status display with the right mouse button and then select the **Configuration Dialog**.
11. Connect the status display with RMT1/NK112/CFC_NK112/Valve /QOPENED and close the configuration dialog.
12. As described above, create a status display with two alternatives (horizontal) for the valves "NK 113" and "NK 114".

13. Connect the status displays with the following variables:

Valve Name	Tag in the Tag Browser
NK113	RMT1/NK113/CFC_NK113/Valve/QOPENED
NK 114	RMT1/NK114/CFC_NK114/Valve/QOPENED

14. As described in the section "Creating Symbols for the Alternatives", create **two alternatives** for pump "**NP111**", ("pump_v1_v_0" and "pump_v1_v_1") in the Status.PDL picture. Use the objects **Circle** and **Polygon** from the object palette.

Tip: You can put together individual elements to form a single element. With the picture open (Graphics Designer), click each individual element while holding down the shift key and then select "Edit > Group > Group".



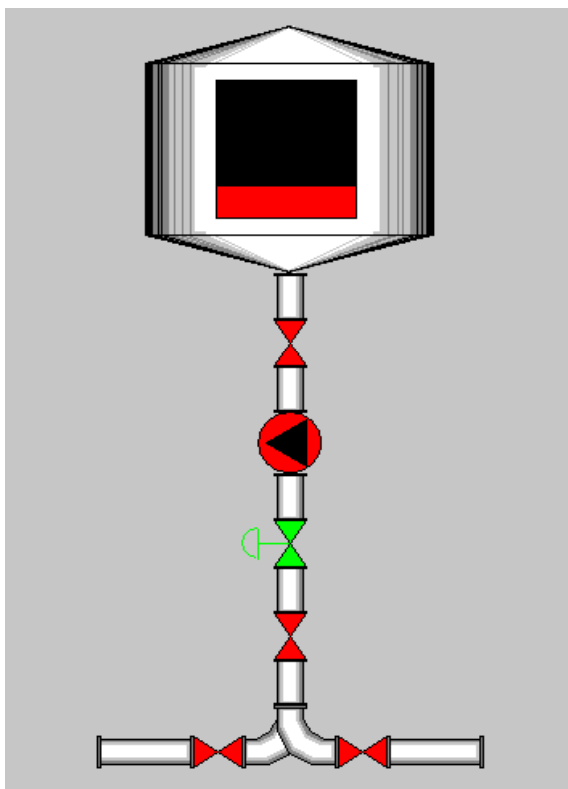
15. Change to the **RMT1** process picture and create the status display for the pump **NP111**. Follow the same procedure as described in Steps 2 to 7.
16. Using the tag browser, interconnect the status displays of the pump with output **QRUN**" of the MOTOR block "**NP111**".

You have now created the required status displays. You can use the alternatives you created in the Status.PDL picture throughout the entire project using the file names specified for export.



Video

The following figure shows the current status of your process picture.



7.7 Displaying I/O Fields

Operator input and visualization is made using I/O fields that you will insert now.

1. Select the I/O Field in the Object Palette under Smart Objects.
2. Open an I/O field beside the valve **FC 111** (see also the figure in the section Inserting a Text Field).
3. Interconnect this I/O field with the output "**LMNR_IN**" of the CTRL_PID block "Plant1/RMT1/FC111/CFC_FC111/CTRL_PID". Using this I/O field, you can check the setting of the valve during run time.



Video

4. As described above, now include a further I/O field beside the valve **NK 112**.
5. Interconnect this I/O field with the parameter "**I0**" of the OP_D block "Plant1/RMT1/FC111/CFC_FC111/PARA_DOS_RM1_SEL".
With this I/O field, you can decide which reactor (1 or 2) will be filled (value 1 > fill tank 1; value 0 > fill tank 2).

The next step is to set the color of the I/O fields. Follow the steps outlined below:

6. Click an I/O field with the right mouse button and select **Properties**.
7. In **Colors**, change the **Background Color** and the **Border Color** to **light gray** (double-click the color following the text border color or background color).
8. Close the **Object Properties** dialog box.
9. Do the same for the second I/O field.

The reactor selection field (I/O field beside valve NK 112) must now be converted to a binary numeric format. Follow the steps outlined below:

10. Click the I/O field with the right mouse button and select **Properties**.
11. In **output/input**, change the data format to **binary** (double-click on the text after the "Data Format" field) and set the **output format** to **1**.
12. Close the Object Properties dialog box.

To input the required dosing volume (setpoint) and to check the actual volume dosed (actual value), you require two further I/O fields that should be located using the procedure described above beside the pipe to Reactor 2 (see also the figure in Inserting a Text Field). Connect the setpoint to the tag **Plant1/RMT1/FC111/CFC_FC111/ PARA_DOS_RM1_ VOL.U** and the process value with the tag **Plant1/RMT1/FC111/CFC_FC111/ Dose.PV_OUT**. The default for the I/O fields is 3 places. As default, you dose, however, 5000 liters (4 places). Change the properties of the two I/O fields accordingly.

13. **Click** the I/O field of the setpoint with the right mouse button.
14. Select "**Properties**" and then select "**Output/Input**".
15. In the right-hand window, double-click "**Output Format**" and set the output format to "**9999**".
16. Close the properties of the object.
17. Repeat the steps for the I/O field of the dosing actual value.

7.8 Inserting a Text Field

Text fields are used to allow you to label objects and to simplify the assignment of the picture objects to the process for the operator.

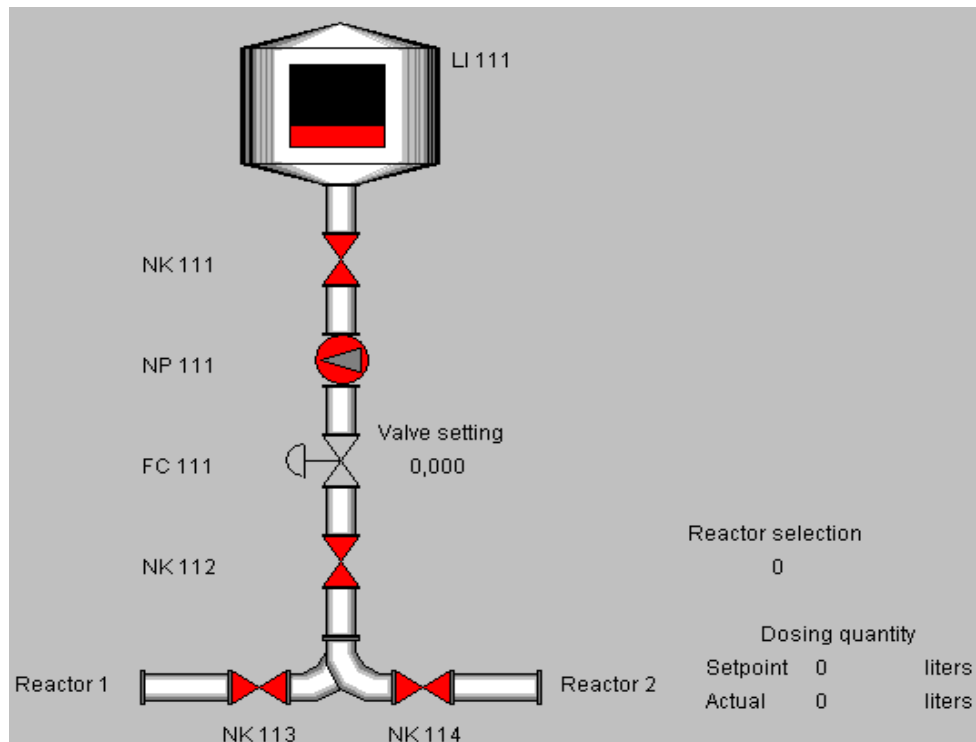
1. Find Static Text in the Object Palette in the Standard Objects and select it.
2. Open a field approximately 3 cm long beside the NK 111 valve.
3. Type in "**NK111**" and press the **Enter** key on your keyboard.
4. Click the text box with the right mouse button and select **Properties**.
5. Under **Colors**, change the **Background Color** and the **Border Color** to **Light Gray**.
6. Close the Object Properties dialog box.



Video

7. Duplicate the text field and change the text to "NP 111" (double-click on the text). Drag the text to a position beside the pump.
8. Create the other text boxes in the same way.

Arrange the objects as shown in the figure below.



