SIEMENS

SIMADYN D

System- and communication configuring D7-SYS

Manual

Edition 12.2003

Safety guidelines

This Manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the Manual by a warning triangle and are marked as follows according to the level of danger:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

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We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Editions

SIMADYN D

Manual

System- and communication configuring D7-SYS

Edition 12.2003

NOTE

Please note that the current edition of this documentation contains different editions of the individual chapters. The following overview tells you when a chapter was revised the last time.

Overview (chapter editions)

Chapter		Edition
	Foreword	Edition 12.2003
1	In just a few steps to the first project	Edition 12.2001
2	Systemsoftware	Edition 03.2001
3	Communications configuring	Edition 12.2003
4	Changeover from STRUC V4.x to D7-SYS	Edition 03.2001
5	Closed-loop thyristor current control	Edition 06.2002

Foreword

Purpose of this Manual

This Manual explains the principle use and functions of the STEP 7 automation software with the main focus on the appropriate technological and drive control components T400, FM 458-1 DP, SIMADYN D, SIMATIC TDC or D7-SYS.

Basic knowledge required

This Manual addresses programmers and commissioning engineers. General knowhow regarding automation technology is required in order to understand the contents of the Manual

Validity of the Manual

This Manual is valid for SIMATIC D7-SYS Version 6.1.

Additional support

If you have questions relating to the use of the products described in the Manual, which cannot be answered here, then please contact your local Siemens office. You can also call the Hotline:

- **Tel.:** +49(9131) 98-5000
- **Fax:** +49(9131) 98-1603
- **e-mail:** adsupport@siemens.com

Training Center

Appropriate training courses are available in order to make it easier to get to know the SIMADYN D automation system. Please contact the central Training Center in D-Erlangen (I&S IS INA TC):

- **Tel.:** +49(9131) 7-27689, -27972
- **Fax:** +49(9131) 7-28172
- **Internet:** www.siemens.de/sibrain
- **Intranet:** http://info-tc.erlm.siemens.de/

NOTE

This user part of the Manual does not include any detailed information/instructions with individual descriptions, but is only intended to provide a basic procedure. More detailed information on the dialog boxes in the software and how they are handled is provided in the appropriate online help.

Information overview

This manual is part of the overall documentation for the technological and drive control components T400, FM 458, SIMADYN D, SIMATIC TDC and SIMATIC D7-SYS:

Title	Content
System and communications configuring D7-SYS	**The first project in a few steps** This Section provides an extremely simple entry into the methodology when assembling and programming the SIMATIC TDC/SIMADYN D control system. It is especially conceived for first-time users of a control system. **System software** This Section provides basic know-how about the structure of the operating system and an application program of a CPU. It should be used to obtain an overview of the programming methodology, and basis for configuring user programs. **Communications configuring** This section provides you with basic know-how about the communication possibilities and how you configure links to the communication partners. **Changeover from STRUC V4.x to D7-SYS** Essential features are included in this section, which have changed over STRUC V4.x with the introduction of SIMATIC D7-SYS.
STEP 7 option packages for D7-SYS	**Basis software** This section explains the essential use and the functions of the STEP 7 automation software. For first users, it provides an overview on configuring, programming and commissioning a station. When working with the basis software, you can access the online help which provides you with support when it comes to detailed questions on using the software. **CFC** The CFC language (Continuous Function Chart) allows you to graphically interconnect blocks. When working with the particular software, you can also use the online help which can answer detailed questions regarding the use of the editors/compiler. **SFC** Configuring sequence controls using SFC (Sequential Function Chart) of SIMATIC S7. In the SFC editor, you generate a sequence chart using graphic resources. The SFC elements of the chart are then positioned according to specific rules.
Hardware	The complete hardware spectrum is described as reference in this Manuals.
Function blocks	These Reference Manuals provide you with an overview of selected function blocks for the associated technological and drive control components T400, FM 458-1 DP, SIMADYN D and SIMATIC TDC.

Guide

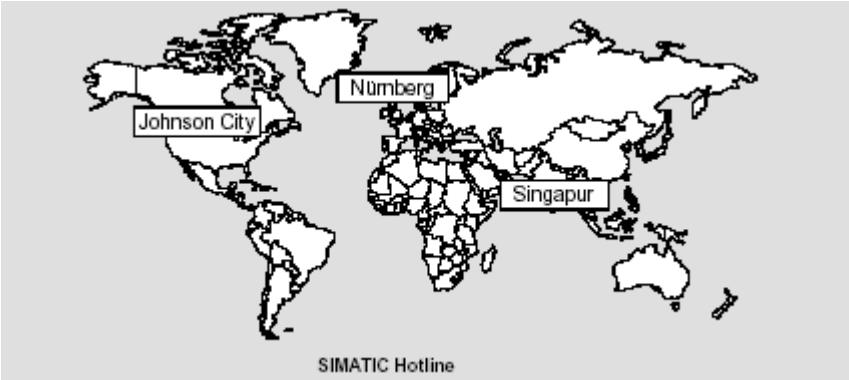
As first time user, we recommend that this Manual is used as follows:

- Please read the first section on using the software in order to get to know some of the terminology and basic procedure.
- Then use the particular sections of the Manual if you wish to carry-out certain processing steps (e.g. loading programs).

If you have already executed a small project, and have gained some experience, then you can read individual sections of the Manual in order to get up to speed about a specific subject.

Automation and Drives, Service & Support

Can be accessed globally at any time of the day:



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Contents

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1 In just a few steps to the first project

Section overview

1.1 Prerequisites

Introduction

These brief instructions are intended for introductory level personnel and it outlines the basic procedure when generating a project.

More detailed information about the dialog boxes of the development software and their processing is provided in the corresponding online help.

1.1.1 Software and hardware

Software

Three software packages

- STEP 7
- CFC
- D7-SYS

must be installed precisely in this sequence on your PG/PC with Windows 95/98/ME/NT 4.0/2000. Authorization is required for STEP7 and CFC.

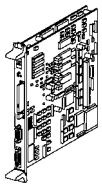
NOTE

The installation and user instructions are provided in the particular "readme" files. Please observe the interdependencies between versions!

When installing STEP7, you will be prompted for the online interface, however, for SIMADYN D nothing has to be selected and installed. ("Close" window and exit the following window with "OK".)

Hardware

You will require the following hardware components for the "My First Project" project example:

Components	Function	Diagram/Order No.
SR6 subrack with power supply 6 slots, backplane PC board with L bus, without fan	... if the subrack is for a SIMADYN D station. ... it is used to mechanically accommodate the modules and supply them with power.	 **6DD1682-0BB0**
CPU module PM5 *(at slot 1)*	... executes the user program. ... exchanges data with other modules via the backplane PC board of the subrack. ... communicates with a PG/PC via the serial interface.	 **6DD1600-0AJ0**

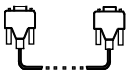
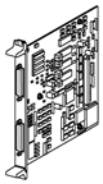
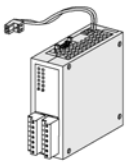
MS5 program memory module *(for PM5)* PC card standard, 2 Mbyte flash memory and 8 Kbyte EEPROM	... saves the operating system, the user program and the online changes.	 **6DD1610-0AH0**
PC cable SC 57 Zero-modem cable	... connects the CPU module to the PG/PC.	 **6DD1684-0FH0**
Expansion module IT41 *(at slot 2)* 16 digital inputs and outputs, 8 analog inputs and outputs, 4 incremental encoder inputs.	... expands the CPU module by technology-specific functions. It is especially fast, as it is directly screwed to the CPU module and the backplane bus is not used.	 **6DD1606-3AC0**
Interface cable SC 54 Length: 2 m	... connects the inputs/outputs of the IT41 module with up to 5 SBxx or SU12 interface modules.	 **6DD1684-0FE0**
Interface module SB10 2 x 8 screw terminals, LED displays	... allows you to test the user program during commissioning and in operation, as the statuses of the digital outputs are displayed using LEDs.	 **6DD1681-0AE2**

Fig. 1-1 Module list for the project example "My First Project"

NOTE It is also possible to use other hardware platforms (T400, FM 458) by appropriately taking this into account in the configuring.
Technical data is provided in the SIMADYN D Hardware Manual, additional ordering information in Catalog DA99.

1.1.2 What you can expect

From the task to the first project

The example "My First Project" guides you step-by-step to a project which can actually run.

1. **Analyze the particular task**
   This allows you to identify the function blocks, inputs and outputs which you require and which hardware:
2. **Define the hardware**
   You will use this hardware information in STEP7 in order to enter the modules and define your particular properties.
3. **Configure and compile**
   You generate the configured software in CFC using the function blocks and compile this. You can configure the hardware after all of the checks have been made.
4. **Test the configuring software**
   You can now run the program, tested online and change it on the SIMADYN D modules.
5. **Archive the project**

You can subsequently apply this procedure for you own applications.

The task

The task comprises two sections:

1. A **sawtooth generator** with a fixed frequency, outputs its value via a D/A converter.
2. **Running Lights** with 8 channels.

To start off with, define the individual functions for the appropriate sub-tasks and define the necessary hardware:

1. Sawtooth generator

A sawtooth waveform is generated by an integrator, which resets itself after an upper limit has been exceeded. The integrator value is output via an analog output.

2. Running light

Eight comparators compare the sawtooth value with constant values. The results are output through digital outputs and control the LEDs on the interface module.

The running light has the following phases:

- All of the LEDs are dark.
- The LEDs are switched bright and then dark again so that only one is bright at any one time.

1.2 Creating a new project

Step	Procedure	Result
1	**Double-click** on the symbol  . (if the STEP 7 Assistant starts, cancel this.)	The SIMATIC Manager is opened.
2	Select **File > New**. Enter **"My First Project"** into the dialog box, Project. In the dialog box, select the path **„LW:\Siemens\Step7\S7proj"**. Click on **OK**.	Your new project is displayed.
3	Select **Insert > Station > SIMADYN D station**.	The "**SIMADYN D station"** hardware object is inserted.

1.3 Defining the hardware

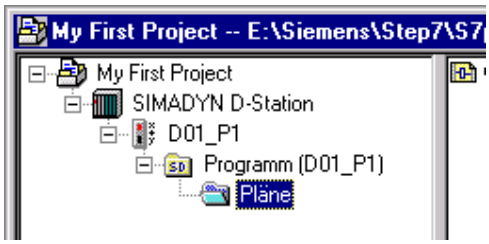
The SIMADYN D subrack structure is entered in STEP 7 (HW Config).

Step	Procedure	Result
4	Select the hardware object **"SIMADYN D station"** and select **Edit > Open object**.	**HW Config** is called-up.
5	Open it, if required, the hardware catalog with **View > Catalog**.	The hardware catalog with all of the available family of modules is opened.
6	Select the **SR6** from the **SIMADYN D** family of modules and Catalog **Subracks** and drag it to the (upper) window	The subrack is displayed with six slots.
7	Locate them one after the other **>CPU Modules >PM5** at slot 1 **>Expansion Modules >IT41** at slot 2 **>Slot covers >SR81** at slots 3 to 6	The subrack is equipped.
8	Open the properties dialog box of the PM5 CPU module with **Edit > Object properties**.	The PM5 dialog box with general module information and the setting registers for addresses, basic clock cycle, cyclic tasks and interrupt tasks are displayed.
9	Select the basic sampling time T0 (in this case: 1 ms) under the **basic clock cycle** tab. Click on the **cyclic tasks** tab and set the sampling time T1 to 2 ms and T2 to 4 ms. Click on **OK**.	The required sampling times are entered. The properties dialog box is closed.

10	Open the properties dialog box of module IT41 using **Edit > Object properties**.	The IT41 dialog box with general module information and the setting tab for addresses is displayed.
11	Under the **Addresses** tab, click on the **Pre-assign** button. Click on **OK**.	All of the addresses are assigned symbolic names for subsequent use in CFC charts.
12	Check your hardware with **Station > Check consistency**.	If fault/error-free, continue with Step 13, otherwise check the hardware configuration.
13	Compile your hardware configuration with **Station > Save and compile**.	The hardware has been fully configured.

1.4 Generating a CFC chart

1.4.1 Generating a new chart

Step	Procedure	Result
14	Change into the SIMATIC Manager and open the project tree up to the Charts object. Select the charts by clicking on them.	
15	Generate a new CFC chart twice with **Insert > S7 software > CFC** .	The CFC 1 and CFC 2 charts are displayed as new objects at the righthand side of the project window.
16	Select chart CFC2 in the project window and open the properties dialog box with **Edit > Object properties** . Enter the "sawtooth generator" name. Click on **OK**.	You obtain the properties dialog box of the CNC chart. The Properties dialog box is closed.
17	Repeat step 16 with the CFC2 chart and re-name it "Running lights".	The charts appear in the project window under their new name.

1.4.2 Inserting, parameterizing and inter-connecting function blocks

Step	Procedure	Result
18	Select the "sawtooth generator" chart and open the "CFC Editor with **Edit > Open object**.	The CFC Editor is opened with the working area (>1 sheet) and the block catalog. (Catalog missing? Select **View > Catalog**) (>1 Sheet? Select **View > Sheet** view)
19	Open the family of blocks **Closed-loop control** and drag the function block **INT** (integrator) to the working area.	The block is now located on the sheet and has the ID for running in cyclic task T1.
20	Open the properties dialog box of function block INT with **Edit > Object properties** .	The INT dialog box with general block information and the setting tab I/O appears.

21	Under the **General** tab, change the name to „sawtooth“.	
22	Under the **I/O** tab, enter the values for the block inputs, e.g. • X = 1 • LU = 11250 • TI = 5 ms Click on **OK**.	The Properties dialog box is closed and the function block inputs now have values assigned.
23	First **click on** output QU and then on input S.	The output QU (upper limit) is now coupled back to input S (set).
24	Select **DAC** (analog output) from the block family **ON/OFF** and locate it next to function block INT. Open the dialog box using **Edit > Object properties** and change the name to "analog output“. Enter, for example under the **I/O** tab: • DM = 0 • OFF= 0 • SF = 1E6 Click on **OK**. Select connection AD (hardware address), and call-up the dialog box to interconnect the object with **Insert > Connect to operand**. Then mark the selection window. Select the first entry and click on **OK**	The block inputs are parameterized. The hardware address of the first analog output channel is assigned.
25	In the "sawtooth“ block, **click** on output Y and after this on input X in the "analog output" block.	The sawtooth generator is connected to the analog output.

All changes made in the CFC chart are immediately saved.

Proceed the same for the second sub-task (running lights) (from step 18). Change into the SIMATIC Manager, open the CFC chart "running lights" insert the function blocks into the CFC chart, parameterize and connect them.
All of the necessary information (number of blocks, types and block parameters) can be taken from the following diagrams. Arrange the first function block and all others, via
Edit > Run sequence in cyclic task T2. The connection between the "sawtooth" block and the comparators is realized by changing the CFC window (**Window > ...**).

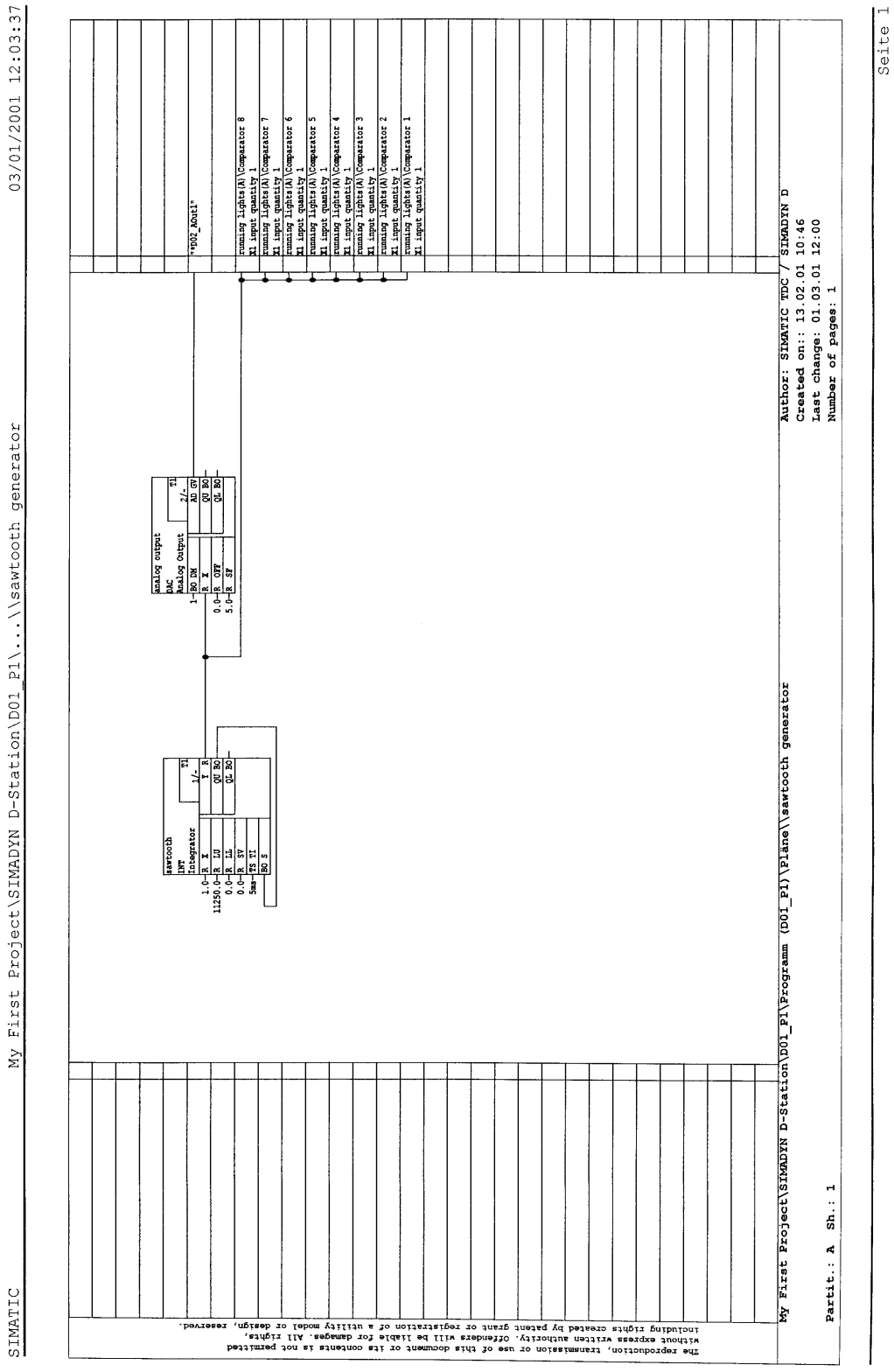


Fig. 1-2 "Sawtooth generator" chart

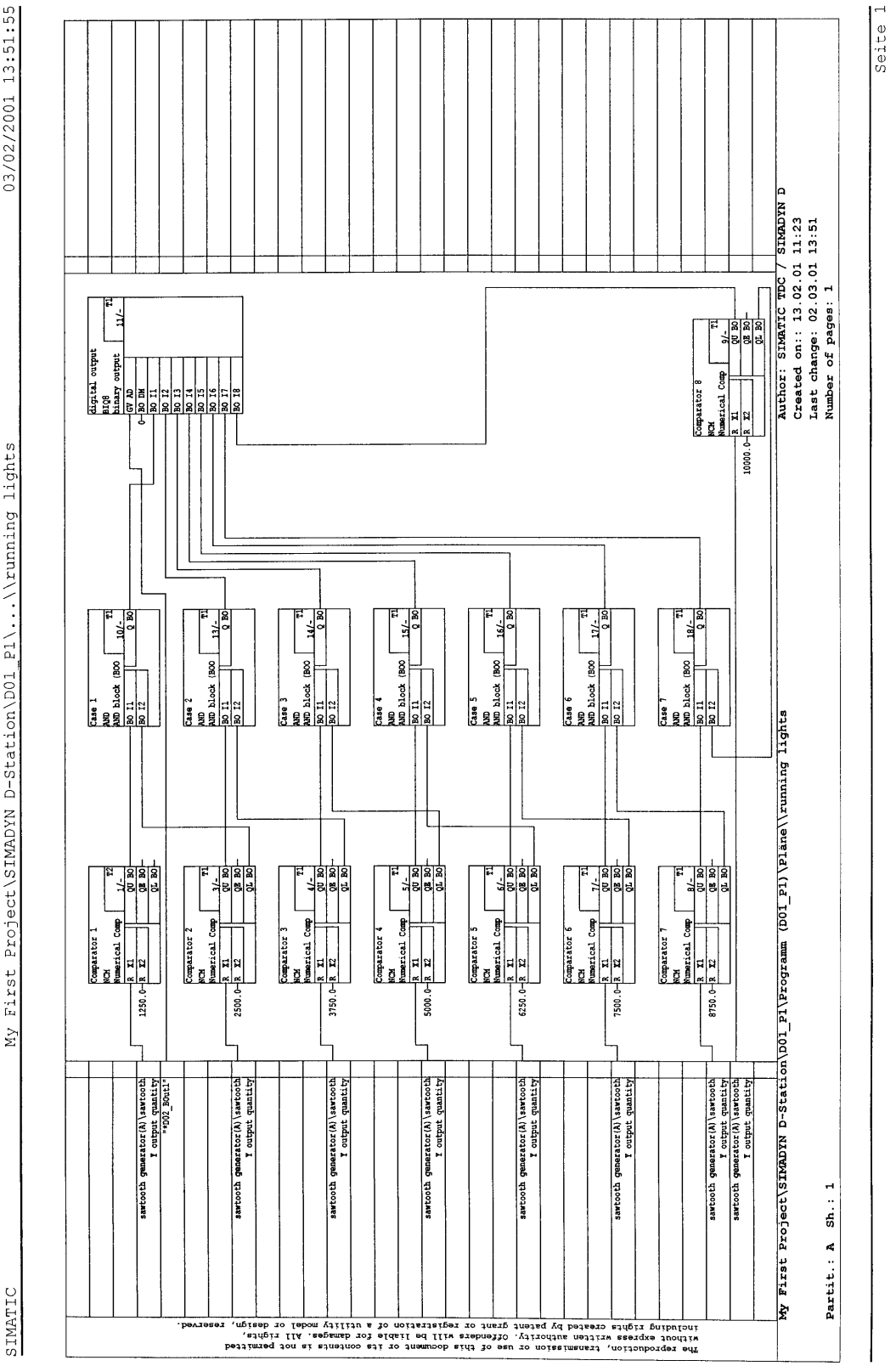


Fig. 1-3 "Running lights“ chart

1.5 Testing, compiling and downloading the project

1.5.1 Checking the project consistency and compiling

Step	Procedure	Result
26	Start the consistency check of your project with **Chart > Check consistency > Charts as program**, then **OK**. **Acknowledge** the dialog window or evaluate the error messages via **Details**.	The result is displayed in the dialog window.
27	Start to compile the project after a successful consistency check with **Chart > Compile > Charts as program**, then **OK**. **Acknowledge** the dialog window or evaluate the error messages using **Details**.	The result is displayed in a dialog window. You have created your first user project.

1.5.2 Downloading the user project into the SIMADYN D-CPU module

Introduction

SIMADYN D allows you to

- download online or
- offline.

Downloading offline

Maybe you do not have a connection from your PC/PG to the SIMADYN D station, which is why you can use the possibility of downloading into a memory module.

Step	Procedure	Result
28	Select **Target system > Download**.	You will obtain a dialog window with options.
29	Select "User program" and "Offline" Insert the memory module into the PCMCIA slot of the PG/PC. Start to download with **OK**.	A progress display shows how the system and your user program are being downloaded into the memory module.
30	Insert the memory module into the SIMADYN D station and re-start it.	Your user program is then started.

Downloading online

You have established a connection from your PC/PG to SIMADYN D station, and you can download the program memory module into the CPU module.

Step	Procedure	Result
28	Check whether your SIMADYN D station (hardware) is correctly configured, assembled and connected.	Observe the configuration instructions and connection possibilities for the individual hardware components in the appropriate hardware documentation!
29	Insert the memory module into the CPU module and start the SIMADYN D station.	A flashing zero appears on the CPU module display
30	Install the interface between the SIMADYN D station and the PC in the SIMATIC Manager using the menu command: **Options > Set PG/PC interface...**.	You obtain a dialog window "Install/uninstall interfaces" in which the various interfaces are listed.
31	In the dialog window, select "DUST1 protocol" and install this protocol with **Install→** Acknowledge with "yes" and then **close** the dialog window. Select the interface used and acknowledge with "**OK**".	You obtain a dialog window in which you can decide, by entering either "Yes" or "No" whether you wish to immediately go online. The "Set PG interface dialog window" is displayed where you can select the access route "DUST1 (COM1)" or "DUST1 (COM2)".
32	Select the **Target system > Download**.	You obtain the dialog window with options.
33	Select the "System and user program", "Online (COM1)" and initialization when first downloading the user program. **Note:** If a user program is downloaded again, you can also specify "User program" without "initialization". Start with "download"	A progress display shows how the system and your user program are being downloaded into the memory module. If download has been completed, the dialog window "Operating status" is displayed with the "STOP" status and a 1 is displayed on the CPU module.
34	Start the SIMADYN D station with "Restart" and then select "Close". **Note:** If you use an SR6 subrack, then you must manually initiate a restart using a "RESET" at the subrack.	Your user program is started and the "Operating status" dialog window is displayed with the "RUN" status.

1.6 Testing the user project

Introduction

In the test mode, you can

- Monitor the values of block I/O and change the values of block inputs,
- Generate and delete connections, and
- Insert and delete blocks.

The values which are registered for test, have a yellow background. You can easily monitor the behavior by changing parameters at the block inputs.

Before you start the test, please check whether the following prerequisites are fulfilled:

- You have established a connection between the PG/PC and your SIMADYN D station.
- You have downloaded the actual project into the memory module, which is located in the CPU module.
- The associated CFC chart (e.g. "running lights") has been opened.

Step	Procedure	Result
35	Select the menu command: **Target system > Compare**, to display the "Compare" dialog field.	The CPU name with data and time of the last compilation between the actual configured software and the current CPU program are displayed. If they match, the result is: "The configuring and the CPU program match". You have checked that the PG/PC and the SIMADYN D station can communicate.
36	Select the menu command: **Test > Test settings** Enter the refresh period for the screen display in tenths of seconds. Acknowledge the change with "OK".	In the test mode, the values of the I/O are updated cyclically on the screen with the selected refresh period. If the computation time is not sufficient to fulfill the refresh periods, then you will be warned. The closed-loop control always has the higher priority
37	Before you go into the test mode, change over the test mode from "Process operation" to "laboratory operation" with **Test > Laboratory operation**. **Note:** In "Process operation", the default setting is that **no** I/O are registered for monitoring. In this test mode, you must select the appropriate blocks and explicitly log them-on for monitoring.	This means that all of the block I/O are automatically switched-in for "monitoring" (the values have a yellow background).
38	Select the menu command: **Test > Test mode**	The "Test: RUN (laboratory)" text appears with a green background in the status bar. In the test mode, you can monitor and change the dynamic behavior (online).

1.6.1 Disconnecting the connection online

Procedure In the CFC chart, using the mouse pointing device, select the block I/O which you wish to disconnect. Then remove this with **Edit > Delete**.

Result The connecting line between the I/O disappears and at the I/O, the last value, which was transferred on the connection, is displayed as parameter value.

NOTE Connections to global operands can neither be generated online nor deleted.

1.6.2 Generating a connection online

Procedure In the CFC chart, using the mouse pointing device, select the block I/O where you wish to establish a connection.
With the changeover key pressed, now select the block I/O to which this connection should be made.

Result The connecting line between the selected I/O is generated, and the actual parameter value, which is presently being transferred, is displayed at the output.

1.6.3 Changing the parameterization online

Procedure Select the block input whose parameter value is to be changed, by double-clicking. The dialog box "Properties I/O" is displayed in which you can change the value.

Result You can immediately identify the effect of the change in the CFC Chart

1.6.4 Inserting a block online

Procedure Using the command **View > Catalog**, call-up the block catalog. Open the block family and drag the selected function block to the working area.

NOTE Not all of the function blocks can be inserted online. Refer under "configuring data" in the online help for the block.

1.6.5 Deleting blocks online

Procedure Select the function block and remove it using the command **Edit > Delete**.

1.7 Results

You have now got to know some of the simple handling operations in the CFC configuring. You now know how a project is created using the SIMATIC Manager, how a CFC Chart is generated and function blocks inserted from a library. You have interconnected and parameterized the function blocks. You have generated a program which can run and which has been downloaded into the CPU. You can observe and modify the dynamic behavior in the test mode

You can now review the results for the project example "My First Project“ in **process operation** if you have assembled and connected-up the necessary hardware of the SIMADYN D station (refer to Table 1-1, Section 1.1.2).

Sawtooth generator

In order to view the sawtooth, you must first connect an oscilloscope to the SIMADYN D station. The following table shows the assignment of the pins at output connector X6 of expansion module IT41. The output voltage range extends from -10 V to +10 V.

Pin	Function	Output
15	Analog output 1	Sawtooth
48	Ground	

Table 1-1 Excerpt from the pin assignment of IT41, connector X6

Running light

You can observe the running light function at the LED display of interface module SB10.

1.8 Archiving the project

Step	Procedure	Result
44	In the SIMATIC Manager, select **File > Archive**.	The "archiving" dialog field is displayed.
45	In the dialog field "Archiving", select the user project with "My First Project“. Click on **OK**.	The "archiving - select archive dialog field" is displayed. The default file "My_first.zip" has already been entered with archiving path.
46	In the dialog field "archiving - select archive", when required, change the file name and/or the path and then click on "save"	The project is now saved in the selected path and filenames as zip file.

NOTE When you select menu bar **File > De-archive**, the archived project can always be re-established with this particular release.

2 Systemsoftware

Overview

2.1 Configuring

2.1.1 General description

This Chapter provides instructions and support when configuring SIMADYN D. It explains the general requirements when configuring SIMADYN D hardware and software.

It is assumed that the reader is knowledgeable about Windows 95/98/NT, handling the SIMATIC Manager, HWConfig and the CFC Editor; they will not be explained in this document. The configuring instructions are illustrated using diagrams and graphics. These illustrations are intended to highlight specific features, and do not necessarily precisely illustrate the CFC window. This Manual does not discuss the hardware (e. g. CPUs, memory modules, cables etc.), even if hardware designations are used in the configuring examples; if hardware information is required, then please consult the "Hardware" User Manual.

This Manual is sub-divided into the following Chapters:

- General description
- Configuring the hardware
- Creating CFC charts
- Operating statuses of a CPU module
- Configuring example for a CPU module
- Using signal transfer mechanisms
- Significance and uses of the process image
- Significance and uses of the CPU synchronization
- Significance of processor utilization

To implement most of the applications, the information in Chapter "General description" up to the Chapter "Creating CFC charts" is sufficient. More detailed information regarding special system characteristics of SIMATIC TDC/SIMADYN D is described in the following Chapters.

2.1.1.1 Configuring tools

In practice, a configuring engineer can select the required hardware modules from a module spectrum and achieve the desired technological functions by generating function diagrams and block diagrams. SIMATIC TDC/SIMADYN D supports these activities using ***HWConfig*** (configuring tool to define the hardware configuration of SIMATIC TDC/SIMADYN D stations) and ***CFC*** (block technology using numerous standard function blocks).

2.1.1.2 Configuring steps

SIMATIC TDC/SIMADYN D is configured in the following sequence

1. The hardware configuration is generated, and
2. The CFC charts are created.

2.1.1.3 Terminology and libraries

Assigning a name

When configuring SIMATIC TDC/SIMADYN D, the names to be assigned must be as follows:

- Station names
  - max. 24 characters
- Modules
  - maximum length, 6 characters.

Sequence	Characters permitted	Example
First character	Alpha- and special characters	A-Z, @
Second character	Alphanumeric characters and special characters	A-Z, 0-9 , _ , or @ if the first character is @
Additional characters	Alphanumeric characters and special characters	A-Z, 0-9 , _

Table 2-1 Nomenclature when assigning names to modules

- Chart- and function block names
  - when both names are connected, the total number of characters may not exceed 24.

Name	Max. length	Permitted characters	Characters which are not permitted
Chart	22		*, _, ?, <, >, |
Function block	16		“

Table 2-2 Nomenclature when assigning names to charts and function blocks

- Comments
  - for modules, maximum of 255 characters
  - for charts, maximum 255 characters
  - for function blocks and parameters, max. 80 characters

- Connections (I/O) with special functions have the following suffixes:
  - the dollar symbol "$" (connecting signals between CPUs),
  - the star symbol "*" (symbolic hardware addresses),
  - or the exclamation mark "!" (virtual addressing).

HWConfig or CFC automatically enter these suffixes. A function block name may only appear once on a CPU. The name syntax and rules are checked when entered.

Libraries

Hardware modules and function block types are saved in libraries. The required function blocks can be called-up from the libraries using HWConfig or the CFC editor.

Several function block libraries can be used for each CPU. The "FBSLIB" standard function block library is pre-assigned. It has over 200 function blocks, whose functionality is sufficient for most applications. When required, additional supplementary libraries can be imported for the particular CPU. The libraries can be found in the directory "step7\s7cfc\sdblocks\std (SIMADYN D) or ...\tdc (SIMATIC TDC)".

2.1.2 Configuring the hardware

Configuring SIMADYN D stations

HWConfig is used to configure the hardware of SIMATIC TDC/SIMADYN D stations. A SIMATIC TDC/SIMADYN D station consists of a rack with up to 20/8 CPUs and other hardware modules. When required, several stations can be coupled with one another. The modules to be configured can be selected from the modules in the HWConfig hardware catalog. Racks, CPUs, I/O modules, coupling modules etc. can be selected.

HWConfig defines the system hardware configuration as result of

- the rack used together with the defined bus structure (bus termination, Daisy Chain),
- the configured hardware modules inserted in the rack as well as
- defining hardware-relevant information such as tasks, synchronization etc.

2.1.2.1 The first step: Selecting the hardware modules

Short overview of the hardware

The following modules are available in the HWConfig hardware catalog:

Hardware	Description
Subracks	Various types depending on the slot number, bus configuration, cooling etc.
I/O modules	Peripheral modules to input/output process signals (analog-binary I/O, speed sensing signals etc.)
Expansion modules	Peripheral modules to input/output process signals. They are used to achieve higher data rates by bypassing the backplane bus, and are directly connected to a CPU module.

Hardware	Description
Communication modules	Modules to provide communication utilities
Communication buffer modules	Modules to transfer data between several CPUs
CPU modules	Modules on which the configured open-loop or closed-loop control program is executed. A maximum of two expansion modules can be inserted next to a CPU.
Special modules	Modules with special functions.
Slot covers	Slot covers cover empty slots against dirt accumulation and as EMC measure
Sub-modules	A sub-module is inserted in or on a module, e. g. a memory module for a CPU or an interface module for a communications module
Technology components	Subracks as well as modules for drive converters

Table 2-3 Hardware components

Further information
Refer to the " SIMATIC TDC/SIMADYN D hardware“ Manual for the individual modules which can be selected.

Using HWConfig, a module is configured, possibly with a sub-module for every subrack slot. This provides a precise image of the rack as it is in reality while the hardware is being configured. When selected, each module is given a name (recommended) which can be changed in accordance with the syntax for names. Slot covers must be provided for those slots which remain empty.

2.1.2.2 The second step: Parameterizing the hardware modules

After they have been selected, the modules must be parameterized using HWConfig. The following must be set

- the sampling times of the cyclic tasks,
- synchronizing cyclic or interrupt-control tasks of several CPUs of a station,
- the process interrupts and comments

Various parameterizing dialog windows are provided in HWConfig for this purpose.

Parameterizing dialogs in HWConfig

The pre-settings of the modules can still be changed in the module dialog windows. For instance, the parameterizing dialog for CPU modules includes the "Cyclic tasks" information. This allows the sampling times of 5 cyclic tasks to be changed.

Designation schematic

At least one rack and all of the modules and sub-modules which it accommodates must be configured in HWConfig. When a module is generated, a recommended module name is assigned. This recommended name can be overwritten as long as it conforms to the maximum name length (max. 6 characters) and the character exists (refer to the Chapter "General description"), with (A-Z,0-9,_,@). It is recommended that the names are selected according to the schematic in the following table for the plant/system components:

Hardware	Logical name	Designator	Significance
Subrack	An00	n	Subrack number, starting at 1
CPU	Dxy_Pn	xy n	Slot number CPU number
Sub-module	Dxyj	xy j	Slot number Sub-module number
Communication buffer module	Dxy__A	xy	xy = slot number
Rack coupling	Dxy__B	xy	xy = slot number
Serial couplings	Dxy__C	xy	xy = slot number
Other modules	Dxy	xy	xy = slot number

Table 2-4 Designation schematic for the hardware configuration in HWConfig

Slot number definition

The slot number of a module specifies the number of the slot in the subrack where the actual module is configured. For a SR24 with 24 slots, these are slots 1 to 24.