7.9 Connecting Tanks with Process Values

The tank you have inserted in your picture is raw material tank 1. You will now connect this tank with the corresponding block on the SIMATIC station. This provides you with the current level of the tank. Follow the steps outlined below:

1. Click the tank with the right mouse button.
2. Select **Properties**.
The **Object Properties** dialog box is opened at the **Properties** tab.
3. Select **Tag Assignment**.
4. To connect the level of this tank with a tag, click the "light bulb" in the **Dynamic** column of the **Fill Level** line in the right-hand window with the right mouse button.
5. Once you have selected the **Tag...**, the tag browser is opened.
6. Now double-click the tag "Plant1/RMT1/LI111/CFC_LI111/LIA.U".
The tag is connected to the tank, the dialog box with the tags is closed and the light bulb in the fill level line is green.
7. Right-click on the "light bulb" after the "**maximum value**" and click "**Delete**".
The default variable is deleted and the default value 100 becomes active.
8. Do the same for "**minimum value**".
9. Close the Object Properties.



Video

7.10 Inserting Faceplates

The next stage is to insert a faceplate for each of the four valves (NK 111 to NK 114) for the controller (FC111) and for the pump. Later, while the simulation is active, these faceplates will display the properties and states of the valves, the controller and the pump. Technically, the faceplates are implemented as OLE controls.

1. Select the Control in the Object Palette in Smart Objects.
2. Open a field (approximately 3 cm wide and 1 cm high) beside valve NK111 holding down the mouse button.

The **Insert a Control** dialog box is opened as soon as you release the right mouse button.

3. From the list, select **PCS7 VALVE Control** and click OK.

This specifies the block type. The next step is to specify the valve from which the faceplate will be updated.

The control field is still selected.

4. Move the **Dynamic Wizard** palette to your graphic (by double-clicking the "Dynamic Wizard" label in the header of the palette).

If the Dynamic Wizard palette is not visible, select the menu command **View > Toolbars** and click the **Dynamic Wizard** option.

5. Enlarge the Dynamic Wizard window in the picture (position the left mouse button on the edge of the window and drag the edge holding down the mouse button).

6. Select the **Standard Dynamics** tab in the **Dynamic Wizard window**.

7. Double-click **Connect picture block to tag structure**.

In the resulting dialog box, the Dynamic Wizard tells you what it will be doing in the next steps.

8. Select **Next**

9. To select a tag, click the **button** beside the empty box.

You can now select the appropriate valve directly.

10. If necessary increase the size of the "**Name**" field so that you can read the complete name.

11. Select the valve block **ES Tags/Plant1/RMT1/NK111/ CFC_NK111/Valve** and click **OK**.

12. In the **Set Options** dialog box, click **Next** and in the next dialog box click **Finish**.

The faceplate is now connected to the correct valve block. Now arrange the display to suit your purposes. Follow the steps outlined below:

13. Double-click the faceplate and select the "**Symbol**" tab in the "**PCS 7 Control Properties**".

14. Set the length of the faceplate to "**110**" (**Width:** field)

15. Set the height of the faceplate to "50" (**Height:** field)
16. Double-click the text "**visible**" after the "**Tag Name**". The text "**invisible**" then appears and the tag name appears only during run-time.
17. Exit the Properties dialog with the **OK** button.



Video

Note:

The next faceplates are inserted in exactly the same way. When inserting the other faceplates you will not learn anything new, however you will have the opportunity to practice inserting faceplates. If you do not need any practice, you can move on to the next chapter.

Insert the next OLE controls following the same steps outlined above but at the following positions and with the following connections.

Position	Control Type	Connection
To the right of valve NP111	PCS7 MOTOR Control	Plant1/RMT1/NP111/C FC_NP111/MOTOR
To the right of valve FC 111	PCS7 CTRL_PID Control	Plant1/RMT1/FC111/C FC_FC111/CTRL_PID
To the right of valve NK 112	PCS7 VALVE Control	Plant1/RMT1/NK112/C FC_NK112/VALVE
Below valve NK 113	PCS7 VALVE Control	Plant1/RMT1/NK113/C FC_NK113/VALVE
Below valve NK 114	PCS7 VALVE Control	Plant1/RMT1/NK114/C FC_NK114/VALVE

You have now inserted all the faceplates you require for the PCS 7 project.

Your pictures are now complete. You can close the Graphics Designer as follows:

1. Save the picture RMT1 (menu command: **File > Save**).
2. Close the Graphics Designer (menu command: **File > Exit**).
3. Confirm the message "Save changes in Status.PDL" with YES.

7.11 Transferring the Data to the Operator Station

General

You have created the hardware configuration for the "COLOR_GS" project, created the CFC and SFC charts and configured the operator station. The last stage is to transfer the parts of the PLC configuration data relevant for operator control and monitoring to the operator station.

Procedure

1. Change to the **SIMATIC Manager** (taskbar of Windows NT).
2. Select the menu command **Options > PLC-OS Connection Data > Transfer**.
3. In the first step "**Introduction**" select the "**Next**" button.
4. You display the step "Which S7/M7 programs do you want to transfer?". Deselect the check box in front of "S7 Models" (models are not transferred to the OS) and select "**S7 Program(1)**".
5. Select the **S7 Program** in the right-hand window click the "**Connection**" button and select the required network via which data will be exchanged between the PLC and OS in run-time. For this example, specify "**MPI**" and close the window with the **OK** button.
6. Click the "**Next**" button.
7. In the step "Select the transfer data and the transfer mode", select the following **transfer options**:
 - Transfer data: "Tags and Messages", "SFC Visualization", "Picture Tree"
 - Transfer: "All" and "Clear operator station(s)"Click the "**Next**" button.
8. Start the transfer by clicking the "**Transfer**" button.
The transfer is started.
9. On completion of the transfer, a warning is displayed telling you that "The transfer was completed with warnings. Do you want to display the log?". If you want to view the log, click "Yes". The warning relates to the "Models" hierarchy folder. Since there is no picture in the "Models" hierarchy folder, this hierarchy is not entered in the picture hierarchy of the OS. Since models contain only model charts that are not relevant to the operator, this is also the desired behavior.



Video

This completes connection configuration.

7.12 Starting the Operator Station

You have now completed the configuration required for the example and can start the run-time system on your PC. This puts you in the position of the operator. During runtime, you can operate and monitor your process. Start run time as follows:

1. Change to the **WinCC Explorer** of the operator station (if this is not already displayed on your screen; taskbar of Windows NT > WinCC Explorer ...).
2. Select the menu command **File > Activate**

The operator station now switches to the runtime mode. During runtime you will first be asked for your login and the corresponding password. Following this, you can change from one process picture to another using the fields (RMT1 and RMT2) at the upper edge of your screen (plant overview).

3. Enter your **Login** and the corresponding **Password** from the user administrator.
4. Click "**RMT1**" in the plant overview.

In the picture "**RMT1**" you can now see the level of the raw material tank.

To start dosing of the raw material, you must start the SFC chart.

Start **SFC Visualization**. Follow the steps outlined below:

5. Click the "**Keyset Change**" button. 
6. Click the "**SFC Visualization**" button .
7. Select your SFC chart **SFC_RMT1**.
8. Click **OK**.

The overview of the SFC chart appears.

9. Double-click a free area of the chart.

The detailed display of the SFC chart appears.

10. Start the chart with the  button in the keyset of the chart.
11. Close the SFC operation window with **OK**.

The SFC chart is started and runs through the steps and transitions. The active step is displayed in bright green and steps that have been completed are in dark green. You can open the active transition (brown) by double-clicking it and can see the satisfied conditions (green line) and the conditions that are not yet satisfied (brown line). The values currently being queried are displayed in the columns "1st address" and "2nd address".

With the default settings, the SFC runs through the right-hand side of the alternative sequence (dosing in reactor 2). If, however, you change the value for the reactor selection (double-click the I/O field below the text) and change it to 1, the next time the SFC starts, dosing will be in reactor 1.

While the process is active, warnings and alarms with messages are displayed in the upper line of your screen.

- Acknowledge the messages with the button to the right of the message line.
You can also view all the messages and alarms in a list. You may need to click the **"Keyset Change"** button to see the **"Alarm Logging"**.



- Click the **"Alarm Logging"** button

From here, you can jump to the various message and alarm lists.