All sub-modules of a module are consecutively numbered starting from 1. The sub-module which is located at the top of the table is number 1.

The recommended CPU rack name is 6 characters long. The logical processor number (in the rack, from left to right) is displayed in operation, independently of the assigned name on the 7-segment display of the CPU module.

NOTE The configured module names within a station must be unique.

The various tasks of a SIMADYN D CPU

The configured function blocks are processed via

- 5 cyclic tasks and/or
- 8 interrupt tasks.

The start of an interrupt task with respect to the instant that the process interrupt was initiated can be offset by a freely-configurable delay time.

SIMADYN D system chart

The system chart, in which the behavior/characteristics of the 7-segment display, acknowledge button etc. is configured, is administered in a newly created SIMATIC TDC/SIMADYN D program, and may not be deleted. The sampling time of the system chart is pre-assigned in the factory at approx. 128 ms.

2.1.2.3 The third step: Checking the configuring

When the hardware configuration has been completed, the configured data must be verified using a consistency check over the complete station. The complete hardware configuration is checked using HWConfig. If the software has bugs or is incomplete, these are displayed and can be „debugged“ (refer to the Chapter "Configuring example of a CPU module").

2.1.3 Creating CFC charts

Description of the CFC editor

A CFC chart (Continuous Function Chart) is generated using the CFC editor. This is a configuring tool to describe continuous processes by graphically interconnecting complex functions in the form of individual function blocks. Thus, the CFC is used to graphically implement a technological application by interconnecting and parameterizing function blocks. For a configuring engineer this means that he can program using a system which is closely related to block diagrams.

CFC chart structure

A CFC comprises of several CFC charts, each with 6 sheets. Each sheet can have a different number of various function blocks. The actual number is only limited by the graphic layout. In the overview of the CFC editor, all 6 sheets of a chart are displayed, and in the sheet view, an individual sheet can be displayed in detail. The function blocks which can be called-up in the CFC editor are sub-divided into function block classes, which include the interconnected (associated) functional scope. For instance, this can include logic blocks, arithmetic blocks etc.. Each function block class in turn includes a number of various function block types.

The CFC editor defines the technological configuring by:

- selecting, interconnecting and parameterizing the configured function blocks,
- defining of the sequence characteristics of the function blocks,
- generating programs to program the CPU memory modules.

2.1.3.1 The first step: Selecting the function blocks

The various function block classes are available in the FBSLIB standard library. The individual function blocks can be called-up using the CFC editor, and located on the chart sheets. Individual blocks or block groups can be subsequently deleted, shifted and copied at any time.

Additional information
For further information on the function blocks refer to the Reference Manual "SIMADYN D function block library".

2.1.3.2 The second step: Parameterizing and interconnecting function blocks

After the function blocks have been selected, these are interconnected and parameterized using the CFC editor. The task, in which the individual function blocks are computed, must also be defined.

Parameterizing dialogs in the CFC editor

By double clicking on the function block header or under the menu selection **Edit > Object characteristics**, the following data can be configured deviating from the pre-settings:

Data	Description
General	The name and a comment text which is displayed in the function block header can be configured. Under "special object properties" you can execute the steps which are necessary to prepare a block for operator control and monitoring using WinCC.
Run-time properties	Here, the execution sequence of a function block, defined under function block insert, can be changed within a task. The selected function block can be "searched for", "cut-out" in the execution sequence, and "inserted" in another position.
I/O	The following I/O data can be entered here for all parameters: • value and comment for input and output parameters • visibility in the CFC chart for parameters which are not interconnected • set or inhibit parameter ID for test • scaling value for parameters, REAL data type • texts for the various units

Table 2-5 Configuring function blocks

Additional information
Refer to the Manual "TEP7 Optionspakete für D7-SYS, Section CFC".

Defining the run-time properties

Function blocks which are consecutively executed within a task can be combined to form a run-time group. In addition to structuring the task, this allows task execution to be individually enabled/disabled.

NOTE

If a run-time group, is disabled via a function block input which is connected to it, then all of the function blocks contained in it are no longer computed.

By assigning the function blocks to a cyclic or interrupt-controlled task or run-time group and defining the position within the task or run-time group the configuring engineer can define the run-time properties of the function blocks. These properties are decisive for the characteristics of the target system as far as

- deadtimes,
- response times,
- the stability of time-dependent structures.

Assigning the function blocks to cyclic tasks

The function blocks are assigned to one of the 5 possible cyclic tasks by calling-up the block using the CFC editor or in the program section, execution sequence of the CFC editor. Each function block can therefore be assigned to a cyclic task and a processing sequence within the sampling time of the task.

Assignment of the function blocks to interrupt task

In order to process function blocks and run-time groups, interrupt-controlled, when they are called-up, or in the execution sequence of the CFC editor, they are entered in the required sequence under one of the 8 possible process interrupts. Thus, individual function blocks or a run-time group can be executed, initiated by a specific process interrupt.

NOTE

Contrary to cyclic tasks, interrupt tasks are not started in equidistant time intervals, but when a process interrupt occurs.

Configuring the equivalent sampling time

Several function blocks, e. g. some control blocks, have to be processed at regular interval as result of the program design. If these are to be configured in an interrupt task, then an equivalent sampling time must be configured in the HWConfig program section for this particular interrupt task. This should approximately correspond to the average time between two process interrupts.

By clicking twice on the module, you can configure the equivalent sampling time under the menu item **Basic clock > Synchronization**.

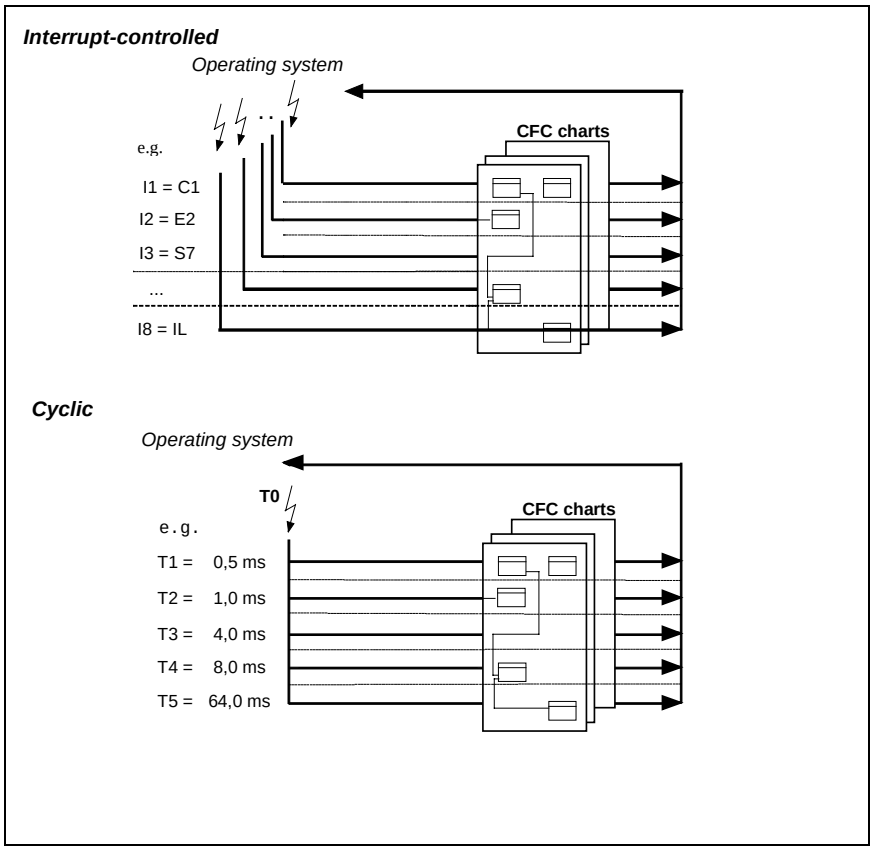


Fig. 2-1 Function block processing by the operating system

Executing the function blocks

The actual open-loop and closed-loop control task can be implemented using SIMATIC TDC/SIMADYN D, almost the same as in a block diagram, by interconnecting and parameterizing the function blocks. A function block type can be used as often as required. The function blocks are parameterized and interconnected at the block inputs and outputs.

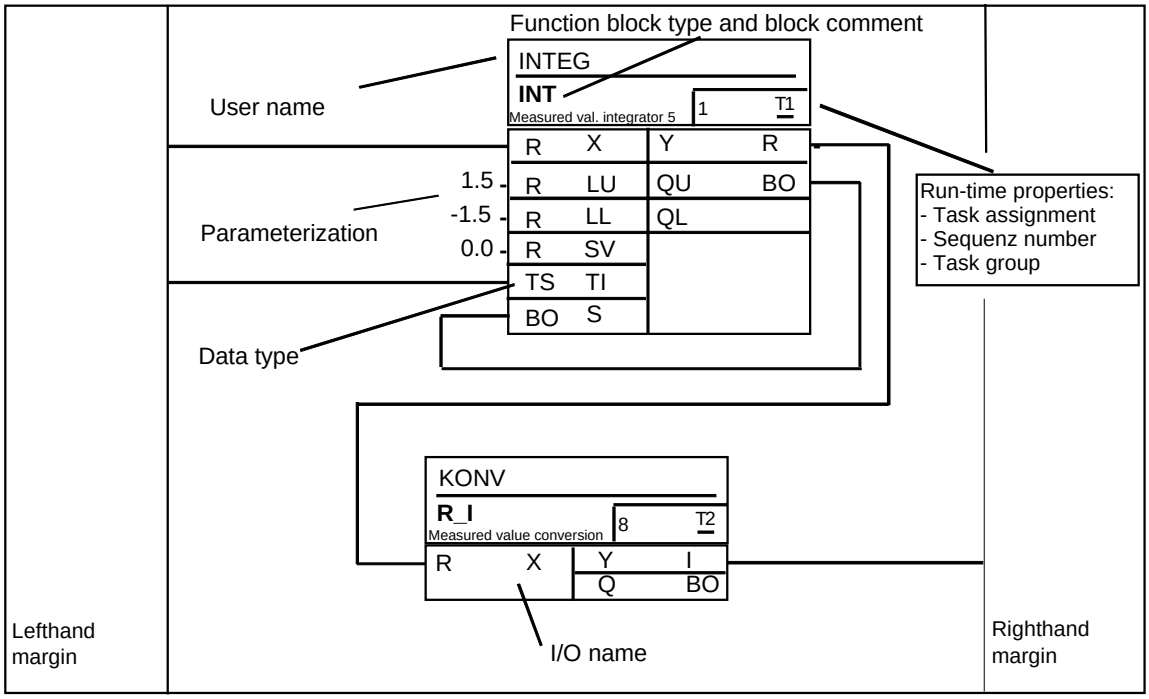


Fig. 2-2 CFC chart sheet- work area

For general parameterization of the function blocks and interconnections between the function blocks, there are

- inputs (function block inputs) and
- outputs (function block outputs).

Inputs

The configuring engineer can parameterize the inputs with constants or connect them to other function block outputs. When the function blocks are called-up, the inputs and outputs are pre-assigned, but these can be changed.

Outputs

The outputs can be connected to other inputs or assigned an initialization value which is different than the pre-assigned value. This value is available at this output if the function block is executed for the first time in the INIT operating status. This is practical, if the output of a flipflop block is to be pre-assigned.

Margins

The margins at the left and right of a CFC chart include, on one hand, the references to the objects to be interconnected, e. g. other blocks or run-time groups, which are not located on that sheet. On the other hand, they also include the number of the connector (termination location), if the autorouter cannot draw the connecting line to the margin as the sheet is overfilled.

Overflow sheets

Overflow sheets are automatically created, if more margin entries are generated on a sheet than there is space to display them. An overflow sheet consists exclusively of the margins and does not contain any objects.

Parameterization

Instead of an interconnection, a constant, deviating from the pre-assigned constant, can be parameterized at each input or output.

A block connection can be designated as parameter using a pseudocomment.
Additional information
on parameterizing, refer to the Manual "System and Communications Configuring D7-SYS , Section "Parameterizing SIMATIC TDC/SIMADYN D"

Interconnecting

Interconnecting involves the following:

- connecting a function block output to another function block input on the same CPU.
- connecting a function block output to a run-time group
- connecting a function block output to a global operand or a global operand with a function block input. A global operand can be:
  - a name with a "$" dollar symbol as suffix, i. e. connecting a signal from or to a function block on another CPU.
  - a virtual connection name or a virtual connection, i. e. transferring process data between function blocks or via any links using the process data utility.
  - a symbolic hardware address. A hardware address is in this case a symbolic designation of one or several associated terminals of a module. For example, binary inputs of a binary input module. The symbolic hardware address is defined in the HWConfig program section.
  - a name reference, i.e. the name of a message system

All types of interconnections which leave a chart sheet, generate an appropriate cross reference at the margin of the CFC chart.

Comments:

Each function block I/O on the CFC chart can be provided with a comment text.

Pseudo comments

There are three pseudo comments, which are identified by the @ character as suffix and can be separated by blanks in front of the standard comment text:

1. @DATX

- The input is connected, bypassing the consistency mechanisms (refer to the Chapter "Description and use of the signal transfer mechanisms").

2. @TP_bnnn

- A connection identified like this can also be addressed as parameter. (The parameter can be read and changed at the block inputs using operating control devices and can only be read at the block outputs:

- The I/O, defined as parameters, can be read and changed via these interfaces; and also via drive converter operator control panels or SIMOVIS. The following variables are used:
- b: range identification "H", "L", "c" or "d"
  - identifies the parameter number range
  - "H" or "L": connections can be read and changed
  - "c" or "d": connections can only be read
- nnn: three-digit parameter number
  - 000 to 999

1. @TC_nnnn:

- A technology connector @TC_nnnn at a block output can be interconnected with a parameter at a block input using BICO technology. A technology connector is identified using ist number:
- nnnn: four-digit technology connector number
  - 0000 to 9999

Additional information
on parameters and technology connectors, refer to Manual "SIMADYN D Control System, Communications Configuring D7-SYS", Section Parameterizing SIMADYN D.

2.1.3.3 The third step: Compiling and loading the user program into the CPU

After all of the required hardware modules have been configured with HWConfig and the required function blocks on the individual charts using the CFC editor, the software can be compiled into the CPU machine code using the compiler. There are 2 ways to do this:

Offline loading A memory module is programmed with the PCMCIA interface of the configuring PC. After all of the correctly programmed memory modules of all of the subrack CPUs have been inserted, the modules are ready.

Online loading The user program and operating system are directly loaded from the configuring PC into the CPU via a serial communications link.

2.1.4 Operating statuses of a CPU module

In the SIMATIC TDC/SIMADYN D system, the system statuses, shown in the following table are possible:

Operating status	**Power off**	**I N I T**	**R U N**	**S T O P**		
Internal system status				**User stop**	**Initialization error**	**System error**
Status description	No-voltage condition	System run-up (initialization)	Cyclic operation (standard operation)	Stop initiated by the user	Status after initialization error	Status after fatal system error
Characteristics/properties	System not operational	System run-up --> external control not possible	Functionality in accordance with that configured	No cyclic processing -> fast download	Initialization erroneous --> no transition into cyclic operation	Fatal system error -> processing aborted
7-segment display	Dark	'0'	PN number ('1' ... '8') and 'C', 'E', 'b', 'A'	'd' (flashing when downloading)	'0' (the cause flashes)	'H' (the cause flashes)
Red LED on T400	Dark	Off	Flashes at a low frequency	Flashes at a medium frequency	Flashes at a high frequency	Lit (bright)
Available diagnostic interfaces	--	None	All of those configured (**one must be at the first CS7-SS**) and local interface		Local interface and first CS7 interface	Local interface
Possible operator control functions	--	None	Complete functionality of CFC online	Only diagnostics or download	Only diagnostics or download	Only diagnostics or download
Administered through the user interface (CFC)	--	--	The user can interrogate the statuses per interactive dialog			

Table 2-6 System statuses of a CPU module

Terminology:

Term	Description
First CS7-SS	Interface module (SS4 or SS52) which is inserted at the top in the first CS7 in the subrack (when counting from the left).
Diagnostics	Only possible to read-out error fields

Table 2-7 Terminology

INIT, RUN and STOP are the operating statuses, whereby STOP is subdivided into three different system statuses.

System status user stop

The "User stop" system status has been newly implemented and is used to **quickly** load a program via SS52/MPI, SS4/DUST1 (SIMADYN D), CP50M0 (SIMATIC TDC) or a local interface. Fast program loading means that cyclic processing is stopped in this status and the full performance of the CPU is available for download. A 'd' is displayed in the 7-segment display which starts to flash when a program is being loaded. This status is initiated by the user, whereby the parameterization as far as the configured diagnostics interface is concerned still remains valid (SS4, SS5x interface module in the CS7 module, CP50M0).

Download in the RUN status

It is also possible to download a program in the RUN status using each utility however this does not involve significantly longer download times (data is loaded in parallel with the cyclic processing).

It is only possible to changeover into the "User stop" status out of the RUN status by the user explicitly requesting this via a service interface (local or configured). In this status, all configured service interfaces and the local service interface are still available, i. e. diagnostics and downloading are still possible via all of the service interfaces (this is necessary if several PCs are connected at the rack).

2.1.5 Configuring example of a CPU module

The procedure when generating a new project with the "HWConfig" and "CFC" configuring tools in the SIMATIC Manager under Windows 95/98/NT is now explained in this Chapter using a real example.

Additional information
on generating a project, refer to the Manual "STEP7 Optionspakete für D7-SYS, Basis Software for D7-SYS" and "CFC for SIMADYN D, Continuous Function Chart".

2.1.5.1 Task

This is a basic configuring example involving a SIMADYN D-CPU PM5 with MS5 memory module in a SR6 subrack. 2 function blocks (e. g. an integrator and a conversion block) are to be configured in the first chart of this CPU. The software is then to be compiled and the CPU memory module programmed.

2.1.5.2 Solution

SIMATIC Manager

Open the "SIMATIC Manager" under Windows 95/NT by double clicking on the **SIMATIC Manager** symbol.

Create a new project with the menu bar and the "**File** > **New** > **Project**" function, with the name "Project name".

Insert a SIMADYN D station using the menu item "**Insert** > **Station** > **SIMADYN D station**".

The "SIMADYN D station" directory, available below the "Project name" can now be selected after the project tree (project hierarchy) has been displayed. The HWConfig program is now started by clicking twice on the hardware symbol in the righthand side of the window.

HWConfig

Call-up the hardware catalog in the HWConfig window via the menu bar **Insert > Hardware components**.

For this project example, the **subrack** folder must be selected from the **SIMADYN D** directory. Select the required **SR6** subrack by double clicking on it or per drag & drop, whereby the selected subrack must be dragged, with the mouse key held, into the HWConfig window of the SIMADYN D station.

Proceed in the same way for the required PM5 CPU module. It is located in slot 1 in the subrack displayed.

The MS51 program memory module, automatically integrated in slot 1.1 in PM5 by HWConfig is now be removed. This is done by marking it and removing it using the menu bar **Edit** > **Delete**. The MS5 program memory module is now inserted, via the hardware catalog, into the directory **SIMADYN D** > **Sub-module** > **Program memory** > **MS5** per drag & drop or clicking twice with the mouse.

Parameterizing the hardware

The hardware can be parameterized differently than that pre-assigned by double clicking on the CPU or on the memory module in the subrack.

Before HWConfig is terminated, the entered hardware configuration is checked via the menu bar **Station** > **Check consistency**. HWConfig can then be closed via **Station** > **Save** and **Station** > **Terminate**.

SIMATIC Manager

Now select the "Charts" directory, located under "Project name" after displaying the complete project tree and select the menu item "**Insert** > **S7 software** > **CFC**".

Start the "CFC editor" program section by double clicking on the **CFC** symbol in the righthand section of the window.

CFC editor

Create the function block catalog from the menu bar using **View** > **Catalog**.

Drag the standard library FBSLIB on to a chart sheet of the CFC window from the catalog. For example the function block types INT and R_I from the control blocks and conversion blocks type classes.

By double clicking on the function block inputs/outputs or the function block header, the pre-assignments can be changed in the CFC window under **View** > **Sheet view**".

Creating interconnections

If the data format is the same, interconnections are created by a single click on the output followed by a click on the required input.

NOTE

The sheet view can be increased (zoomed) using **View** > **Zoom** on the menu bar.

The assignment of the function blocks to the cyclic tasks and the interrupt tasks can be changed using the **Edit** > **Sequence** menu item.

When configuring has been completed, the generated software can be checked with the **Chart** > **Check consistency** menu item, and then compiled into the machine code with **Chart** > **Compile**.

The **Target system** > **Load** menu item then allows the memory module to be programmed.

2.1.6 Description and use of the signal transfer mechanisms

Signal transfer is data exchange between various blocks.

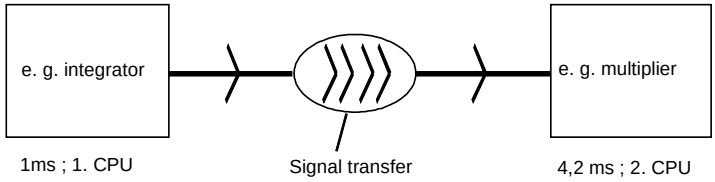


Fig. 2-3 Data transfer between two tasks

2.1.6.1 Data consistency

For interconnections between different cyclic tasks, SIMATIC TDC/SIMADYN D ensures the consistency of all data which is transferred. This means, that all data transferred from a task come from the same computation cycle of this task. All values calculated during a sampling cycle are "exported" at the end of the task. When starting a task, the required values are "imported", whereby it is ensured that there is no overlap (from a time perspective) between reading and writing the values (buffer system). As deadtimes are unavoidable with this concept, a signal should not be routed via several tasks and CPUs - if this can be avoided.

A differentiation is made between the following signal transfer types :

- Data transfer within the same task of a CPU
- Data transfer between various tasks of a CPU
- Data transfer between cyclic tasks of several CPUs
- Data transfer between alarm tasks of several CPUs

2.1.6.2 Data transfer within the same task of a CPU

Each function block output in the system is assigned a memory location. The function block saves its computed value in this memory location after being processed. All inputs, which are connected with the outputs in the same task, retrieve their values from the memory locations assigned to the connected output. In order to prevent deadtimes, the blocks of a task should if possible be computed corresponding to the "signal flow“, i. e. that block whose outputs are used as inputs for the following block is first computed etc.

2.1.6.3 Data transfer between various CPU tasks

Data transfer between various tasks of a CPU is realized via a buffer system so that the data consistency can be guaranteed (refer to the Chapter "Data consistency"). However, for data transfer from a faster to a slower task, it should be observed that value changes are not sensed in the slow task or are only sensed with a delay. If this cannot be tolerated, then the software must be appropriately adapted, e. g. using pulse-extending function blocks.

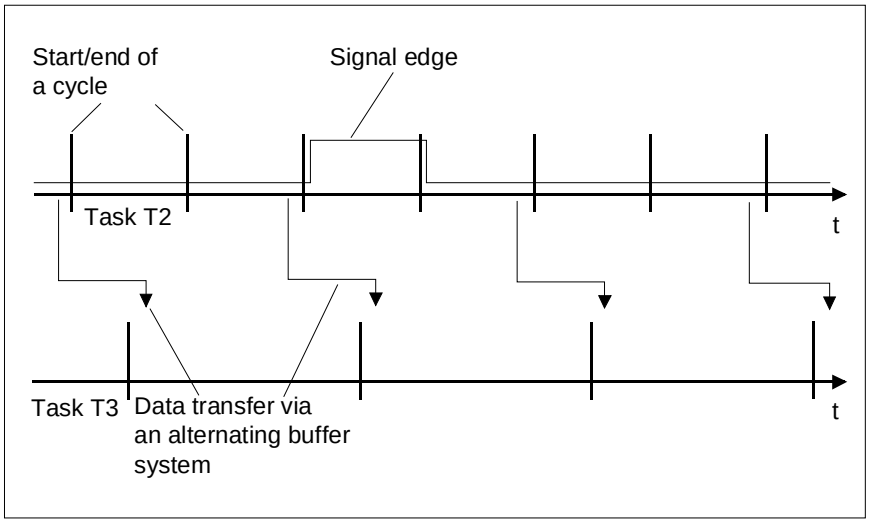


Fig. 2-4 Signal not sensed in task 3

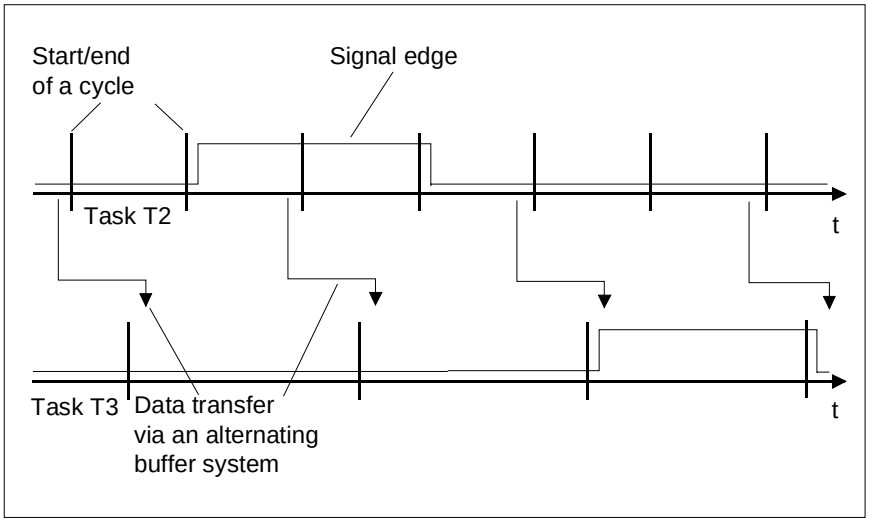


Fig. 2-5 Signal sensed with delay

2.1.6.4 Data transfer between cyclic tasks of several CPUs

Signals are transferred between the CPUs using the MM3, MM4 and MM11 (SIMADYN D) or CP50M0 (SIMATIC TDC) communication buffer modules. $ signals are used to handle the connections between function blocks, which run on different CPUs within the same SIMADYN D station (menu item "Insert-connection to the operand " in the CFC editor). The following data are required to configure a $ signal:

- the signal name,
- type
- bus assignment.

The dollar signal type defines whether data transfer is to be

- consistent ("standard") or
- inconsistent ("fast $ signal")

For a fast $ signal, the user (destination) can always access a current value. The deadtime, generated during signal transfer is then minimal if the generator (source) and user (destination) are configured in the same task, and if the tasks are possibly synchronized (refer to Chapter "Significance and application of the CPU synchronization").

The bus assignment defines whether data is to be transferred via the L bus or the C bus.

NOTE If time-critical functions are processed on the CPUs of a subrack, then please observe the following rules:

- Limit the number of $ signals to a minimum.
- Select the L bus for the $ signals, which are configured in interrupt tasks (alarm tasks).
- Select the C bus for the $ signals, which are not configured in interrupt tasks (alarm tasks).
- If possible, configure all of the communication links of the rack coupling to one or a maximum of two CPUs of the subrack.
- Configure the CPUs with the configured communication links of the rack coupling so that, if possible, there are no additional CPUs between these CPUs and the rack coupling module.

2.1.6.5 Data transfer between interrupt tasks of several CPUs

Fast $ signal A fast $ signal must always be configured if the signal is generated or used in an interrupt task. This is the because an interrupt event can occur at any instant in time and therefore the consistency mechanisms must be bypassed in order to prevent data loss. In this case, a conflict could occur between the demand for data consistency and low deadtimes. A decision must now be made depending on the particular application.

NOTE It should always be checked as to whether problems could occur if there is no data consistency (data consistency mechanism bypassed).

The data consistency can be achieved by looping the signals through a cyclic task on the CPU module which is used to calculate the interrupt task. The deadtime computation is illustrated in the following table.

Time interval	Computation
Minimum value	1 * Tx
Maximum value	2 * Tx + 1 * Ty + 1 * T_interrupt

Table 2-8 Deadtime computation

- Tx = sampling time of the cyclic tasks through which the signals are looped,
- Ty = sampling time of the source/destination (target) CPU and
- T_alarm = maximum interrupt repeat time of the interrupt task.

2.1.6.6 Minimizing the deadtimes

To minimize the deadtimes, a signal can be directly transferred, bypassing the data consistency mechanism. It can be directly "connected" to the output of the generating block. They are two ways to configure this:

- Pseudo comment @DATX for interconnecting tasks of a CPU
- Fast $ signals for interconnecting several CPUs

2.1.6.7 Processing sequence within a basic CPU clock cycle

The task administrator (refer to the Chapter "Mode of operation of the task administrator") of the operating system is started with the basic CPU clock cycle T0. This then decides which tasks are to be started (T1 and maximum of one other Tn,

with Tn from {T2...T5}.

Essentially, the following components are to be executed within the task processing:

- Buffer changeover for the tasks to be started (T1 and, if required an additional task Tn)
- System mode of the blocks in T1 corresponding to the module sequence (refer to the Chapter "Significance and uses of the process image")
- System mode of blocks in Tn corresponding to the block sequence (refer to the Chapter "Significance and uses of the process image");
- **Importing signal interconnections in the T1 and standard mode T1**
- **Exporting signal interconnections from T1**
- **Importing signal interconnections in Tn and standard mode Tn**
- **Exporting signal interconnections from Tn**

The components relevant for signal transfer are highlighted.

2.1.6.8 Interconnection changes and limited number of interconnections

Interconnection changes during the configuring test phase

Interconnections extending beyond the task limits can only be changed with some restrictions using the test mode of the CFC editor. The CFC editor test mode is used to test and optimize the user program, which is already running online on the CPU.

When service makes changes such as these, there are only a limited number of reserves for additional interconnections. The number of additional interconnections is

- minimum of 10 additional interconnections, and
- maximum of 20 % of the already configured number of interconnections.

Example: There are already 5 interconnections from cyclic task T2 to cyclic task T3. For interconnection changes from T2 to T3 there is then a reserve of 10 interconnection changes, as 20 % of 5 = 1, however a minimum of 10.

For 100 existing interconnections, there are an additional 20 reserve interconnections, as 20 % of 100 = 20.

Limited number of interconnections

A differentiation is made between interconnections within a task, between tasks of a CPU and between several CPUs of a station. For operation with several CPUs, an additional differentiation is made between standard- and fast $ signals.

For interconnections between tasks of a CPU, the alternating buffer system on the processor is used. The maximum number of interconnections is limited by the main memory expansion stage.

Connections between several CPUs of a station are handled via the communication buffer modules. The number of possible interconnections is dependent on the communication buffer module used and the signal types.
Further information
on the communication buffer modules refer to the " SIMATIC TDC/SIMADYN D hardware" Manual

For an MM11 module with 64 Kbyte memory each for the L- and C bus, the following are obtained when using:

Signal type	Bytes/interconnection	Number of interconnections
Fast $ signals	4	Approx. 16000 per bus type
Standard signal	Max. 36 (No. CPUs + 1)* 4)	Min. 1800 per bus type

Table 2-9 Calculating the maximum number of interconnections

NOTE If standard and fast interconnections are combined, an appropriately lower number are obtained.

2.1.7 Significance and uses of the process image

A process image is an instantaneous image of all interface signals from the process at the start of a cyclic task.

Necessity for data consistency

For a digital control system, the interface signals must be processed consistently to the individual processes. In this case, interface signals are the digital and analog input- or output signals of a hardware module.

The input signals of the various tasks must be kept constant during a computation cycle. If this was not the case, interface signal changes while processing a task and run times of the individual function blocks would unpredictably influence the result of a computation cycle.

The data from the hardware interfaces is processed in the so-called process image, implemented by the system mode of the function blocks when a task is started to be processed.

The task administrator (refer to the Chapter "Mode of operation of the task administrator") of the operating system is started with the basic CPU clock cycle T0. This decides which tasks are to be started (T1 and a maximum of additional Tn,

with Tn Ɛ{T2...T5}.

Task processing

Within the task processing, the following components are to be executed:

- Buffer changeover for the tasks to be started (task 1 T1 and if required an additional task Tn)
- **System mode of function blocks in T1 corresponding to the block sequence**
- **System mode of function blocks in Tn corresponding to the block sequence**
- Importing signal interconnections in T1 and standard mode T1
- Exporting signal interconnections from T1
- Importing signal interconnections in Tn and the standard mode Tn
- Exporting signal interconnections from Tn

The components relevant for the process image are highlighted; for the other components refer to the Chapter "Description and use of the signal transfer mechanisms".

2.1.7.1 Implementing the process image

System mode

The system mode is used to implement the process image before a task is computed. In the following Fig. 2-6 Sequence of the function block computation in the system- and standard modes, the sequence in which the function blocks are executed in the system- and standard mode is illustrated in cyclic operation (CPU in the RUN status). In this example, functions blocks 10 and 30 in the system mode are computed within the process image so that the results can be subsequently consistently used in the standard mode.

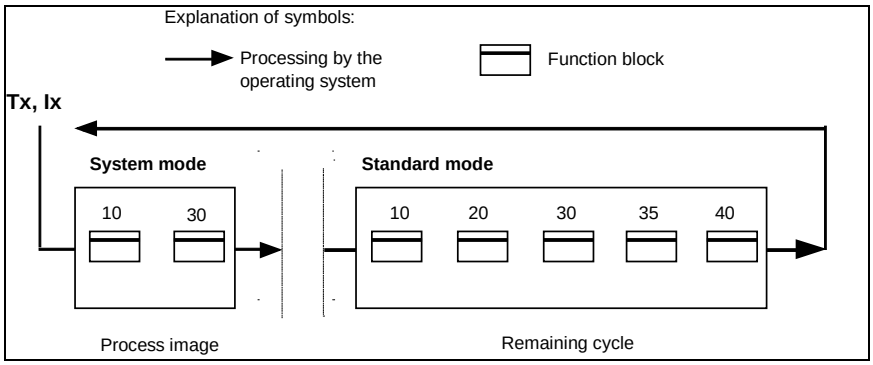


Fig. 2-6 Sequence of the function block computation in the system- and standard modes

The system mode starts immediately after the initiating event (process interrupt or basic clock cycle) in order to create a real time process image. The execution between the jump into the operating system up to the end of the system mode can only be interrupted by a higher priority system mode. Among other things, function blocks with access to the periphery are computed.

2.1.7.2 Process image for cyclic tasks

Input blocks with system component

For input blocks, which have a system component or whose system component is activated, the input signals are read-in from the hardware and buffered. The signals are evaluated with the blocks in the standard mode of the same cycle.

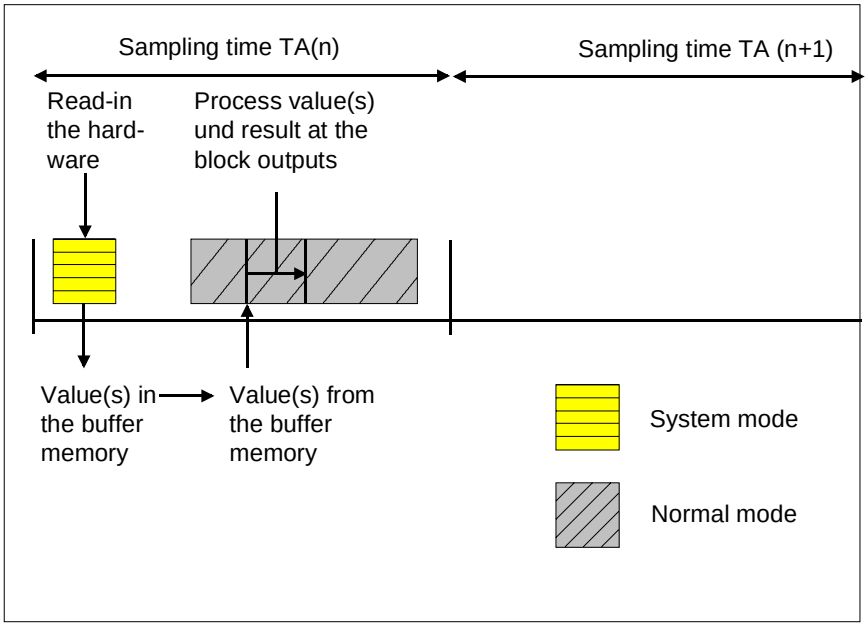


Fig. 2-7 Sequence of the system mode for input blocks

Output blocks with system component

For output blocks, which have a system component and whose system component is activated, in the standard mode of the previous cycle, the signals to be output are calculated corresponding to the block function and the actual connection (I/O) values. These signals are buffered. Signals are output to the hardware in the system mode at the start of the next sampling cycle.