To return to the **"RMT1"** picture,



- Click the **"Previous Graphic Picture"** button

To see the valves and to control them,

- Click a faceplate in picture **"RMT1"**.

A window is opened in which you can monitor the statuses of the valves. If the valve block was enabled for the manual mode, you could also operate it from the operator station.

Note:

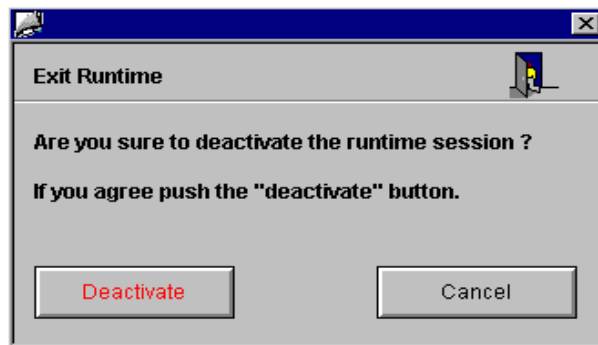
This, of course, does not cover all the options open to you in run-time. Try out some of the other functions and see what happens.

If you do not have a valid license for SFC visualization on your operator station, you will receive a message telling you that your software license has expired and that you should obtain a valid license. Acknowledge this message with the **"OK"** button.

If you want to exit run time,



- click the **Exit Runtime** button"



- Click the **Deactivate** button.

The result:

In this tutorial, you have specified the connection from the PLC to the OS and have transferred the data to the OS on this connection. You have learnt how to create the base data and new users on the operator station. By specifying the picture hierarchy, you have also decided which pictures will be visible at which hierarchy level.

You have learnt how to connect the levels of the tanks to the process. By inserting a text field, the faceplates and the I/O fields you have learnt some of the capabilities of the OS.

You have also configured the startup of the computer and started simulation.

You have now worked through Getting Started completely.

Note:

As an additional task, you can visualize raw material tank 2 extremely quickly and learn how simple it is to create a copy of an existing section of plant. This is not absolutely necessary if you want to run the "COLOR_GS" project!

7.13 Creating Raw Material Tank RMT2 from RMT1 (extra task)

In the following example, you will work more or less alone. You have already worked through the dialogs you require in this Getting Started so that you only need a concept as a basic guideline.

In the "COLOR_GS" project, two identical raw material tanks are required. This means that you can copy the entire RMT1 hierarchy.

1. Change to the SIMATIC Manager and select the plant view of the "COLOR_GS" project.
2. Drag the "**RMT1**" hierarchy folder to the "**Plant1**" hierarchy folder.

The SIMATIC Manager creates a copy of the "**RMT1**" hierarchy folder in the "**Plant1**" hierarchy folder and names it "**RMT1(1)**". A number in the names of the copied CFC charts located in the relevant hierarchy folders will also be incremented.

Note:

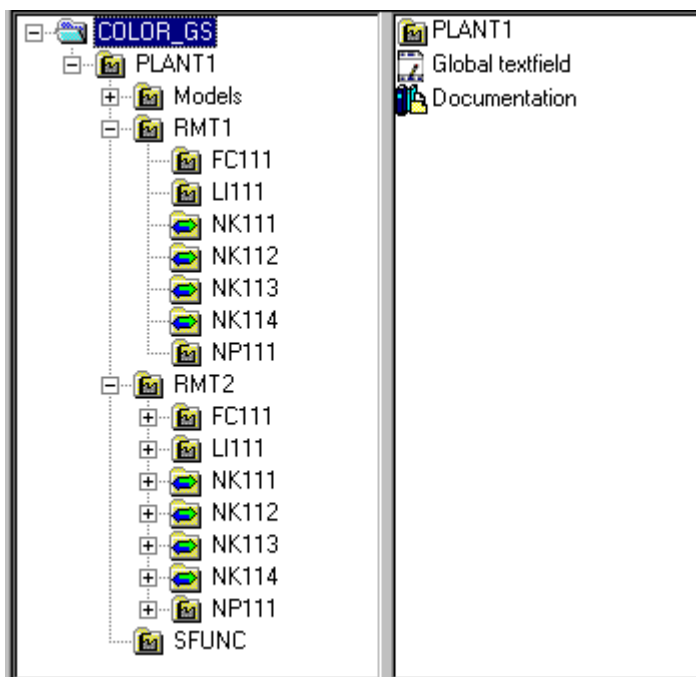
When you copy / move **hierarchy folders** with CFC charts and OS pictures, the references of the dynamic objects from OS pictures to CFC blocks **are included** in the destination hierarchy folder.

If necessary, you can adapt the names of the **hierarchy folders** and the names of the **charts** to your requirements. For the "COLOR_GS" this is, however, not necessary.

Caution:

If you copy or move the charts and pictures separate from the hierarchy folder; in other words **only selected contents**, the references of the dynamic objects are **lost** and must be linked to the blocks again in the pictures. This also applies to renaming CFC/SFC charts.

By copying the complete hierarchies, you have created the hierarchy folders along with the CFC charts.

**Note**

You can also interconnect blocks across sheet or chart boundaries. For more detailed information on these topics, refer to the online help.

Adapting the SFC_RMT2 Sequential Control System

The SFC_RMT2 sequential control system is a copy of the SFC_RMT1 sequential control system.

All the access within the sequential control system is to blocks of the "RMT1" technological area.

You only need to adapt these to the "RMT2" area if you want to automate the second raw material tank. Simply call up the individual actions and transitions in the copied SFC chart, check them and adapt them to the variables where necessary.

Compile the charts again and download them to your CPU.

Transferring PLC-OS Connection Data

1. Transfer the PLC/OS connection data
(refer to Transferring the Data to the OS, the run time must not be active).
2. Open the picture RMT2 and adapt the texts to raw material tank 2 (for example valve NK 111 becomes valve NK 115 etc.).
3. Check and, if necessary, change the tag links of the status displays (right mouse button > Configuration Dialog).
PLANT1/RMT1/NK111/CFC_NK111/Valve.QOPENED becomes, for example, PLANT1/RMT2/NK111/CFC_NK118/Valve.QOPENED etc.
4. Check and, if necessary, change the tag assignments of the faceplates (double-click on the faceplates).
5. Check and, if necessary, change the tag assignments of the I/O fields (right mouse button > Configuration Dialog).
6. Check and, if necessary, change the tag assignment of the tank (refer to Connecting Tanks with Process Values).
7. Save the picture and check all your changes in run time.

Glossary

A

Access

Chart elements or block I/Os can access addresses, charts, block I/Os, or run-time groups. A distinction is made between read and write access.

Access Path

Setting in the  setting the PG/PC interface tool. In the "access path" tab, you assign a module parameter set to an access point. This means that the applications that use this  access point, access the module belonging to the module parameter set.

Access Point

Setting in the  setting the PG/PC interface tool. An access point establishes the connection between an application, an interface parameter set, and a module

Acknowledge Tag

The "acknowledgment state" of a message is entered in the acknowledge tag. This allows a central signaling unit to be activated using the acknowledge tag.

Acknowledgment (OS Message System)

A pending message can be confirmed in two ways:

Single acknowledgment: Messages that do not have the attribute "group acknowledgment capability" must be confirmed individually.

Group acknowledgment: Using a group acknowledgment, all the individual messages visible in a  message window and that have the attribute "group acknowledgment capability" are confirmed together.

Acknowledgment Philosophy (OS Message System)

The acknowledgment philosophy is the way in which a message is displayed and processed from "entering state" to "leading state". In the OS message system (Alarm Logging), the following acknowledgment philosophies can be implemented:

- Single message not requiring acknowledgment
- Single message requiring acknowledgment of entering state
- Single message requiring acknowledgment of leaving state
- Initial value message with single acknowledgment
- New value message with single acknowledgment
- New value message with double acknowledgment
- Message without "leaving state" status not requiring acknowledgment
- Message without "leaving state" status requiring acknowledgment

Acoustic Indicator

Horn, bell, buzzer or similar as an acoustic indication that a new message has arrived at the operator station (in run-time).

Action

(SFC) Actions allow the activation or deactivation of run-time groups and SFC charts as well as modifications to blocks and shared resources by assignments to their input parameters. The actions are formulated in the Properties dialog.

Address

An address identifies a specific address or address area, examples: Input I12.1; memory word MW25; data block DB3. An address can be specified in either absolute or symbolic form.