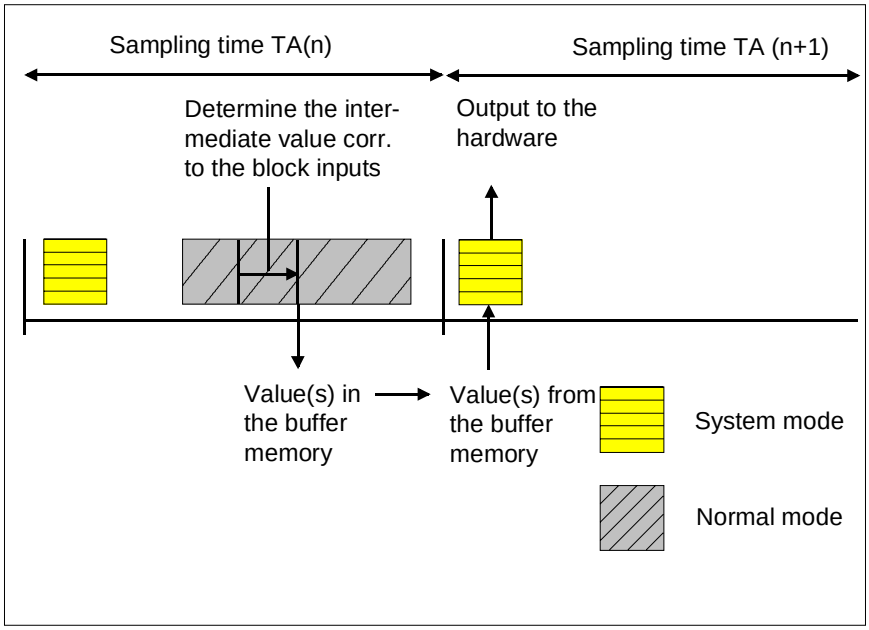


Fig. 2-8 Sequence of the system mode for output blocks

As the system component is essentially restricted to the input and output of hardware signals, the system mode is processed within just a few micro seconds.

For several input/output blocks, the „DM“ block input can be used to control whether an input/output is made in the system mode or in the standard mode. For computation in the **standard mode**, the interface signals at the blocks are computed, bypassing the process image within the **standard mode**. For input blocks, the signals are read-in immediately before being computed, and for output blocks, immediately after their computation.

2.1.7.3 Process image for interrupt tasks

An interrupt task has essentially the same behavior as a cyclic task.

Mode of operation of an interrupt task

An interrupt task can interrupt a cyclic task running in the standard mode. However it cannot be interrupted by cyclic tasks. Thus, e. g. for longer computation times of an interrupt task, the start of cyclic tasks and therefore output to the hardware can be delayed. This is because, for output blocks with system mode, the signal is only output to the hardware after the next task has been started.

Further it should be precisely checked when using input/output blocks with the system mode within an interrupt task for non quasi-cyclic interrupts. In this case, the output is only realized after the next interrupt event whose timing is unknown. For specific input/output blocks, this problem can be remedied by using a block input so that input/output is realized in the standard mode.

2.1.8 Significance and application of the CPU synchronization

Configuring the CPU synchronization

The CPU synchronization is configured in the HWConfig program section. The directory of the appropriate SIMATIC TDC/SIMADYN D station is opened in the SIMATIC manager and HWConfig is activated by double clicking on the hardware symbol in the righthand section of the window. Now select the required CPU module. There are separate dialog windows to synchronize the basic sampling time of the CPUs and the interrupt tasks under **Edit** > **Object characteristics.**

SIMADYN D synchronizing mechanisms

SIMATIC TDC/SIMADYN D provides the following synchronizing mechanisms:

- Time synchronizing
- Synchronizing its own basic clock cycle to the clock cycle of a master CPU
- Synchronizing its own basic clock cycle to an interrupt task of a master CPU
- Synchronizing its own interrupt task to interrupt tasks of a master CPU
- Synchronizing several stations
- Response when synchronization fails
- Configuring the CPU basic clock cycle synchronization
- Configuring the interrupt task-synchronization

2.1.8.1 Time synchronization

The real-time clocks of all CPUs in a SIMATIC TDC/SIMADYN D station are synchronized to the clock of CPU inserted at slot 1. This prevents the various CPU clocks from drifting apart. This synchronization is automatically realized every 10 s.

2.1.8.2 Synchronizing its own basic clock cycle to the basic clock cycle of a master CPU

The basic clock cycle can be switched from a CPU to the L- and/or C bus of the subrack and can be received from other CPUs of the station, or by several SIMATIC TDC/SIMADYN D stations, which are coupled using the rack coupling or GDM coupling. For the receiver CPU, an offset can be configured between the basic sampling time and the transmitter basic sampling time. This time offset can also then be changed online with the CPU in the RUN status using the DTS function block type.

2.1.8.3 Synchronizing its own basic clock cycle to an interrupt task of a master CPU

At the start or at the end of an interrupt task of a transmitting CPU, it is possible to initiate an L- or C-bus interrupt. This can be received from one or several other receiver CPUs where it is then used to generate the basic clock cycle.

2.1.8.4 Synchronizing its own interrupt tasks to interrupt tasks of a master CPU

To synchronize an interrupt task it is possible to use an L- or C-bus interrupt, initiated at the start or the end of an interrupt task from a transmitter CPU. This interrupt can be received at one or several other receiver CPUs in order to initiate an interrupt-controlled task there.

2.1.8.5 Synchronizing several SIMATIC TDC/SIMADYN D stations

CS12, CS13 and CS14 modules (master rack coupling) and CS22 (slave rack coupling) (SIMADYN D) or CP52M0, CP52IO and CP52A0 (SIMATIC TDC) are available to synchronize the basic sampling time over several stations. In this case, the bus systems of the two stations are connected via coupling modules.

Further information
on synchronization please refer to the "System and communication configuring D7-SYS" Manual.

2.1.8.6 Response when the synchronization fails

The basic clock cycle is monitored on the synchronized receiver CPUs using a hardware timer. If the transmitted clock is no longer available for 4 cycles, the basic clock timer on the CPU module, generates the basic clock cycle. The basic sampling time configured in HWConfig is used as basis, which in this case serves as the equivalent sampling time. The changeover to the basic clock cycle of the CPU is signaled by a flashing "E" on the 7-segment display of the CPU module, and is flagged in the error field. When the external clock source kicks in again, this can be again used on the basic sampling time clock receiver using the “DTS" function block type.

2.1.8.7 Configuring the CPU basic clock cycle synchronization

The configuring is set in the dialog window "Basic clock cycle" of HWConfig (refer to the Chapter "Significance and use of CPU synchronization). The synchronization is disabled as default.

Basic clock cycle generated by the CPU itself

If the CPU should generate a basic clock cycle itself, the following settings must be made in the dialog field „Basic clock cycle“ (refer to Fig. Dialog field, basic clock cycle in HWConfig):

- Activate the „Generate“ button with a mouse click.
- Enter the required basic sampling time from 0.1 to 16 ms.

In the lower section of the window it can be defined as to whether the selected CPU should be used as the source for the basic clock cycle. The appropriate bus must be set for this purpose. „No“ is pre-assigned (default).

Synchronizing the basic clock cycle to a source.

If the basic clock cycle is to be synchronized to another source, HWConfig requires the following settings:

- Activate the „Synchronizing“ button with a mouse click.
- Select the required source from a list, e. g.

  L- or C-bus basic clock cycle

  L- or C-bus interrupt (SIMADYN D)

  bus interrupt (SIMATIC TDC)
- Enter an equivalent sampling time of 0.1 to 16 ms.

  Pre-assignment = 1.0 ms (default)
- If required, enter a synchronization delay time of 0.1 ms up to the equivalent sampling time.

  No sampling time is pre-assigned (default value)

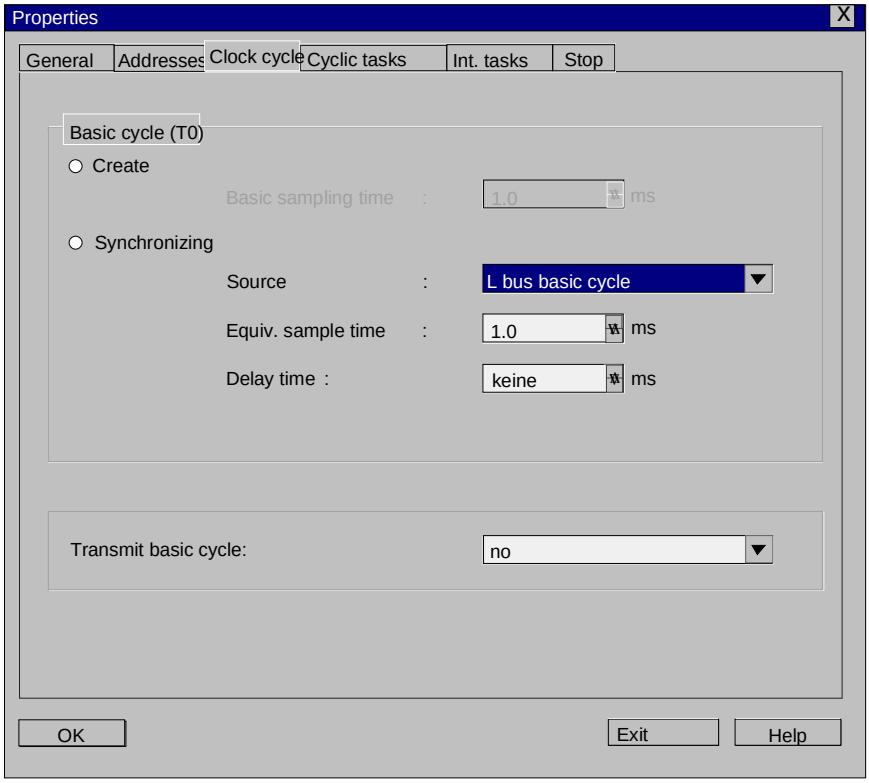


Fig. 2-9 Dialog field, basic clock cycle in HWConfig

2.1.8.8 Configuring the interrupt task synchronization

The setting is made in the dialog window "Interrupt tasks" of the HWConfig (refer to the Chapter "Significance and use of CPU synchronization"). The synchronization is disabled as default, i. e. no process interrupts are defined and a bus interrupt is not transmitted.

Setting the interrupt task synchronization

- The mouse is used to select one of the 8 possible interrupt tasks I1 - I8.
- Select the required source of the defined process interrupt from a list, e. g.

  C bus interrupt or

  CPU counter C1 or C2
- Enter an **equivalent sampling time** from 0.1 to 16 ms.

CPU as interrupt source for the subrack

In the lower window section, select whether the selected CPU is to function as the process interrupt source for the subrack. In this case, one of the defined interrupt tasks I1 - I8 must be selected, and transmitted on the L- and/or C bus. It can be decided as to whether the interrupt task is sent at the start or at the end of the interrupt task processing.

Transmitting at the start of interrupt task processing

It is practical to transmit the interrupt task at the start, if several alarm interrupts must start in synchronism on several CPU modules without any delay. However, the interrupt task on the receiver CPU module may end before the interrupt task on the transmitting CPU module as the transmitting task was inhibited by a higher-priority interrupt.

Transmitting at the end of of interrupt task processing

If transmitted at the end, it is ensured that the task on the receive side is not started before the transmit task has been completed. This second possibility can be used when data is being transferred from a transmit- to a receive task.

2.1.8.9 Example of a synchronization configuration

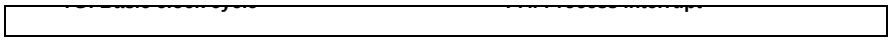


Fig. 2-10 Synchronization configuration

Description

In Fig. 2-10 Synchronization configuration, CPU 1 transmits its basic clock cycle onto the L bus. Further, the C bus interrupt is used as interrupt event by an interrupt-controlled task of the CPU 1.

CPU 2 retrieves its basic clock cycle from the basic clock line of the L bus and switches the interrupt from counter C1 (configuration with function block PAC) to the L bus interrupt line.

CPU 3 retrieves its basic clock cycle from the L bus interrupt line and switches the interrupt, received via the binary input (configuration with function block PAI) to the C bus interrupt line.

2.1.9 Significance of the processor utilization

2.1.9.1 Determining the approximate processor utilization

When compiling, the CFC determines a value for the CPU computation time utilization. A list is accessed, in which the computation time of a block is entered for each function block type. When developing the blocks, these computation times are determined for the "worst case", and are specified in the User documentation, function block library (Edition in Autumn 1997).

For several function blocks, especially for blocks, which access hardware, the worst case situation will generally result in higher time and therefore a typical computation type is used (e. g. for medium bus load levels). Based on these nominal values, for several function block types, the actual computation time can fluctuate significantly.

The computation time, entered in the block catalog, specifies the typical block computation time on a PM5 in µs. However, this value especially for communication blocks, can deviate from the actually required time, depending on the quantity of data to be transferred.

After the charts of a CPU have been compiled using the CFC editor via the menu item **Chart > Compile** the path of a MAP list is specified in an info window or in an error window. The processor utilization, entered in the MAP list, is an approximate value for the reasons mentioned above, which is generally accurate to approximately +/- 10 %.

2.1.9.2 Calculating the precise processor utilization

Function block PSL

The precise CPU utilization can only be determined when the PSL "Permanent System Load" block is configured. The PSL block is configured in any cyclic task in the CPU to be investigated.

It has 5 outputs (Y1..5) which display the actual utilization of the individual tasks in the form of a load factor. The displayed factor should not exceed 1.0 (100%). Values exceeding 1.0 indicate that a CPU is overloaded.

Further, the PSL block has 5 inputs (T1..5) which, for each task, can be used to simulate an additional load in milliseconds (ms). It is then possible to read how such a load effects the utilization of the individual tasks at the outputs. The utilization is determined by measuring the task run times and then dividing this by the actual sampling time. Higher priority tasks occur within the run time of a task which extend the run time and noticeably increase the utilization. Thus, by just adding these values, it isn't possible to obtain an overall utilization level.

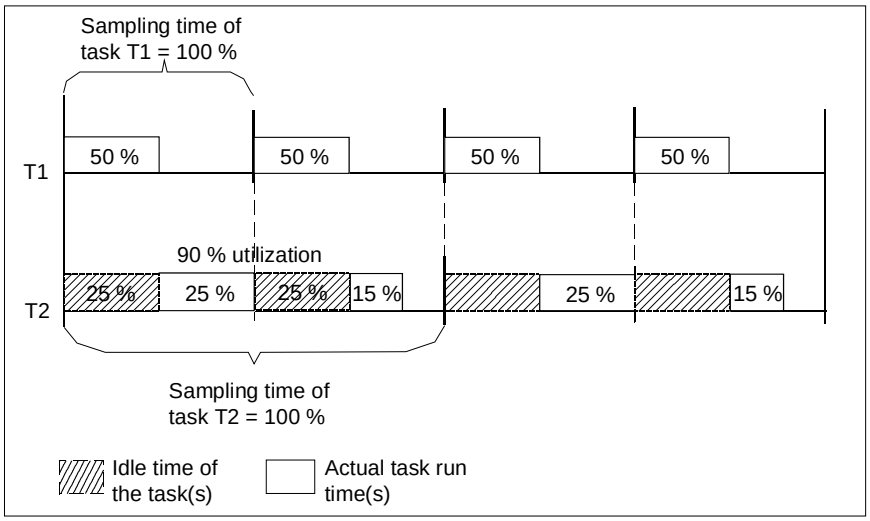


Fig. 2-11 Calculating the run time

2.1.9.3 Mode of operation of the task administrator

The mode of operation of the task administrator is illustrated in this Chapter in Fig. 2-12 Sequence of a configured task.

If a task can be completed within a basic sampling time due to a low computation time, then this is illustrated in the 1st cycle.

If a task can no longer be completed within a basic sampling time due to a higher computation time, then it is completed in the following basic cycles. The tasks with short sampling times are completed before tasks with long sampling times, i. e. T1 before T2, before T3 before T4 before .... This distribution is permissible, i. e. without cycle error, as long as the required sampling times are maintained (refer to the 2nd and 3rd cycle).

Cycle errors

If the computation time loading becomes higher, for the task with the longest sampling time, at same stage a cycle error will occur. This means that the sum of the function blocks cannot be computed completely within the configured sampling time.

NOTE

If a specific number of cycle errors is exceeded, an "E" error ID is set, and is displayed in the 7-segment display on the front panel of the CPU, if this is the highest priority error status of the CPU at this time.

In addition to the configurable interrupt tasks, the cyclic tasks are interrupted, especially by communication interrupts. These interrupts ensure that, for example, the data to be transmitted and received via the serial interfaces is processed before new data is received. Transmit- and receive interrupts such as these can occur independently of the configured cycle time of the appropriate communication blocks at almost any instant in time. As result of this, and the unpredictable occurrence of interrupt tasks, if the process utilization is extremely high, each cyclic task can generate one or several cycle errors due to task back-up.

This can be especially noticed, if

- the utilization by the task with the lowest sampling time is extremely high, and
- the functions computed in this task are extremely sensitive to sporadic sampling cycle failures, (e. g. closed-loop position controls).