Address

An address is part of a STEP 7 instruction and tells the processor what it should perform an operation on. It can be addressed in symbolic or absolute form. In SFC, the address is part of an assignment (step) or condition (transition).

Addressing, Absolute

In absolute addressing, the address is the absolute memory address of the value with which the instruction will be performed. Example: The address Q4.0 identifies bit 0 in byte 4 of the process image output table (PIQ).

Addressing, Symbolic

In symbolic addressing, the address to be processed is specified in a symbolic form (instead of an absolute address). The assignment between the symbol and address is made in the symbol table.

Alarm Logging

Editor for configuring the message system within the operator station and application for displaying, archiving and handling messages.

Alarm Logging Wizard

Dialog-guided menu for creating default settings for the message system within the operator station.

Alternative Sequence

(SFC) A structural element that consists of at least two sequence paths. Only the path whose transition condition is satisfied first is processed by the PLC.

ANSI

American National Standardization Institute

ANSI-C

Part of the C programming language standardized by ↑ ANSI.

Archive

The operator station saves measured values and messages in archives so that the data can be called up over a longer period of time.

Archive Log (OS Message System)

To log the messages, the OS message system provides the ↑ message sequence report and the archive report. With the archive report, you can print out the status changes of messages stored in an archive. In the run-time system of the OS for example, the operator can set a filter for a message page (for example all alarms since 12:00 o'clock) and then output the filtered messages to a printer by clicking the appropriate button.

AS Interface

The actuator-sensor interface is a network system for binary actuators and sensors at the lowest field level.

Associated Value

Current process value that you attach to a message triggered on the SIMATIC station (PLC). On the message page of the operator station, the message along with the current measured value appears in a line (for example 5.5 bar pressure too high).

Autosensing

With Fast Ethernet, ports of the DTEs are capable of both 10 Mbps and 100 Mbps. When Autosensing is active, the maximum transmission rate of the DTE is detected and set at the port.

B

Base Data

Base data includes the ↑ Split Screen Wizard and the ↑ Alarm Logging Wizard.

Basic Operation

Basic operations (BOPs) are objects in the system that provide simple functions such as AND, OR etc. They are displayed as blocks in CFC.

BATCH Flexible

Software for automating recipe-controlled batch processes.

Block

Blocks are separate parts of a user program that are distinguished by their function, their structure or purpose.

CFC operates with "off the peg" block types that can be inserted in a CFC chart. When you insert the block, an instance of the block type is created. These block instances and their graphic representation are blocks in the sense of CFC.

Block Attributes

See system attributes

Block Header

The upper part of a block in the display of the CFC chart containing, among other things the name and the task assignment (run-time property).

Block Input

Block I/O that can be interconnected with a block output and ↑ addresses of a compatible data type or that can have values assigned to it.

Block Instance

A block instance is the implementation of a block type. A block type inserted in a CFC chart becomes an instance. After it is inserted, the block instance has run-time properties and a unique name within the chart.

Block Interface

Consists of the inputs and outputs of a block.

Block I/O

Block input or block output

Block Library

↑ Library

Block Output

Block I/O that can be connected to block inputs and ↑ addresses of a compatible data type.

Block Type

The block type identifies the various implementations of blocks. Block types, include for example data blocks (DB), function blocks (FB), functions (FC).

Block Type

Block types are ready-made program sections that can be inserted in a CFC chart (for example controllers, multiplexes etc.). When a block type is inserted, a block instance is created. You can create any number of block instances from a block type.

The block type determines the characteristics (algorithm) for all implementations of this type. The name of the block type is specified in the symbol table.

Branch&Merge

The division of a project into various subprojects (for example every PLC is a subproject and the OS is a further subproject) so that several configuring engineers can work on a project at the same time.

Bus

A path for electrical systems allowing the exchange of data and control information between various components of a computer architecture.

Bus System

Generic term for hardware components and the transmission specification for
↑ busses.

C

C Action

see ↑ scripts

Central Processing Unit (CPU)

The CPU is a central module in the programmable controller in which the user program is stored and executed. It includes the operating system and the communications interfaces.

CFC

Continuous Function Chart.

1. Continuous function chart (CFC chart) with the graphic interconnection of technological functions (blocks).
2. A software package (CFC editor) for plant-oriented, graphic configuration of an automation task. Using CFC, ready-made blocks are put together to form an entire software structure (CFC chart).

Chart

Document in which continuous automation functions can be created with the CFC configuration tool or sequential control systems with SFC.

Chart Element

(SFC) Chart elements are the basic elements (step, transition, text) and structure elements (sequence, simultaneous sequence, alternative sequence, loop and jump).

Chart Folder

Folder in the project structure; this contains the charts of a user program.

Chart-in-Chart Technique

See ↑ nested chart

Chart I/O

You can provide a chart with I/Os to extend your options such as

- inserting the chart in a different chart (↑ nested chart) and interconnecting it with other charts or blocks
- or to compile it as a ↑ block type.

Chart Overview

The overview of a CFC chart (partition) with its six sheets.

Chart Partition

Part of a CFC chart. A CFC chart can be divided into a maximum of 26 chart partitions (labeled: A to Z) each with 6 sheets.

Chart Topology

(SFC) In the chart topology, the chart elements are represented according to fixed syntactical rules (for example order, spacing, extent and arrangement of the elements). The syntactical rules are kept to automatically when you create the chart topology with the editor.

Cold Restart

During a cold restart on an S7-CPU, the organization block OB102 is executed (↑ Startup of an S7-CPU).

The following rules apply to the "Cold restart":

- Data blocks created by SFCs in the work memory are deleted, the other data blocks have the default values from the load memory.
- The process image and all timers, counters, and memory bits are reset regardless of whether they were set as retentive.

During a cold restart, the process image input table is read and the STEP 7 user program is executed starting at the first instruction in OB1.

Commissioning

To support commissioning, the CFC/SFC editor has integrated test functions that allow the sequence of events on the PLC to be monitored, influenced and if necessary parameter settings changed.

Compilation

Conversion of the graphic CFC to a user program (SCL for S7 or C for M7).

Component View

Device-oriented view in the SIMATIC Manager. The project is displayed with its components (station, module, program ...); alternative to the ↑ plant view.

Connection Table

Table for defining communication connections between modules in a network.

Connector

(CFC) The connection point on the block with a reference to the I/O to which it is connected. Connectors are used when no more connecting lines can be drawn on a sheet because it is already full. The connectors allow complex CFC structures including those extending to other sheets to be displayed completely.

Consistency Check

Checks the consistency of block types, shared addresses etc. of the chart folder.

Consistency Error

The output of an error message with detailed information following a ↑ consistency check.

Continuous Archive

After the configured number of data records or after a configured time, the ↑ archive is overwritten cyclically beginning with the oldest data record.

Control and Monitoring Attributes

See system attributes

Control block for SFC

With the SFC control block (SFC_CTRL), you can query the status of an SFC chart and influence its execution in CFC. The control block is inserted in the CFC chart, interconnected, and assigned parameters. It has its own run-time properties and can be modified (along with the SFC chart) in the run sequence. The control block must always be installed immediately before an SFC chart in the run sequence.

CP

Communications Processor - communications module for installation in computers or programmable controllers.

CP 443-1

↑ CP for use in ↑ Industrial Ethernet

CP 443-5 Basic

↑ CP for use in ↑ PROFIBUS

CSV

CSV stands for "Comma Separated Value" and is an ASCII text format in which tabular data are saved. CSV files used in the IEA must have the extension .IEA.

Cycle Time

The cycle time is the time required by the CPU for processing the user program once.

D**Data Block (DB)**

Data blocks are areas in the user program that contain user data. There are shared data blocks that can be accessed by all logic blocks, and there are instance data blocks that are associated with a particular function block call. In contrast to all other types of blocks, they contain no logic instructions.

Data Type

A data type specifies how the value of a variable or constant is used at a block I/O. "BOOL", for example, defines a binary variable; "INT" defines a 16-bit fixed-point variable.

dBase-III

Format of the database program of the Borland company (American software manufacturer).

DCF 77

Time transmitter in Frankfurt/Mainflingen. This provides the highly accurate official time for Germany based on a cesium clock.

Diagnostic Buffer

Battery backed memory area on the CPU in which all diagnostic events are entered in the order in which they occurred.