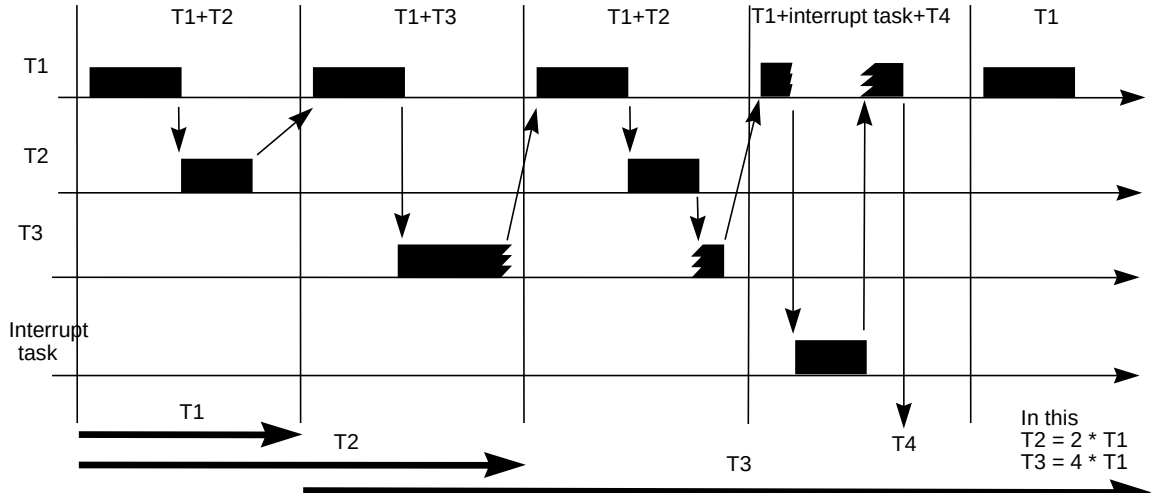


Fig. 2-12 Sequence of a configured task

2.1.9.4 Eliminating cycle errors

The modular SIMATIC TDC/SIMADYN D provides the following possibilities of eliminating cycle errors:

- Increasing the configured basic sampling time
- Shifting configured blocks from fast to slow tasks.
- Using several or higher-performance CPUs or several SIMATIC TDC/SIMADYN D stations
- Reducing the number of blocks or changing the block types
- Checking the necessity to have communication interfaces on this CPU
- Checking the necessity for interrupt function packages on this CPU

NOTE On a case for case basis it should be checked the most cost-effective way to achieve the desired result.

2.1.10 Technical data of the operating system

2.1.10.1 Features

The most important properties and technical data of the operating system are specified in the following.

Number of CPU modules

A maximum of 8 (SIMADYN D) or 20 (SIMATIC TDC) CPU modules can be inserted in a subrack. A CPU module requires 1 slot. Slots which are not occupied by CPU modules can have peripheral modules.

Number of function diagrams

The maximum number of function diagrams is dependent on the particular software, but is approximately 65536.

Cyclic tasks

System diagram	Available automatically
Basic sampling time T0 can be configured	From 0.1 [ms] to 16 [ms] in steps of 0.1 [ms]
Number of configurable cyclic tasks	5
From the basic sampling time	T0
To	T0 * (2 ** 15)
Configurable from	T0 to 32768 * T0 e. g. of 1 [ms] to 32768 [s]

Table 2-10 Technical data of the cyclic task

Interrupt tasks

Number of configurable interrupt tasks		8
Number of available interrupt sources, total		54 (SIMADYN D) or 19 (SIMATIC TDC)
Of which		
	Software interrupts	8
	CPU timer interrupts	2
	Interrupts for binary inputs	4
	Bus interrupts (L/C)	2 (SIMADYN D) or 3 (SIMATIC TDC)
	LE bus interrupt	4 (only SIMADYN D)
	LE bus interrupt, extended	32 (only SIMADYN D)
	Only T400 ISL, ISR	2

Table 2-11 Technical data of the interrupt task

Computation times of the operating system

The run times of the operating system are specified in the following, based on the PM5 CPU module. For PM6 CPU modules, the computation time is shortened to approximately one third of the specified times.

The signals, which are transferred along the L- and/or C bus represent an almost consistent system load, as the bus is always clocked at 8 MHz.

The minimum time is shown in the following table which is required to process each cycle of a task (refer above for the basis for the calculations!):

Time to start	40 µs
Time to end	40 µs
Additional component for a local buffer system	20 µs
C-bus buffer system	20 µs
L-bus buffer system	20 µs

Table 2-12 Computation times of the operating system

Memory requirement of the operating system

The code and data of the operating system are copied from the memory module into the CPU RAM on the CPU module and the data is „unzipped“. Memory requirements are as follows:

- CPU-RAM area: 400 Kbyte
- Memory module area: 200 Kbyte („zipped“)

On the communication buffer modules, the operating system after the start uses 1 Kbyte of the C-bus- and the L-bus buffer memory as data area to administer operating system lists. This is supplemented by the appropriate memory requirement, depending on the configured software, for the buffer system and additional components, e. g. communications.

Operating system version

The operating system is identified by a version ID in the form „yymmddVxyz“. The significance of the individual letters is

- yy: Year, mm: Month, dd: Day
- "V": Version
- xzy: Version number

e. g. for version 5.0 as "961201V500".

2.1.10.2 The basic operating system functions

Operating system components

The operating system is comprised of the following components:

- Task administrator for cyclic- and interrupt controlled processing
- Hardware and software initialization
- Memory administration (buffer administration)
- Operating system data and lists
- Interface to the central AMC lists
- Coupling to the other components (system interfaces)

The operating system is capable of multi-processing and multi-tasking.

The basic operating system functions are embedded in the overall system, whereby these represent the most important interfaces to the environment.

Operating system functions	Initiated by
Initialization	RESET
Cyclic processing	Sampling time timer
Interrupt-controlled processing	Process interrupts
Process image	
Exception handling and diagnostics	System interrupts
Communications, I/O	Input/output interrupts
Service	
User program	
Utility programs	

Table 2-13 Basic operating system functions

Initialization

Initialization is initiated by powering-up the power supply or depressing the RESET button to output a reset pulse. The initialization conditions/prepares the hardware and software so that the system can go into the standard operating mode (RUN status).

Cyclic processing (RUN operating status)

The task administrator ensures that the functions, assigned to the various tasks are cyclically processed. The cyclic tasks are in a ratio to the power of 2 to each other

T(i) = T(0) * (2 ** j) with T(0) as basic sampling time,

j defines the sampling time value with 0 <= j <= 15

i numbers the sampling times with 1 <= i <= 5.

Example:

For a basic sampling time of 1 ms, the sampling times can be 1 ms, 2 ms, 8 ms, 32 ms and 128 ms. The basic sampling time is defined for each CPU module during configuring, using the HWConfig program section of the SIMATIC Manager. The sampling times of the tasks running on the particular CPU module are also configured at this time.

In order to prevent bottlenecks, the tasks are started, phase-shifted with the basic clock cycle, so that with the basic clock cycle, the start of a second, lower-priority task is flagged. As result of the discrete distribution of the sampling times, based on a ratio to the power of 2, also low-priority tasks are completely taken into account. This means that it no longer occurs as a low-priority sampling time on the basic clock cycle. (refer to the Chapter "Processor utilization"). The priorities of the various tasks decreases with increasing sampling time.

The task administrator is started with the clock cycle of the basic sampling time of the sampling time timer. This determines the second task, task Tn to be started in addition to T1 (Tn from {T2...T5}). If the task to be started has a lower priority than an interrupted task, its start is buffered, and the interrupted task is continued. Otherwise, the determined task is started. The status of the interrupted task is written into a task-specific data area, which allows the task to be further processed as soon as a higher-priority task is no longer present (refer to Fig. Calculating the run time).

The time component required by the operating system itself is not taken into account in this description. If the diagram was to be precise, then the actual starting instant of the task would be shifted by these amounts.

Interrupt-controlled processing

In addition to cyclic processing, the operating system also administers tasks, which are started by non-cyclic interrupts, especially process interrupts. Interrupt sources could be:

- software interrupts
- CPU-timer interrupts
- L/C-bus interrupts
- LE-bus interrupts

The priority of the interrupt tasks is defined by the data configured in HWConfig (I1 > I2...> I8). The programming engineer programming the user program configures, using HWConfig, the interrupt sources which he or she requires for his or her application, and their processing in the interrupt-controlled tasks.

Process image (system mode)

Before a task is processed, it is first investigated whether an associated process image must be updated. If yes, this is realized before the task is started, by calling-up the system mode of the function blocks (refer to the Chapter "Significance and use of the process image"). The update is referred to:

- binary inputs/outputs, for example, the status images for controller enable signals and the position of limit switches.
- analog inputs/outputs, for example, values for temperature, speed, etc.

NOTE

The system mode is started for both tasks to be started before standard mode processing (refer to the Chapter "Significance and use of the process image").

Error differentiation

SIMATIC TDC/SIMADYN D differentiates between errors, which occur during initialization and those which occur during standard operation.

Errors from the initialization (INIT operating status) result that the system is not released for start (transition into the RUN operating status).

For errors in standard operation (RUN status), a differentiation should be made whether processing is to be continued or terminated.

The system informs the user about its status, especially about the error statuses, using the 7-segment display on the CPU module.

When an error situation occurs, detailed information is deposited in the error data fields of the operating system. These error data fields permit a precise error analysis to be made.

This data can be read-out and changed using the service utility.

The significance of the error signals and information can be taken from the online help "D7-SYS, Help on events".

Communications

Communications handles all of the input/output data transfer between the hardware as well as the associated software components and the user interfaces. The interfaces and their parameterization are configured in the user program using CFC.

Service utility

The service utility is the central interface of the CPU modules. It is an instrument for start-up, diagnostics and troubleshooting.

As the processing time of the service utility is undefined, the task associated with it as well as the tasks with lower priority can be blocked. This has been implemented, so that service is allocated a maximum processing time within its cycle (maximum of one basic clock cycle T0).

The service units form the user interface via which the communications software is controlled.

User program

The user program is used to implement the technological tasks on the target hardware. It is generated at the programmer in the CFC programming language, using the available utility programs such as HWConfig, CFC editor, CFC compiler, linker/locator and the memory module driver.

The CFC source code of the user program is converted into data structures using the CFC compiler, and loaded on the target hardware where it is processed by the operating system.

Utility programs

Utility programs are basic system functions for the operating system. These include watchdog functions, functions to handle the CPU display, special test- and interrupt routines to handle system errors.

2.1.10.3 The service utility

The service utility provides a pool of information functions so that the user has access to system information on the processor. The service utility is designed as support resource for start-up and testing.

Start-up area

Configured data (setpoints/actual values) are displayed and/or changed here and the software optimized (e. g. interconnection changes, controller times changed etc.).

Testing

Causes of plant/system faults (crashes, run-up problems) and faults, which are caused in the CPU module itself, are identified here.

All activities of the service utility are controlled via tasks, which are received via "its" data interface (corresponding to the parameterization of the service function block I/O).

All devices which can process the task- and response language of the utility can be used as handling devices for the service utility. In the SIMATIC TDC/SIMADYN D world, these are the programs (tools) CFC in the test mode and service IBS (service start-up).

NOTE

The user can also use his own tools. They must be compatible with the interface definitions of the service utility. The interface specification can be sourced from ASI 1 R.

The service utility is made available with the "SER" function block. This function block ensures that none of the messages/data get lost.

Task processing

The service utility differentiates between cyclic and non-cyclic tasks. A non-cyclic task is completed when its response telegram has been sent.

A cyclic task remains active until it is explicitly terminated, either by being aborted via a reset or as result of a new task. A task comprises of at least one response telegram.

NOTE

The service utility can always only process one task. The next task is only processed if the previous task was responded to.

System loading, response times

The actual service utility processing is realized in a 32 ms sampling time (the next sampling time below 35 ms is selected; the sampling times specified at the SER blocks are not significant for processing). In the cyclic task used, the service blocks are provided a certain computation time, which may use as maximum the basic clock cycle T0. The ratio of the basic clock cycle T0 to the used task defines the CPU performance available and therefore the system loading.

Example 1:

Basic clock cycle T0 = 1 ms; selected sampling time = 32 ms. Every 32 ms, 1 ms is reserved for the service utility. Thus, the system load is calculated of

1ms / 32 ms = 0.03125 = 3.125%

Example 2:

Basic clock cycle T0 = 2ms; selected sampling time = 16 ms. Every 16 ms, 2 ms are reserved for the service utility. Thus, a system load is obtained from

2ms / 16 ms = 0.125 = 12.5%

This available computation time is used by all service blocks to the same extent, i. e. as long as the time is sufficient, if possible, all of the SER blocks are processed once. An SER block processes a maximum of one task per clock cycle. For cyclic tasks, for each clock a maximum of one response telegram is received. The advantage of this mode of operation is that for cyclic tasks, equidistant-timed responses are obtained.

If the reserved computation time is not fully utilized, because, for example, there is no task to be processed, then this time is made avasilable to the system.

For multiple configuring with simultaneous access to system resources which are only available once (e. g. change memory of the memory module), resources are assigned to the first component which makes the request. All others are rejected and output at the latest after 1 second, an error message ("resource occupied") via the data interface.

Behavior under fault conditions

In a fault condition (exception), i. e. for initialization errors or online faults, the system goes into the stop mode. Thus, there are special conditions for the service utility. It is then no longer computed in a cyclic task, but runs continuously, started from an exception administrator. Under fault conditions, the service utility cannot be connected to the configured user. In order to still permit system diagnostics, the CPU’s own diagnostics interface is connected. The DUST1 protocol runs here (refer to the Chapter "Operating statuses of a CPU module").

2.2 Function description and user instructions

2.2.1 Fatal system error "H"

If a fatal system error occurs, processing (initialization or normal operation) is interrupted, and the system goes into the stop mode. The error cause is available for diagnostic purposes.

NOTE

Before investigating a fatal system error, the INIT_ERR and SYS_ERR system error fields should first be investigated. If errors are entered there (especially hardware (monitoring) errors), then this could be the cause of a fatal system error.

A SAVE area is set-up in the upper area, in the local RAM of each CPU module. This area is not erased at re-initialization, if the status of the RAM copy is appropriate. An error buffer is set-up in this SAVE area, which includes the error protocol (error report) consisting of several messages.

The error buffer consists of an administration part and a ring buffer, in which the error messages are saved. The ring buffer is implemented as buffer which can be overwritten, i. e. if the buffer is full with error messages, then the new messages overwrite the oldest messages.

There are 2 different types of error messages. A long message is output in the case of a non-maskable interrupt NMI. A short message for a power-OFF.

The service communications utility is available, (even if it has not been configured) to troubleshoot fatal system errors. It can be accessed via the local diagnostics interface, after pressing the acknowledge button. Using the service utility, the error causes can be output in plain text.
What is especially important is the error cause, specified under an ID code and supplementary ID. If a function block is being calculated at the instant that the system error occurs, then this is output. In addition, the results of the last bus accesses are displayed; these are important, if a bus access is the error cause. Further, all of the process registers are displayed for the system specialists to allow them to make a precise error analyses.

NMI handling

When a non-maskable interrupt occurs, this is considered as fatal error and causes initialization or normal operation to be interrupted. All of the modules, inserted in the subracks, are no longer processed.

A large flashing $\overline{H}$ is displayed on the CPU module display of the faulted module, which caused this fatal error. A large $\overline{H}$ is displayed as steady display on the other CPU modules which received an NMI as result of the faulted module. The debug monitor can be activated by pressing the acknowledge button or setting the status value.

The symbols output on the 7-segment display have the following significance:

Steady H : CPU module was shutdown by another module.

Flashing H : Fatal error on this CPU module (error cause).

Example for an error protocol (error report) for fatal system errors

```
Information on the last crash:
Time:                 01.01.93  04:16:24.9294 h        Crash instant
ID:                   #5 CPU
Supplementary ID:     28 (unaligned instruction fetch) } Crash cause
EPC:                  0x04C4F19A                       Crash address and
Return jump address:  0x801201f8                       address of the function call

Running task:         T2
Started levels:       T2(NRM),T5(NRM),BACKGROUND       The running and started tasks
Last processed FB:    FP-KRUMMS.AY0815 (Typ:  ADD8F)   at the crash instant as well as
                      (ALE: 0x80107D84  CODE:          the processed function on the
                                        0x801201E0)    data- and code areas

Last L-bus access:                                     Data on the system bus accesses.
- Access type:        q_read_2byte                     This data is especially interesting,
- BUS address:        0xB0F25874                       if an erroneous bus access is
- Retries:            0                                specified as the cause of the crash
Last C-bus access:                                     specified (NMI) and supplementary
- Access type:        q_read_2byte                     ID.
- BUS address:        0xB4F400B4
- Retries:            0                                Register dump of all process
                                                       registers
The processor status at the crash instant:             Especially important:
EPC     : 0x04C4F19A    BadVAddr: 0x04C4F19A           EPC (crash address, as above) and
Status  : 0xF000FC14    mdlo    : 0x04C4F19A           BadVAddr (bad virtual address,
fpc_csr : 0x00000F04                                   address which was erroneously
                                                       accessed(mainly for ID TLB and
                                                       CPU))
CAUTION: The value of a0, a1 (and possibly a2) is not
valid!

r00/0 : 0x00000000  r01/at: 0x00000000  r02/v0: 0x00000001  r03/v1: 0xB8803000
r04/a0: 0x80064FC8  r05/a1: 0x80064F44  r06/a2: 0x0000000A  r07/a3: 0x00000000
r08/t0: 0x80064FC4  r09/t1: 0x80065048  r10/t2: 0x19999999  r11/t3: 0x00000000
r12/t4: 0x04C4F19A  r13/t5: 0x8007FE90  r14/t6: 0x00000000  r15/t7: 0x00000000
r16/s0: 0x800650CC  r17/s1: 0x8006511C  r18/s2: 0x00000000  r19/s3: 0x8006548C
r20/s4: 0x8006548C  r21/s5: 0x00000020  r22/s6: 0x800812E0  r23/s7: 0x80400000
r24/t8: 0xFFFFFFFF  r25/t9: 0x8007FE90  r26/k0: 0x00000210  r27/k1: 0x04C4F19A
r28/gp: 0x80088BA0  r29/sp: 0x80064EA8  r30/s8: 0x04C4F19A  r31/ra: 0x801201f8

d00:       +Denorm  d02: +6.400000e+01  d04:       +Denorm  d06: +9.999000e-01
d08: +4.687500e+01  d10:       +Denorm  d12:       +Denorm  d14:+2.660285e+154
d16: +3.000001e+03  d18: +4.687500e+01  d20:          QNaN  d22:+8.329648e+298
d24: -1.818767e-12  d26:-1.227518e+306  d28:-3.691391e+249  d30:-2.374690e-237

f00: +4.787490e+01  f02: +0.000000e+00  f04: +4.687500e+01  f06: +4.764729e+05
f08: +0.000000e+00  f10:       +Denorm  f12: +4.787490e+01  f14: -1.960343e+37
f16: +1.024000e+03  f18: +0.000000e+00  f20: -1.693935e+38  f22:          QNaN
f24:          QNaN  f26:          QNaN  f28: -6.835168e-27  f30: -4.550802e-04

----------------------------- End of the diagnostics -----------------------------
```

Causes of fatal error

A fatal system error can have the following causes (ID codes). A supplementary ID describes the error cause in more detail.