DOCPRO

Program for creating project documentation.

Download-Relevant Change

A modification in a CFC/SFC chart is download-relevant when it causes a change in the user program of the CPU (for example a change to an interconnection). Modifications that are not download-relevant, for example, include CFC block positions and comments.

DP

Distributed Peripheral I/Os - input/output modules used in a distributed configuration and located away from the CPU. The programmable controller and the distributed I/Os are connected via the ↑ PROFIBUS DP bus system.

DP Master

A master conforming with the PROFIBUS DP standard (EN 50170, previously DIN E 19245, Part 3) is known as a DP master.

DP/PA Coupler

Connectivity module between ↑ PROFIBUS DP and ↑ PROFIBUS PA. This module does not require any parameter assignment.

DP/PA Link

Hardware made up of an IM 157 interface module and several ↑ DP/PA couplers. The DP/PA link connects ↑ PROFIBUS DP with ↑ PROFIBUS PA and must be configured in hardware configuration.

DP Slave

A slave operated on PROFIBUS with the PROFIBUS DP protocol is known as a DP slave.

Dynamic Display

Dynamic display means that the input or output values of a block in the CFC chart or address values in the SFC chart can be updated with the values of the CPU in the test mode.

Dynamic Display Window

Window in CFC for monitoring selected block I/Os on CPUs.

Dynamic Wizard

Configuration dialogs for creating graphic objects, connections to graphic objects, archives etc.

DynWizEdit

Editor for creating ↑ dynamic Wizards.

E**Edit Mode**

(Alternative to the ↑ test mode)

In **CFC**, blocks can be inserted, copied, moved, deleted, renamed, have parameters assigned, or be interconnected.

In **SFC**, the sequential control system is created in this mode. Chart elements can be inserted, copied, moved, deleted, renamed, and assigned parameters.

EMC

Electromagnetic compatibility State in which electrical or electronic devices do not interfere with each other.

EMSR Designation

Elektro-, Meß-, Steuerungs,- und Regelungstechnik designation. Standardized designations for graphic symbols and identifiers in process control engineering.

Enable Attribute

The enable attribute is a run-time attribute. It activates or deactivates a run-time group or an SFC chart. As long as it is deactivated, the group (or SFC chart) is not executed regardless of any other conditions. The enable attribute can be set dynamically. In this case, the output value of a CFC block or the assignment in an SFC Action decides whether the group or SFC chart is activated or deactivated.

ET 200M

This is a modular I/O system for single-tier configuration with the degree of protection IP 20. The ET 200M can be extended with the signal, function and communication modules of the S7-300 programmable controller. Communication between ET 200M and the PLC is on ↑ PROFIBUS DP.

Ethernet

One of the earliest local area networks. Today, Ethernet is used on coaxial cable or fiber-optic cable.

F

Faceplate

A software block written in Visual Basic or Visual C that allows a block instance to be controlled and monitored during run-time on an operator station.

Fail-Safe Systems

Following the failure of a component, these systems change to a fail-safe state to avoid injury to persons and damage to equipment or the environment.

FAQ

Frequently Asked Questions - information on several Internet pages with Tips & Tricks for PCS 7 "<http://www.ad.siemens.de/csinfo>".

Fast Ethernet

Fast variant of ↑ Ethernet. Approximately 10 x faster data transmission.

Fault-Tolerant System

A PLC (S7 400H) in which all the essential components exist twice. If one of the subsystems fails (for example a component failure) the other takes over automation of the plant without any interruption.

FDL Connection

Fieldbus **D**ata **L**ink – Layer 2 of the ISO reference model in PROFIBUS; it consists of Fieldbus Link Control (FCL) and Medium Access Control (MAC).

Function (FC)

According to IEC 1131-3, functions are logic blocks without memory. A function allows parameters to be passed on in the user program. Functions are ideally suited for programming commonly occurring complex functions, for example calculations.

Note: As there is no memory available, the calculated values must be processed immediately following the FC call. See also ↑ block type.

Function Block (FB)

(FUNCTION BLOCK) According to IEC 1131-3 a function block is a logic block with static data. An FB allows you to pass parameters in the user program. This means that function blocks are suitable for programming complex functions that are required frequently, for example controllers, operating mode selection. As function blocks have a memory (instance data block) its parameters (for example outputs) can be accessed at any time and any point in the user program. See also ↑ block type.

G**Global Script**

Editor in the control center of the OS for creating ↑ actions, project functions and standard functions.

GPS

Global Positioning System – satellite system for exact position detection on earth. The individual GPS satellites orbit the earth at a height of approximately 20000 km in different orbits. Each satellite has a highly accurate atomic clock.

Graphics Designer

Editor in the OS for creating plant pictures.

Group Display

Group displays are used for two purposes:

- Displaying of the status of a PCS 7 tag (for example an instance of a MOTOR block) on a process picture on the OS.
- Implementing OR logic for all status information of all PCS 7 tags of a process picture and displaying this information in a process picture of a higher hierarchy level.

Group Message (OS Message System)

In the OS message system (Alarm Logging), there are two types of message: group messages and ↑ single messages. Group messages are used to group together several single messages. The events associated with the single messages therefore only trigger the common group message. The triggering single message is no longer recognizable. One group message can be set up per message class and message type. In addition to this, group messages can also be put together from any selection of single messages.

H

Hardware Catalog

Catalog for selecting PCS 7 components within ↑ HW Config.

HART

Highway **A**dressable **R**emote **T**ransducer - registered trademark of the "HART Communication Foundation" (HCF). Standard protocol for transmission of information between a field device and PLC.

Higher Level Designation (HID)

It is made up of the hierarchical path of the plant hierarchy.

HW Config

Hardware configuration - editor within the SIMATIC Managers for configuring hardware and configuring networks.

I

IEA Editor

A separate application for creating and editing import/export files. When working with the editor, the formats specified for the import/export files are supported.

IM

Interface **M**odule

Import/Export Assistant (IEA)

Software component in PCS 7 for handling ↑ models and generating ↑ replicas of the models.

Industrial Ethernet

↑ Bus system for industrial application based on ↑ Ethernet.

Initial Value Message (OS Message System)

On the OS, a distinction is made between an initial value message and a ↑ new value message. Among a group of messages, an initial value message is the message whose status changed first since the last acknowledgment.

Interconnection

(CFC) Connection between an interface I/O and another element. The value of an interconnected input is fetched from the other end of the interconnection during runtime.

Interface

The interface consists of the inputs and outputs of a block (block interface) or a chart (chart interface) that can be interconnected and assigned parameters.

Internal Block

A block within a $\uparrow$ multiple instance block.

Internet

Worldwide network of UNIX data networks; originating from the university environment. Today, the largest data network worldwide. On the INTERNET, the $\uparrow$ TCP/IP protocol is used.

IP Address

Address of a node on the $\uparrow$ Internet or Industrial $\uparrow$ Ethernet

ISO

International **S**tandards **O**rganization

J

Jump

(SFC) A jump is a structured element in SFC with which the execution of the SFC chart is continued at a different step within the same chart depending on a transition condition.

L

Ladder Logic (LAD)

Graphic representation of the automation task with symbols from a circuit diagram complying with DIN 19239.

Library

A folder for objects that can be used more than once and that is not project-related. Blocks are made available according to certain criteria (block families, alphabetical arrangement etc.) in block libraries. Different block libraries are used depending on the target system or particular situation.

Lifebeat Monitoring

Program belonging to the run-time system (operator station) for monitoring the programmable controllers, ↑ OS servers and ↑ OS clients connected to an OS server. The connected systems are visualized in a plant picture.

Local Data

Local data are the data assigned to a ↑ logic block that are listed in its declaration section or its variable declaration.

Location Identifier

Based on a sequence of letters and numbers, the exact location of a tag within a process plant is defined (in much the same way as a street in a street map). The location identifier can be specified when working with the IEA.

Lock List (OS Message System)

The lock list displays all the locked messages in the system. It is structured like the message window. Locked messages can be unlocked using a button in the toolbar.

Logic Block

A logic block in SIMATIC S7 is a block that contains part of the STEP 7 user program. In contrast, data blocks contain only data.

The following logic blocks exist:

- ↑ Organization blocks (OB)
- ↑ Function blocks (FB)
- ↑ Functions (FC)
- System function blocks (SFB)
- System functions (SFC)

Logs

Apart from the ↑ sequential message log and the ↑ archive log, the configuring engineer can specify a user log with static and dynamic contents in the control center of the OS. During run-time, the log is output cyclically on a printer or as the result of an event (for example clicking a button).

Long-Term Archive (OS Message System)

In a long-term archive, the archive size is decided by the length of time for which the messages are archived. A long-term archive can be set up as a first-in-first-out archive or as a continuous archive. In a first-in-first-out archive, the oldest messages are overwritten when the maximum number of archived messages is reached. In a continuous archive, the messages continue to be written sequentially until the maximum capacity of the storage medium is reached. The messages stored in a long-term archive are displayed in a ↑ message window.

Loop

(SFC) Structure element consisting of a ↑ sequence (S sequence) and a return branch that encloses the S sequence and contains exactly one transition.

LOOP-in-Alarm

Function in the run-time of the OS. After clicking the appropriate button within a message line, the faceplate belonging to the loop is displayed.

M**Machine Code**

The program that can run on a programmable controller. The machine code is compiled by ↑ CFC and downloaded to the PLC.

Memory Reset

During a memory reset, the following memory is deleted on the CPU:

- work memory,
- write/read area of the load memory,
- system memory except for the MPI parameters and the diagnostic buffer.

Message Blocks (OS Message System)

Status changes of a message are displayed in run time in a message line. The information to be displayed in the message line is specified using message blocks. There are three different types block:

- System blocks (for example, date, time, period, comment, ...) allow predefined and not freely usable information to be specified. With assistant blocks, the value of the message block (for example, the time) is displayed in the message line.
- New Sir text blocks allow you to assign up to ten different freely defined texts to a message. With user text blocks, the content of the message block (the user-defined text) is displayed in the message line.

- Using process value blocks, you can display the values of variables in the message line. You can also define the formatting used. With process value blocks, the content of the message block (the variable value specified by the user) is displayed in the message line.

Message Configuration

Creation of messages and their attributes and texts. Messages can be configured within CFC/SFC.

Message Event (OS Message System)

Message events are the messages "entering state", "leaving state" and "acknowledgment". All message events are stored in the message archive.

Message Frames (OS Message System)

Message frames originate either from the process more from the process control monitoring. They are exchanged between the controller (or the monitoring application) and the OS message system.

Message Line (OS Message System)

Each message is displayed in a ↑ message window in a separate message line. The content of the message line depends on the ↑ message blocks to be displayed. With ↑ system message blocks (for example, date, time), the value of the message block for ↑ process and ↑ user text blocks displayed is the content of the blocks (for example, the text you specified).

Messages

A message system is used for the chronological signaling and archiving of sporadic events occurring in the process at a central location. The cause of a message can be an event or a message frame.

In general, a distinction is made between operating messages, fault messages, and system messages. Operating messages are used to indicate a status in the process. Fault messages are used to indicate a problem in the process. System messages are used to indicate error messages from other applications.

In the message system (Alarm Logging), messages that behave in a similar way (acknowledgment philosophy, color scheme for message states) can be grouped together in message classes and message types.

Message Sequence Report (OS Message System)

To log the messages, the OS message system provides the ↑ message sequence report and the archive report. In the message sequence report, all status changes

(entering data, leaving state, confirmed) of currently pending messages are printed out as a single line. Message Class

The message class determines the property of the message. In SIMATIC PCS 7, there are the message classes alarm, warning, tolerance, PLC and OS control system message, process message, operator prompt and operating message. Message classes differ from each other in terms of the acknowledgment philosophy. Messages with the same acknowledgment philosophy can be put together in one message class.

Message Status (OS Message System)

Message statuses are the possible statuses of a message: "entering state", "leaving state", "confirmed".

Message Tag

With the bit message technique, the controller signals the occurrence of an event in the process using the message tag. Several messages can be masked by a message tag.

Message Technique (OS Message System)

The OS message system (Alarm Logging) supports several message techniques: The bit message technique, the technique of chronological messages, and the technique of analog alarms for limit value monitoring.

- With the bit message technique, the controller signals the occurrence of an event in the process using the message tag. The time stamp (date and time) of the message is assigned by Alarm Logging.
- With chronological messages, the controller sends a frame with the data on the message when the event occurs. This is evaluated in Alarm Logging. The time stamp (date and time) of the message is assigned by the controller.
- With analog alarms, the changes in an analog variable can be monitored for upper and lower limit value violations.

Message Texts

These are configured within the blocks in ↑ CFC and transferred to the OS. When a message is triggered, the message texts are output on the message pages.

Message Types (OS Message System)

Message types are subgroups of ↑ message classes and can differ from each other in the color selected for the message status. You can create up to 16 message types in each message class on the OS.

Message Window (OS Message System)

In run time, the status changes of messages are displayed in a message window. The appearance and options for controlling the message window can be defined freely in the Graphics Designer.

A message window contains all the messages still to be displayed in the form of a table. Each message is displayed in its own line, the ↑ message line.

You can influence the content of the message window using definable filters.

Depending on the source of the messages displayed in the message window, a distinction is made between three types of message window.

- Message lists are used to display currently pending messages.
- ↑ Short-term archive windows are used to display messages stored in a short-term archive.
- ↑ Long-term archive windows are used to display messages stored in a long-term archive.

Model

A model consists of hierarchy folders with CFC/SFC charts, pictures, reports, and additional documents from which any number of ↑ replicas can be created.

Model Chart

↑ A CFC chart that exactly represents the model of a commonly occurring structure within a plant configuration. The model chart of a motor controller, for example has exactly the blocks with the corresponding interconnections that are required to control a motor in this plant.

Using the ↑ IEA, the model charts become ↑ models.

Module

- System module
Module required to operate a system (for example programmable logic controller). The system modules include, for example, a power supply, a central processing unit (CPU) and also perhaps a communications module.
- I/O module
Module for acquiring or outputting process signals.

Module Driver

- Input driver
Input drivers adapt the process signals of an input module and provide the signal in CFC for further use.
- Output driver
Output drivers adapt the value formed in CFC and transfer the value to an output module.

MPI Address

In an MPI network, each programmable module must have its own MPI address assigned.

Multiple Instance Block

A block that consists of more than one internal block with a common ↑ interface and common data storage (instance DB).

Multi-Point Interface (MPI)

Interface for linking up to 32 devices (PC, PG, PLC, AS).

Multi-User

Several configuring engineers working at the same time on one project.

N**Nested Chart**

A CFC chart that is inserted in another CFC chart (nested or top chart). Nested charts are not displayed in the SIMATIC Manager.

NetPro

Editor for graphic configuration of networks. NetPro is started within the SIMATIC Manager or the hardware configuration (↑ HW Config).

Network Components

Within the ↑ NetPro, there is a catalog of network components. From this catalog, you can take, for example single stations and interconnect them to form networks.

New Value Message (OS Message System)

On the OS, a distinction is made between a new value message and an ↑ initial value message. Among a group of messages, new value messages are the messages whose status has changed since the last acknowledgment.

O**Office / Works Management Level**

Computer-supported enterprise-wide information system of a company.

Online/Offline

In the SIMATIC Manager, objects of the programmable controller are displayed in the online view and the objects of the ES in the offline view. Online, there is a data connection between the PLC and the programming device/PC; offline there is no connection.

Operating Message

Following a change made to a parameter on the operating station, the parameter, the old value, the new value and if applicable the unit of the value is displayed in a message page.

Operating Mode

1. CPU:

The following operating modes can be set with the mode selector on the CPU module:

- RUN with access to the STEP 7 user program using, for example, the programming device ("RUN-P"),
- RUN with access protection ("RUN"),
- STOP and
- memory reset ("MRES").

2. SFC:

The mode decides how an SFC chart is controlled.

- AUTO (process mode): Execution is controlled automatically, for example using the control block.
- MANUAL (operator mode): Execution is controlled manually by an operator, for example using IBS or SFV (SFC visualization in WinCC).

Operating Response

- Rejecting operating response
A command outside the permitted limits is rejected.
- Limiting operating response
A command outside the permitted limits is accepted but restricted to the maximum permitted limit value.

Operating State

1. The SIMATIC S7 programmable logic controllers can adopt the following operating states: STOP, STARTUP, RUN and HOLD.
2. (SFC) The sequential control system can adopt the operating states OFF, ACTIVE and HOLD.