Supplementary ID code (precise description)

NMI a non-maskable interrupt
- second bus clear for task-controlled access
- bus clear for direct access
- timeout during L/C-bus arbitration/assignment (module missing/defective, daisy chain missing)
- ready internal from L/C bus (error on another CPU module)
- ready internal from the local expansion bus (LE bus)
- system bus controller overrun
- timeout when accessing the local periphery
- spurious interrupt (an interrupt source cannot be identified)
- direct access to the L/C bus (bypassing the driver functions)

CPU exceptional status of the CPU
- internal error
- reserved Instruction
- unknown Syscall
- unaligned instruction fetch (jump to address which cannot be divided by four)
- user access to kernel space
- unaligned load/store to coprozessor 0/2/3
- unaligned load/store to L-/C-bus address space
- break 6/7 not in div/mul context
- unknown break value
- reserved exception
- task running in endless loop

FPU FPU exception status
- fpu fault at non-fpu instruction
- illegal fpu sub opcode
- operation on NaNs
- add/sub/division of infinities
- mul of infinity and 0

TLB exception status of the TLB
- TLB modified exception
- TLB read/write miss (access to illegal address)
- UTLB miss (access to illegal address)

TIME basic cycle time failure

OFF power down
- power down/reset in the normal mode
- power down/reset in the stop mode (after another exception)

2.2.2 Background processing

If the CPU has no tasks to process during normal operation, it processes the background task.

As background task, the following functions are simultaneously available:

- the online test mode and
- a service utility

The online test mode is normally processed in the background after initialization was successfully completed. However, if the acknowledge button is pressed at the end of initialization, then only the service communications utility is activated.

Errors in the background processing are saved in the UEB element of the error field SYS_ERR.

2.2.2.1 Online test mode

In the online test mode, for example, a battery test, a memory module checksum test etc. are executed. The memory module checksum routine determines the memory module checksum and compares it with the checksum calculated by the programmer and that saved in the memory module. If a memory module checksum error is identified in the online test mode, the user can remove the error by repeatedly generating the memory module. For battery test errors, he can replace the battery.

2.3 System chart @SIMD

Overview

The system chart @SIMD (Part A and B) is a CFC chart made available as standard to the user. They permit standard diagnostics of the hardware and system software.

Program structure

The system chart is configured, structured in the following parts

- Acknowledge — Acknowledge the error display
- Evaluate components — Determine the components which signaled an error
- Display — Output the identified error

System chart @SIMD	
	Function block names
Acknowledge	
Pushbutton	ACK Acknowledge
Service intervention	ACK
Evaluate components	
First error field	FER First error
Communications error field	CER Communication error
Task administrator error field	TER Task management error
Hardware failure Monitoring error	HER HW error
User error field	UER User error
Evaluate errors	DER Display error
Display	
Output, 7-segment display	DST Display status
Output, diagnostics LED	DST
Output, status word SIMS, status bit SIMD	SIMS, SIMD

Table 2-14 Detailed information on system chart @SIMD

Description

The operating system monitors the hardware and system software. If the monitoring function identifies an error, it flags this by setting the appropriate bits (flags) in the system error field.

The system chart @SIMD allow the user access to these flags. An output is displayed on the 7-segment display of the CPU module if a flag of a component was set.

If several messages are generated for the 7-segment display, the highest-priority message is output.

Error name	Error display	Priority
Communications error	C	High
Task administrator error	E	
Hardware failure, monitoring error	b	
User-generated error ID	A	
No error present	CPU number	Low

Table 2-15 Error priorities for the message display

Resetting the flags

The flags of the displayed error and the next priority error code is displayed when the acknowledge button on the CPU module is depressed, or an acknowledge signal is issued via a service unit. If there are no errors present, the CPU number is displayed on the 7-segment display as the lowest priority message. In order to identify that the displayed error message was the first to occur, it is displayed flashing.

Mode of operation

The sequence diagram illustrates the global program sequence of the system charts. It consists of the three functional components

- identify acknowledge signal
- evaluate components, and
- display.

Identify acknowledge

The acknowledge signal is a pulse which is derived from the pushbutton status read-in from the ASI function block or as result of a service intervention at connection ACK000.I (set from 1 to 0). Priority-controlled error fields and therefore their display are acknowledged using this pulse. Output of error codes „C“ and „E“ can be suppressed by changing the ACK050.I connection from 0 to 1.

Evaluating components

The components are evaluated using the function blocks SYF1 and SYF4. The appropriate numbers of the errors fields are documented in the function block description (refer to the reference manual, SIMADYN D function block library). An error field can only be acknowledged if an error was identified for the particular component and this was displayed.

Evaluating the first error field

The first error field evaluation determines which error entry was the first to be identified by the system. The error in the first error field is displayed flashing on the 7-segment display.

All of the components are evaluated according to their priority one after the other. The communications error field cannot be acknowledged, as a software change is required in order to remove this error. When the system runs-up, the CPU could be subject to a higher loading. Task administration errors are automatically acknowledged during the system run-up using a counting logic function.

Control using priority logic

A priority logic circuit ensures that only the highest priority component is displayed. The lowest-priority component supplies a bit signal, which changes-over the display from a CPU number display to an error display (UER070.Q). If the highest priority error component is additionally entered in the first error field, the error display is output flashing.

An acknowledge pulse only resets one error status of a component and its display.

NOTE

If a displayed error is acknowledged, the error source is still present. Before an error can be removed, the error cause must be determined and removed.

Display

When there are no errors, the processor number is displayed on the 7-segment display. If a component signals an error, then the appropriate error code is output.

The status display on a T400 is realized via a diagnostics LED. The flashing clock cycle is increased if the error is a first error.

The status display on a FM 458 is realized via fontside LEDs (refer to User Manual "Application Module FM 458").

Sequence diagram

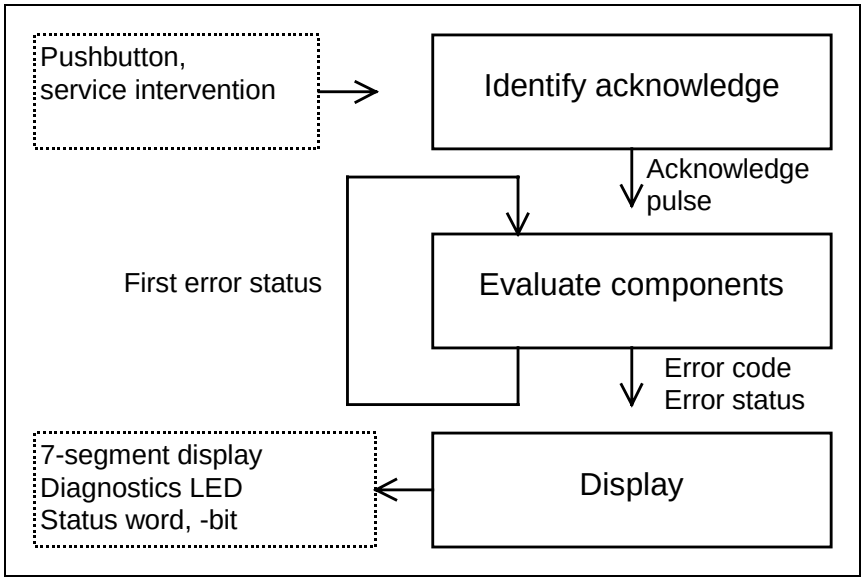


Fig. 2-13 Sequence diagram

Interfaces

The acknowledge button of the CPU module or the possibility of acknowledging via the service interface is provided as external input of the system chart. The 7-segment display of the CPU module or the diagnostics LED (T400) are available as external outputs for the user display.

The two connections SIMS.QS and SIMD.Q can be evaluated to handle an error in the user program. The error outputs of the individual components are combined to form an error status word via the SIMS function block. The SIMD.Q output connection represents a general error status.

The error status word at the SIMS.QS block connection has the following bit assignment:

Bit	**Bit assignment**
Bit1	Unused
Bit2	Unused
Bit3	Unused
Bit4	Task administrator error
Bit5	Unused
Bit6	Hardware failure
Bit7	Communications error
Bit8	Unused
Bit9	Unused
Bit10	Unused
Bit11	User-generated error ID
Bit12	Unused
Bit13	Unused
Bit14	Unused
Bit15	Unused
Bit16	Unused

Table 2-16 Bit assignment of the function block connection SIMS.QS

3 Communications configuring

Overview

3.1 Introduction

3.1.1 Basic information on communications

General information

Communications permit information and data to be transferred to other systems and devices.

To establish communications, the following are required:

- a communications utility must be configured together with a link
- a communications interface must be available

Communications utility

The communications utility defines the information contents (e. g. process data) during communications.

Coupling

The coupling defines the hardware (e. g. CS7/SS52) and the data transfer protocol (e. g. PROFIBUS DP) for communications.

Couplings and communication interfaces

The particular application and communication capabilities of the partner define the communications interface and the data coupling.

3.1.1.1 Overview of the various data couplings

General

Couplings are configured in the CFC application using the central coupling blocks.

CPU-local coupling

Used for the communications partner	• CPU-internal to test transmitters/receivers
Hardware required	• CPU
Communications utility	• Process data
Central coupling block	• @CPN
Features	• SIMADYN D-internal memory coupling

Table 3-1 CPU-local coupling

Communications buffer coupling

Used for the communications partner	• CPU-CPU communications for higher data quantities as an alternative to $ signals
Hardware required	• Communications buffer module (e. g. MM11)
Communications utility	• Process data
Central coupling block	• @CMM
Features	• SIMADYN D-internal memory coupling

Table 3-2 Communications buffer coupling

Subrack coupling

Used for the communications partner	• SIMADYN D
Hardware required	Communication modules for the master interface: • CS12 (master for 1 slaves) • CS13 (master for 4 slaves) • CS14 (master for 8 slaves)
Hardware required	Communications module for the slave interface: • CS22
Communication utility	• Process data, message system, trace
Central coupling block	• @CS1 • @CS2
Features	• Fiber-optic cable • CS12: Point-to-point coupling with CS22 slave interface • CS13: Coupling with 4slave interfaces CS22 • CS14: Coupling with 8 slave interfaces CS22 • CS22: Coupling with master interfaces CS12, CS13 or CS14 • Parallel coupling of up to 9 SIMADYN D subracks • All subracks can be synchronized • Uniform system clock possible (unified) • Fast • The maximum distance between 2 subracks is 500 m • The master and slave can be disabled (disconnected) at any time • Can only be used with subracks which have a C bus

Table 3-3 Subrack coupling

Industrial Ethernet (SINEC H1)

Used for the communications partner	• SIMADYN D • SIMATIC S5/S7 • Third-party systems • COROS
Hardware required	• CSH11 communications module
Communication utility	• Layer 2: Process data • Layer 4: Process data, message system • Layer 7: (STF): Process data and message system
Central coupling block	• @CSH11
Features	• Standardized bus according to Ethernet (IEEE 802.3) • A maximum of 1024 nodes can be coupled • Baud rate: 10 Mbaud • The SINEC system time can be input • The bus can be parameterized using the NML software

Table 3-4 Industrial Ethernet coupling (SINEC H1)

PROFIBUS DP

Used for the communications partner	• SIMATIC S5/S7 • SIMOVERT/SIMOREG drive converters • ET200 • SIMADYN D • Certified third-party equipment/devices
Hardware required	• CS7 communications module with SS52 communications module
Communications utility	• Process data • Parameter processing
Central coupling block	• @CSPRO
Features	• Standardized multi-master bus for communications between SIMADYN D and a maximum of 123 communication partners • Master slave principle (CS7/SS52 is master and/or slave) • PROFIBUS standard according to EN 50170 • Fast • Max. 12 Mbaud • Maximum net data length, 244 bytes • Bus is parameterized using the COM PROFIBUS software

Table 3-5 PROFIBUS DP coupling

PROFIBUS FDL

Used for the communications partner	• SIMADYN D (only if PROFIBUS FDL is used as a result of other communication partners) • SIMATIC S5/S7 • Certified third-party equipment/devices
Hardware required	• Master: CS7 communications module with SS5 communications module
Communications utility	• Process data
Central coupling block	• @CSL2L
Features	• Standardized multi-master bus to couple SIMADYN D (master) to a maximum of 126 coupling partners • Token principle with secondary master-slave principle • PROFIBUS Standard according to EN 50170 • Max. 1.5 Mbaud • Maximum net data length 232 bytes

Table 3-6 PROFIBUS FDL coupling

PROFIBUS FMS

Used for the communications partner	• SIMADYN D (only if PROFIBUS FMS is used as a result of other communication partners) • SIMATIC S5/S7 • Certified third-party equipment/devices
Hardware required	• Master: CS7 communications module with SS5 communications module
Communications utility	• Process data • Message system
Central coupling block	• @CSL2F
Features	• Standardized multi-master bus to couple SIMADYN D (master) to a maximum of 126 coupling partners • Token principle with secondary master-slave principle • PROFIBUS standard according to EN 50170 • Master-master- and master-slave communications possible • Max. 1.5 Mbaud • Maximum net data length 232 bytes • The bus can be parameterized using COM SS5 software

Table 3-7 PROFIBUS FMS coupling

DUST1

Used for the communications partner	• CFC • Basic service tool • SIMADYN D
Hardware required	• CS7 communications module with SS4 communications module
Communications utility	• Service, process data
Central coupling block	• @CSD01
Features	• Low-cost, point-to-point connection • 2400, 4800, 9600 or 19200 baud • Either a 20 mA- or V.24 interface can be used • Maximum net data length, 248 bytes

Table 3-8 DUST 1 coupling

DUST2

Used for the communications partner	• Printer
Hardware required	• CS7 communications module with SS4 communications module
Communications utility	• Message system
Central coupling block	• @CSD02
Features	• Low-cost, point-to-point connection • 2400, 4800, 9600 or 19200 baud • Either a 20 mA- or V.24 interface can be used

Table 3-9 DUST2 coupling

DUST3

Used for the communications partner	• SIMATIC S5 • Other systems, which are suitable for the 3964R/RK512 protocol (e. g. Allen-Bradley)
Hardware required	• CS7 communications module with SS4 communications module
Communications utility	• Process data
Central coupling block	• @CSD03
Features	• Point-to-point connection • 3964 (R) data transfer protocol with/without RK512 communications protocol • 2400, 4800, 9600 or 19200 baud • Either 20mA- or V.24 interface possible • Maximum net data length, 750 bytes

Table 3-10 DUST3 coupling

USS master

Used for the communications partner	• SIMOVERT, SIMOREG drive converters • OP2 operator control devices • VD1 numerical display
Hardware required	• Master: CS7 communications module with SS4 communications module
Communications utility	• Process data • Parameter processing • Message system • Display
Central coupling block	• @CSU
Features	• Single-master bus for communications between SIMADYN D (master) with a maximum of 31 communication partners • Master-slave principle (CS7/SS4 is the master) • 9,6, 19,2, 38,4, 93,75 or 187,5 kbaud • For drive converters: Maximum net data length is 28 bytes

Table 3-11 USS master coupling

MPI

Used for the communications partner	• CFC • WinCC • SIMATIC-OPs
Hardware required	• CS7 communications module with SS52 communications module
Communications utility	• Service • S7 communications
Central coupling block	• @CSMPI
Features	• Multi-master bus with a maximum of 126 nodes • 187,5 kbaud • Standard for SIMATIC S7

Table 3-12 MPI coupling

3.1.2 Overview of the communication utilities

General

Various data can be transferred via the communication interfaces, for example, process data and messages.

The communication utilities define which information/data is to be transferred. The communication utilities are defined by configuring the communication modules.

Communication utilities

Communications utility	Description	Communication blocks to be configured
Display control	Values can be transferred and changed. (OP2, VD1)	Function blocks for displays: @DIS, DIS...
Message system	Establishing alarm- and fault systems	Special message blocks: @MSC, MER..., MSI...
Parameter processing	Reading and processing parameter values from drive converters	@DPH, DPI
Process data	Transferring process data (setpoints and actual values)	Send- and receive blocks: CTV, CRV, CCC4, CDC4
Service	Diagnostics and analysis of CPU programs / CFC	Service- function block: SER
Time synchronization	Time synchronization of all of the CPUs used (e. g. in order to compare messages with a time stamp).	Special function blocks: RTC...
Data trace	Trace process quantities	@TCP, TR...
Network	Transparent data transfer beyond the subrack	@NMC, ...
S7 communications	Operator handling and visualization of CPU program / CFC	Communication function block: S7OS

Table 3-13 Overview of the communication utilities

3.1.3 Communication block I/Os

3.1.3.1 Initialization input CTS

Communication blocks which access a data interface have a CTS input.

Data at the initialization input

The following are specified at the CTS input:

1. The configured name for the communications module

   Syntax for module names:
   - the name is 1 - 6 characters long
   - 1st character: A - Z
   - 2nd - 6th characters: A - Z, 0 - 9, _

2. Connector of the data interface if the data interface is on a CS7 communications module

   Syntax for the connector designation:

- enter "." after the module name
- the name after "." is 3 characters long
- "X01", "X02" or "X03"

Example of data entry at CTS

Configuring example of a subrack:

Slot	Module	Configured module name in HWConfig	Possible data entry at the CTS input
S01	PM5	"D01_P1"	"D01_P1"
S03	MM11	"KOPPEL"	"KOPPEL"
S04	CS7	An SS4 is inserted at "KOMM1" at X01, and an SS5 at X02)	"KOMM1.X01" "KOMM1.X02"
S06	CSH11	"H1"	"H1"

Table 3-14 Configuring example of a subrack

3.1.3.2 Address connections AT, AR and US

General

Communication blocks, which can access a data interface, have an address connection.

Address connection types

Depending on the particular block type, a differentiation is made between three address connection types:

- AT connection: Available when transmitting
- AR connection: Available when receiving
- US connection: Available for function blocks, which are processing a send- and a receive channel

Possible address connection data

The data entries at the address connection are independent of types AT, AR or US. The possible data are:

- "Channel name"
- "Channel name. Address stage 1"
- "Channel name. Address stage 1. Address stage 2"

Channel name

- The channel name addresses a channel at a data interface.
- Transmitter and receiver, which access a data interface with the same channel name, communicate with one another.
- The channel name consists of a maximum of 8 ASCII characters, excluding "Point" and "@".