Operating System

A collective term for all functions which, in conjunction with the hardware, control and monitor the execution of the user programs, the distribution of the operational equipment among the individual user programs, and the maintenance of the operating mode (for example standard operating systems MS-WINDOWS, real-time operating system M7 RMOS32).

Organization Block (OB)

In S7, organization blocks are the interface between the operating system of the CPU and the user program. The order in which the user program is executed is specified in the organization blocks. An organization block corresponds to a ↑ task.

OS

Operator station. A station for controlling and monitoring the process. In PCS 7, the WinCC software system is used for the OS with which all the process monitoring and control functions can be implemented.

Overflow Page

(CFC) An overflow page is created automatically in CFC when there are so many sheet bar entries in a ↑ sheet that there is no longer enough space. An overflow page consists only of the ↑ sheet bars with entries and contains no other objects.

P**Parameter**

A parameter is

1. the value of a CFC block/chart I/O.
2. a variable of an S7 logic block (actual parameter, formal parameter)

PCS 7 Assistant

A multi-page dialog that supports the user when creating a new project in the SIMATIC Manager.

PDM (SIMATIC PDM)

Process Data Manager – software for assigning parameters to DP field devices. SIMATIC PDM is started in the SIMATIC Manager or in HW Config.

PG/PC Interface

A configuration tool for installing/uninstalling communication modules, adding/deleting interfaces and assigning parameters to communications modules (for example bus profile, node number etc.).

Phase Offset

The phase offset moves the point at which the run-time group or SFC chart is activated within the task by a defined value compared with the basic cycle. This achieves a more uniform distribution of load on the CPU. See also ↑ scan rate.

Picture Block

see ↑ faceplate

Picture Hierarchy

The arrangement of the plant pictures on the OS. The pictures are structured at different levels. Each level corresponds to a particular level of detail in the plant. The deeper the level, the more detail is provided with the plant components. The picture hierarchy is shown in the ↑ Picture Tree Manager.

Picture Tree Manager

This is used to manage a hierarchy of plants, units and pictures of the ↑ graphics designer.

Piping and Instrumentation Flow Diagram

Here, the components required in a plant and their interconnections are specified.

Plant Hierarchy (PH)

Structure organized in the form of a hierarchy according to technological aspects.

Plant Picture

see Lifebeat Monitoring.

Plant View

View in the SIMATIC manager according to technological aspects (plant, unit, function ...); an alternative to the ↑ component view.

PLC

The PLC or target system is the programmable controller or a component of the programmable controller on which the user program runs. Target systems include for example SIMATIC S7 and M7.

Priority Class

The ↑ organization blocks are assigned to a particular priority class. The priority class then determines the order in which the organization blocks are called.

Process Control Point

The smallest unit in process control. This satisfies the processing functions of a process variable, such as control, display, alarm etc. from the point of view of process engineering.

Process Image

Reserved areas in the RAM of the CPU. The signal states of the input and output modules are entered in this area.

Processing Phase

(SFC) A step is divided into three processing phases: Initialization, (cyclic) execution, and termination. Each processing phase corresponds to an action with statements.

Process Variable

A neural object in terms of resources. It is used to connect the PLC configuration world (STEP 7, CFC ...) with the OS configuration world (WinCC). It contains information about the location at which it exists at run-time (for example the network address and the memory area on the PLC) as well as information about specify OS-relevant properties.

PROFIBUS

PROcess **F**ield **B**us – a fieldbus complying with EN 50170 Vol. 2 PROFIBUS (DIN 19245; bus system for industrial application based on PROFIBUS).

PROFIBUS DP

DP mode complying with DIN E 19245 Part 3; PROFIBUS DP is a serial bus for the attachment of remote (distributed) peripheral I/Os developed by SIEMENS specifically for the field area.

PROFIBUS PA

The extension of ↑ PROFIBUS DP with optimized transmission for field devices (for example for supplying power to field devices via the data line and for use in hazardous areas) while retaining the communication functions of PROFIBUS DP.

Program

General term for S7 and M7 programs.

Programmable Controller (PLC)

A programmable logic controller is a programmable controller (PLC) in SIMATIC S7, a complete device (PLC with integrated control unit) SIMATIC C7 or a SIMATIC M7 automation system.

Programmable Logic Controller (PLC)

Programmable logic controllers (PLC) are electronic controllers whose function is stored as a program on the controller. Programmable controller has the structure of a computer; it consists of a CPU (central processing unit) with memory, input/output modules, and an internal bus system. The peripherals and the programming language are designed to meet the requirements of control engineering.

Programming Device (PG)

Portable personal computer in a special compact design intended for use in industry. A PG is fully equipped for programming SIMATIC programmable logic controllers.

Project

A folder containing all the objects belonging to an automation solution regardless of the number of stations, modules and how they are networked.

R

Reference Data

Reference data are data available to the user in addition to the graphic chart display in the form of lists, for example the list of access to shared addresses.

Reorganization

During this reorganization, gaps in the PCS 7 project resulting from deleting are eliminated; in other words the memory requirements of the project/library data is reduced.

This function optimizes data storage for the project or library in much the same way as a defragmenter optimizes data storage on a hard disk.

Replica

When you import with the import/export assistant, replicas are created from the models. Each line in an import file creates a replica in the destination project. A replica differs from the model (or from a copy of the model) among other things because instead of an assignment to an import file it has an assignment to a model.

Report Designer

Editor in the control center on the OS for creating and editing logs.

Resources

Resources are sets of objects (FBs, FCs, DBs, OBs, bit memory, counters, timers etc.) that can be accessed when configuring and assigning parameters in a CFC/SFC chart.

Restart

When an S7 CPU starts up (for example after changing the mode selector from STOP to RUN or when the power supply is turned ON), before cyclic program execution (OB1) is started either the organization block OB 100 (warm restart) or organization block OB 101 (hot restart, only on the S7-400) or OB102 (cold restart) is executed (↑ Startup of an S7-CPU). In a warm restart the process image of the inputs in read in and execution of the STEP 7 user program is continued at the point at which it was last stopped (STOP, power down).

The "hot restart" is only possible when the CPU is battery-backed.

All data areas (timers, counters, memory bits, data blocks) and their contents are retained.

Routing

Establishment of communications connections beyond the boundaries of subnets.

Runtime

Process control; the operator controls and monitors the process on the operator station (OS).

Runtime Attribute

Each run-time group has run-time attributes that control how it is activated. The group passes on these attributes to all the blocks it contains.

Runtime Group

Run-time groups are used to structure or group tasks. The blocks are installed in the run-time groups sequentially. Run-time groups activated or deactivated separately. If a run-time group is deactivated, none of the blocks it contains will be activated any longer.

Runtime Properties

The run-time properties of a block determine how the block is included in the processing of the entire structure on the PLC. These properties are vital to the performance of the PLC in terms of reaction times, dead times, or the stability of time-dependent structures, for example control loops.

S

S7 Program

A folder for the ↑ symbol table, the blocks, the source files, and the charts for programmable S7 modules.

Scan Rate

The scan rate is a ↑ run-time attribute. It specifies whether a ↑ run-time group or a chart is executed every time a task is executed or only every nth time. See also ↑ Phase offset.

SCL

High-level language complying with IEC 1131-3 and resembling Pascal for programming complex tasks on a PLC, for example algorithms, data processing tasks.

Script

A program written in ↑ ANSI-C for solving user tasks. Scripts run cyclically/acyclically in the background of the OS run-time or following an event (for example mouse click) on a picture object within a plant picture.

Sequence

(SFC) A structure element consisting of a series of steps and transitions

Sequence Path

(SFC) A sequence is a series of chart elements (in the chart topology seen as a vertical path). A simultaneous sequence or an alternative sequence consists of at least two sequences arranged side-by-side and containing at least one element.

Sequential Archive

The ↑ archive is written sequentially until the configured size is reached or until the storage medium is full (see also ↑ Continuous archive).

Sequential Control System

A sequential control system passes control from one step to the next step dependent on conditions. In PCS 7, sequential control systems are implemented with SFC charts.

Server Name

The server name is required often for addressing a computer (PC) in a network. You will find the server name under "Start (Windows NT taskbar) > Settings > Control Panel > Network > Computer Name".

SFC

An SFC chart represents a ↑ sequential control system that runs as an independent controller in the programmable logic controller.

SFV

Visualization of the SFC chart in the run-time system of WinCC.

Shared Address

Shared addresses are objects that can be addressed by every logic block (FC, FB, OB). These addresses are memory bits (M), inputs (I), outputs (Q), timers (T), counters (C) and elements of data blocks (DB). It is possible to access shared addresses in absolute or symbolic form.

Shared Data Block

This is a block that can be accessed by all blocks in the program. Every CFC block instance can read the shared data from such a block or can write data to the block. Shared data blocks are created with the LAD or STL editor.

Sheet

(CFC) Subdivision of a chart partition. A ↑ chart partition consists of 6 sheets. The sheet is a working area (with sheet bars) on which blocks are positioned, assigned parameters and interconnected.

Sheet Bar

(CFC) The margin at the right and left-hand edge of a sheet. The sheet bars contain:

- The references to connected objects (block/chart interface, address, run-time group) that are not located on the current sheet.
- the number of the connector reference when the connecting line cannot be drawn to the sheet bar because the chart is full.

Short-Term Archive (OS Message System)

In a short-term archive, you specify the size of the archive by the number of messages to be archived. A short-term archive can only be created as a first-in-first-out archive. Once the maximum number of archived messages has been reached, the oldest messages are overwritten. A maximum of 10000 status changes of messages can be stored in a short-term archive. The messages stored in a short-term archive are displayed in a ↑ message window.

SICLOCK

Master clock in Industrial Ethernet.

Sign of Life Monitoring

see ↑ Lifebeat Monitoring

SIMATIC Manager

Graphic user interface for the SIMATIC user under Windows NT. With the SIMATIC Manager, for example, you create projects and access libraries.

SIMATIC Station

see ↑ Programmable logic controller (PLC)

Single Message (OS Message System)

In the OS message system (Alarm Logging), there are two types of message: single messages and ↑ group messages. With single messages, each event is assigned a message.

Source File

Part of a program created with a graphic or textual editor and from which the executable user program is produced following compilation.

Split Screen Wizard

Dialog-guided menu for creating basic data and settings within the operating station.

Startup of an S7-CPU

The CPU distinguishes between the following startup types: ↑ : cold restart, ↑ hot restart or ↑ warm restart. This is selected using a software switch in the object properties of the CPU (HW Config).

Statement List (STL)

Statement List is a textual programming language resembling machine code (complying with IEC 1131–3).

Status Tag (OS Message System)

The status tag contains the "entered state/left state" status of the message type and an ID for messages requiring acknowledgment.

Step

(SFC) The step is an element of a ↑ sequential control system and the control instance for processing the assigned ↑ actions. Each step consists of the three actions: Initialization, (cyclic) processing, and termination.

Step Control Mode

(SFC) Mode by which control passes from step to step:

- C (confirmation by operator)
The sequential control system runs controlled by the operator.
- T (transition only)
The sequential control system runs controlled by the process.
- T or C (transition or confirmation by operator)
The sequential control system runs process-controlled **or** controlled by the operator.
- T and C (transition and confirmation by the operator)
The sequential control system runs process-controlled **and** controlled by the operator.

Step Types

(SFC) SFC recognizes different step types:

- Initial step
- Normal step
- Final step

Storage

An editor for exporting archives (process value archives, curve archives). Storage is started and the settings are made in the control center of WinCC.

Structure

A structure is a structured ↑ data type made up of several elements. An element can be an elementary or a structured data type.

Structure Element

(SFC) Structure elements consist of an arrangement of basic elements. These include the following: "sequence", "simultaneous sequence", "alternative sequence", "loop" and "jump".

Subnet

Self-contained part of a bus system.

Symbol

A symbol is a name selected by the user defined according to syntax rules. This name can be used in programming or in operating control and monitoring once it has been defined (for example, as a variable, a data type, a jump label, or a block)..

Example: address: I5.0, data type: BOOL, symbol: Emer. Stop Switch.

Symbol Table

A table used to assign symbols (= name) to addresses for shared data and blocks.

Example: **Symbol Address**

Emer. stop I1.7,
Controller FB24

System Attributes

System attributes can be divided into two groups:

- Block attributes and

- parameter attributes.

The attributes assigned additional properties to blocks and parameters of blocks (for example automatic inclusion in certain processing levels, or making parameters invisible etc.).

System Resources

When you download the user program to a PLC currently in the run mode, it is important that the newly downloaded sections of program do not exceed the system resources. Exceeding these resources would cause the PLC to change to STOP. System resources include, for example, the local data, the load memory, the work memory, the maximum number of blocks (for example, FB, DB,...), the maximum number of communication blocks, the cycle time, etc.

T

Tag Browser

The tag browser integrated on the OS provides information on the existing tags and allows interconnection to the OS objects (for example, I/O fields).

Tag List

List of all the measuring points in a plant section or a project. The list contains the following information for each tag:

EMSR designation, type of tag, location, measuring range, unit, signal meaning, comment

Tag Logging

An editor in the control center of the OS for creating and editing curves.

Task

Tasks are the interface between the operating system of the CPU and the user program. The order in which the user program is executed is specified in the tasks. A task corresponds to an organization block (OB) in S7 and a priority class in M7.

Task/OB

A task is the interface between the operating system of the M7 CPU and the user program. The tasks are mapped on RMOS tasks (see ↑Task).
In S7, the tasks are implemented as ↑ Organization Blocks (OBs).

TCP/IP

Transport **C**ontrol **P**rotocol / **I**nternet **P**rotocol – the standard for communication between UNIX computers and on the ↑ Internet.

Teleservice

From a central point, it is possible to investigate errors and their causes directly on the PLC or OS of the customer. The service center is linked by a modem and special software (for example Laplink or PC-Anywhere) in the customer system.

Test Mode

(Alternative to the ↑ edit mode) mode in CFC/SFC for testing and optimizing the user program running online on the CPU.

Textual Reference

A textual reference can be used to configure access to chart I/Os inside or outside the current chart folder and even chart I/Os that do not yet exist. After merging the 2 charts, this connection can be closed. If the charts are separated, the connections are opened, but are retained as textual references.

Time-of-Day Synchronization.

see ↑ Time Synchronization.

Time Synchronization

An editor in the control center of the OS. Time synchronization makes sure that all the PLCs and operating stations of the bus operate with the same time of day (time of day synchronization).

Top Chart

CFC chart that is not inserted in another chart and that is displayed in the SIMATIC Manager (↑ nested charts).

Topology

Physical structure of a system.

Transfer

The "PLC-OS Engineering" transfer program transfers the PLC configuration data for operating control and monitoring created on the PLC to the data management of the operator station. The program is started in SIMATIC manager.

Transition

(SFC) The transition is a basic element of SFC and contains the conditions under which a sequential control system passes control from one step to the next.

Transition/Transition and Acknowledgment (T/T and C)

(SFC) Step control mode "T/T and C". The sequential control system runs process-controlled at steps **without** the T/T and C flag (just as in the T mode) and operator controlled at steps **with** the T/T and C flag (just as in the T and C mode).

U**Update Cycle**

In the test mode, this specifies the intervals at which the watched values of the block I/Os are updated.

User Administrator

Editor in the control center of the OS for creating and editing access permissions for operator control and monitoring during Runtime.

User Block

A block written by the user in SCL or Statement List in which the user formulates the required functions. A user block consists of the program source file and the block type from which the instances are created in CFC.

User Object

An object on the operator station made up of different single object (I/O boxes, bars, texts etc.) that is used to display and control several parameters of a block instance.

User Program

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

In S7, the user program on the ES consists of the symbol table, the source files, the blocks and the charts.

V

Value Identifier

Symbolic substitute (text) for defined values of block I/Os of the data types BOOL, BYTE, INT, DINT, WORD and DWORD.

W

Warm Restart

When a CPU starts up, the organization blocks are executed as described in ↑ Startup (↑ Startup of an S7-CPU).

The following rules apply to the "warm restart" (assuming the CPU is battery-backed):

- All data blocks and their contents are retained
- Retentive timers, counters, and memory bits are retained; non-retentive timers, counters, and memory bits are reset.

During a warm restart, the process image input table is read and the STEP 7 user program is executed starting at the first instruction in OB1. In PCS 7, this is the only startup type permitted.

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