NOTE

It is not checked as to whether a channel name is configured a multiple number of times. The configuring engineer must uniquely assign the channel names at a data interface for each transmitter/receiver at the AT,

AR or US connections. If this condition is not fulfilled, then

- transmitter/receiver may be used a multiple number of times, but uncoordinated.
- the transmitter/receiver could log-off with a communications error.

Exceptions:

- Several transmitters are permitted for the "Select" data transfer mode.
- Several receivers are permitted for the "Multiple" data transfer mode.

Address stages

- There is address stage 1 and address stage 2.
- Several couplings, for example, PROFIBUS, require the address stage to be specified for data transfer. For subrack couplings, for example, address stages are not specified.
- Address stage 1 is a maximum of 14 characters long, address stage 2, maximum 20 characters.
- Significance and contents of the address stages are described for the particular coupling.

3.1.3.3 Data transfer mode, MOD input

Overview

There are five various data transfer modi for the various communication requirements:

- handshake
- refresh
- select
- multiple
- image

Selecting the data transfer mode

The data transfer mode is specified at the MOD connection of the appropriate transmitter or receiver.

"Handshake" data transfer mode

The "Handshake" data transfer mode is used,

- if information loss may not occur due to data being overwritten, and
- if there is precisely one receiver for each transmitter.

"Handshake" defines a sequential channel processing. The transmitter first deposits a new data set in the channel after the receiver has acknowledged that it has received the first data set. A net data buffer is provided for data transfer.

The transmitter inputs the net data into the channel in an operating cycle and the receiver reads them out in an operating cycle.

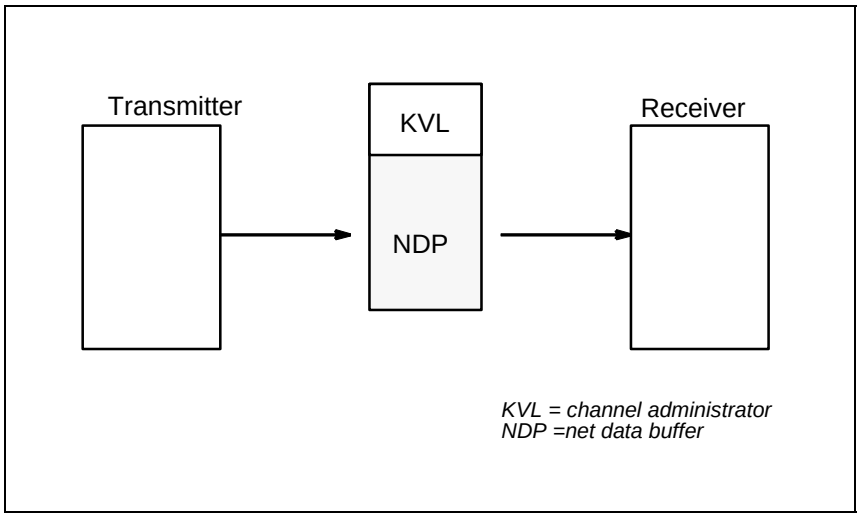


Fig. 3-1 Data transfer in the "Handshake" mode

"Refresh" data transfer mode

The "Refresh" data transfer mode is used,

- if the latest data is always to be made available to a receiver and
- if there is precisely one receiver for each transmitter.

"Refresh" overwrites when it transfers data. The transmitter always deposits the latest data set in the channel without the receiver having acknowledged that it has received the last data set. There are two net data buffers for data transfer, which are used as alternating buffer system. The transmitter flags in which buffer the latest data are located.

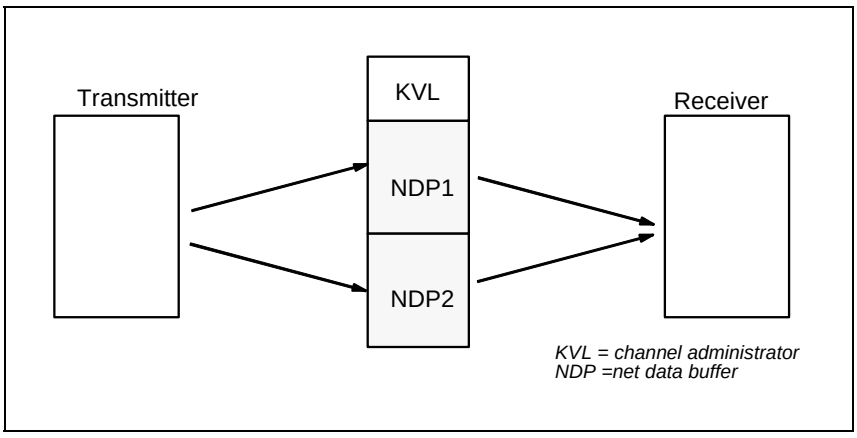


Fig. 3-2 Data transfer in the "Refresh" mode

"Select" data transfer mode

The "Select" data transfer mode is used,

- if information loss may not occur due to data being overwritten, and
- if there can be as many transmitters as required for one receiver

"Select" defines a sequential channel processing. If the receiver acknowledges that it has received the last data set, then the transmitter deposits a new data set in the channel. A net data buffer is provided for data transfer. A channel administrator controls the data transfer.

All of the configured transmitters use the same net data buffer. There is no defined sending sequence for the transmitter. The first one sends first. In order to achieve controlled data transfer, a "1" may only be specified at one transmitter at the EN connection.

The transmitter must be configured in a shorter sampling time than the receiver.

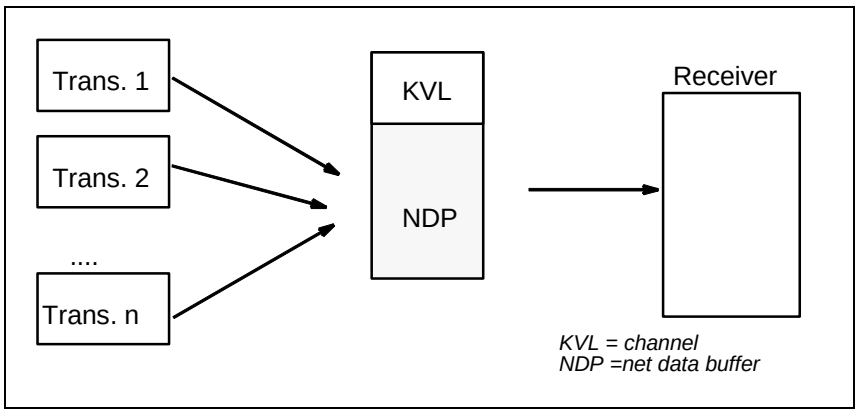


Fig. 3-3 Data transfer in the "Select" mode

"Multiple" data transfer mode

The "Multiple" data transfer mode is used,

- if receivers are to always be provided with the latest data, and
- if as many receivers as required are available for each transmitter.

"Multiple" overwrites data when transferring data. The transmitter always deposits the latest data set in the channel without the receiver first acknowledging that it has received the last data set.

If a transmitter overwrites a buffer, from which a receiver is presently reading, then the receiver rejects the data which were last received. Receive is repeated in the next operating cycle.

There are two net data buffers for data transfer, which are used as alternating buffer system. The transmitter flags in which buffer the latest data are located.

The receivers must be configured in the same or shorter sampling time than the transmitter (the receivers must therefore operate faster).

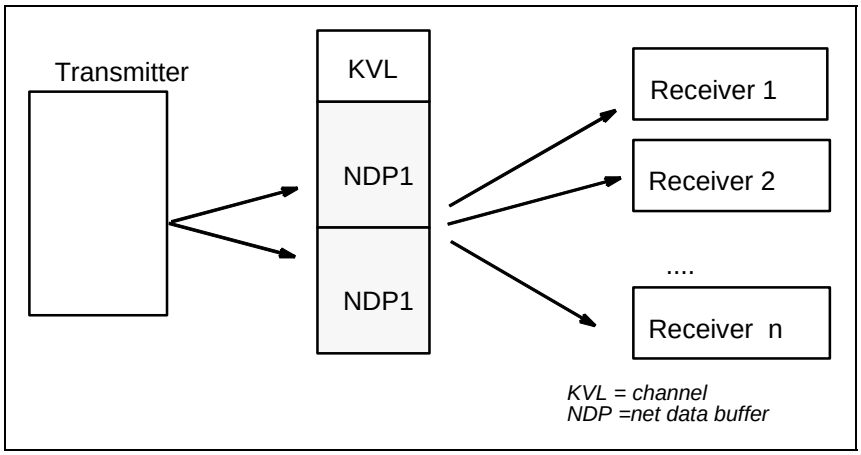


Fig. 3-4 Data transfer in the "Multiple" mode

"Image" data transfer mode

The "Image" data transfer mode" is used for the FM 458-1 DP to communicate via the PROFIBUS DP interface,

- if all of the receivers, which are configured in a task, should be provided with data that come from the same DP cycle,
- if all transmitters, which are configured in the same task, wish to send their data to the DP slaves in the same DP cycle.

To do this, transmitter and receiver FBs synchronize themselves within a task in order to supply consistent data. They form a so-called "**consistency group**". All receiver FBs, associated with such a consistency group, fetch their net (useful) data from a common alternating buffer and all of the transmitter FBs deposit their data in such a buffer.

"Image" is an overwriting data exchange (refer to refresh). There are two net (useful) data buffers which are used for data exchange. They are used as alternating buffer system.

This data transfer mode is only permitted for the PROFIBUS DP interface of the FM458-1 DP application module.

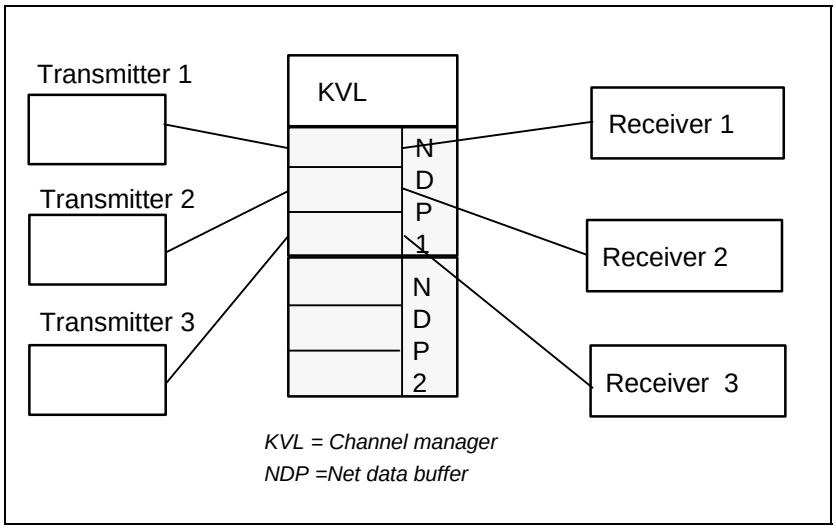


Fig. 3-5 Data transfer in the "Image" mode

3.1.3.4 Firmware status, ECL, ECO connection

General

Central coupling blocks, which communicate with a firmware (e. g. @CSD01 or @CSH11) have outputs ECL and ECO.

Function

The outputs ECL and ECO indicate the status of the appropriate firmware:

- ECL=0 and ECO=0:
  The firmware is in an error-free condition.
- ECL=0 and ECO>0:
  The firmware has an error condition, which can be rectified by the configuring engineer or user. The error cause is described in the Chapters associated with the individual couplings.
- ECL>0 and ECO>0:
  An irreparable firmware error is present.

3.1.3.5 Status display, output YTS

General

The block outputs an error code or the instantaneous data transfer status at its output YTS.

Displayed error

- Real (severe) run-time errors
- Configuring errors, which are identified when the system is initialized, and which are displayed at the 7-segment display of the CPU using a flashing "C".
- Temporary status displays and alarms

Fault diagnostics

The value at output YTS can be read as decimal number using CFC.

Additional information
regarding the significance of the decimal number, refer to the online help "Help on events".

3.1.4 Mode of operation of the couplings

General

A coupling functions as follows:

- CPUs transfer data with a coupling module via the backplane bus (C- or L bus).
- For serial couplings (e. g. for SINEC H1) the firmware on the coupling module "re-structures" and "packages" the data, so that they correspond to the required telegram structure and protocol.
- If the communications partner is also a SIMADYN D (subrack coupling, buffer memory coupling), then the data are not conditioned.

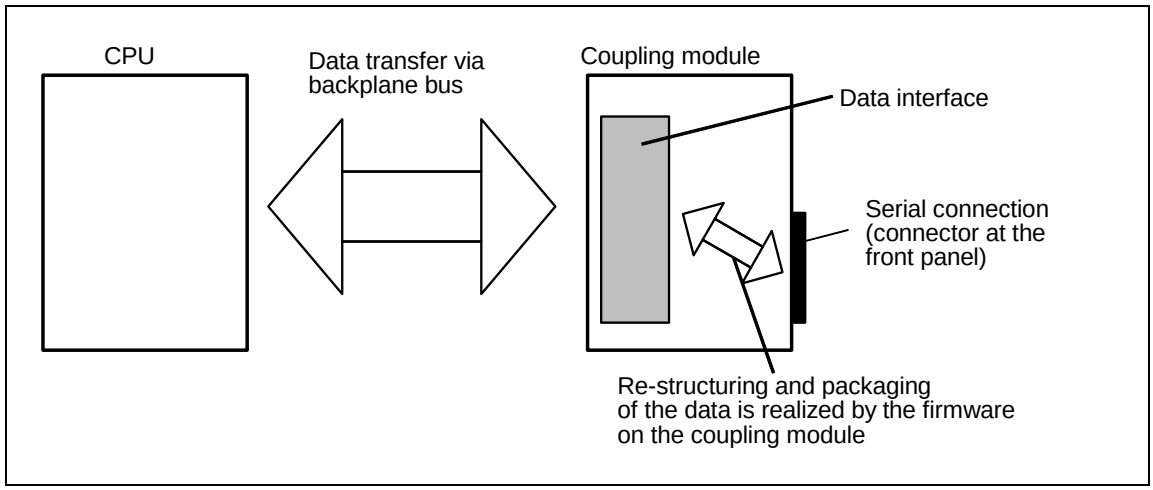


Fig. 3-6 Data transfer between the CPU and coupling module

C- and L bus

- The C- and L buses are structured the same, have the same mode of operation and the same performance features.
- The coupling module bus connection defines whether data are transferred between the CPU and the coupling module via the C- or L bus.

Access to the data interface

As the data interfaces are located on external coupling modules and not locally on a CPU, they can be used by all CPUs in a subrack. However to use a data interface, the CPU and the coupling module must have the same bus connection.

NOTE

For the local CPU coupling, the data interface is located on the CPU RAM. This data interface cannot be accessed by any of the other subrack CPUs. It can only be used by that CPU on which it was configured.

Basic initialization

A coupling module is always initialized (basic initialization) at system run-up.

The CPU to the left of the coupling module and with the same bus connection as the coupling module executes the following tasks:

- checks as to whether the coupling module can be "addressed"
- formats the data interface

Configuring the coupling module

The required coupling module is configured in HWConfig. When initializing a coupling (basic initialization), no explicit configuring steps must be executed.

3.1.4.1 Central coupling blocks

Function of the central coupling blocks

The central coupling blocks have the following functions for a coupling:

- Initialization:
  - copying the configured initialization information (this is configured at the initialization inputs) at the data interface
  - defines as to whether the data interface is in an error-free condition.
- Enabling:
  - after initializing by the central coupling blocks and the coupling module firmware, the central coupling block enables the coupling for all transmitters and receivers in the same subrack. Data transfer can now start.
  - for timing reasons, a coupling is always enabled in the RUN condition after several sampling times.
- Monitoring:
  - the central coupling blocks provide information at their outputs about the status of the coupling and, if relevant, the status of the firmware.

Configuring the central coupling blocks

When configuring, the following points must be observed:

- Exactly one central coupling block must be configured for each coupling.
- The central coupling blocks can all be configured on a CPU of a subrack or they can be distributed over various CPUs of a subrack.
  - configuring all central coupling blocks on a CPU simplifies, for example, diagnostics.
- Central coupling blocks have no transmit- or receive functionality.
- All central coupling blocks must be configured in a sampling time $32\ ms \leq TA \leq 256\ ms$

Errors

The central coupling block makes an entry into the communications error field and no longer processes the coupling module, if

- a central coupling block identifies an error when being initialized
- a firmware does not respond or manifests erroneous behavior,
- the central coupling block is running on the incorrect communications module.

3.1.4.2 Transmitters and receivers

General

Transmitters and receivers are:

- function blocks, which access the data interface of a coupling, either writing and/or reading.
- part of the communications utility which uses the coupling.

Examples of transmitters:

- message output, function block MSI:
  Copies messages from the message buffer into a data interface
- process data transmit block CTV

Examples of the receivers:

- process data receive block CRV

Data entries at the connections

As transmitters and receivers don't differentiate between the individual couplings, at the block inputs of the transmitter and receiver, a coupling type must not be specified.

I/O, trans./ receivers

- CTS input to specify the coupling module
- address connection AR, AT or US to specify channel names and coupling-specific addresses

Synchronizing transmitters and receivers

Before transmitters and receivers can transfer data, they must first identify- and synchronize with one another:

- Identification is realized via the data configured at the connections CTS and AT, AR or US.
- Synchronization is only possible,
  - if a transmitter identifies its partner as receiver (or vice versa).
  - if the length of the reserved data areas coincide.
  - if the net data structure is compatible.
  - if the data transfer mode is identical (data entry at the MOD input for transmitters/receivers).

If one of these conditions is not fulfilled, then the synchronizing transmitter/receiver logs-off with a communications error.

3.1.4.3 Compatible net data structures

General

The net data structures include information regarding the structure of the net data to be transferred:

- data regarding the position and data types of the associated net data

The net data of the transmitter and receiver must be structured the same to permit data transfer between the transmitter and receiver.

Data types

The following standardized data types are used:

Standardized data type	SIMADYN D data type	Length in bytes
Integer 16	Integer	2
Integer 32	Double Integer	4
Unsigned 8	Bool, Byte	1
Unsigned 16	Word	2
Unsigned 32	Double Word	4
Floating Point	Real, SDTIME	4
Octet-String	-	1
Time and Date	-	6

Table 3-15 Standardized data types

NOTE

The SIMADYN D connection types (e. g. SDTIME) are not used as data types, as the coupling partner does not always have to be a SIMADYN D function block.

- **Octet string**
  An octet string is an unstructured data type which does not appear at the block I/O (refer to the Chapter Channel marshalling blocks CCC4 and CDC4).

- **Time and date**
  Data type for the time which does not appear at the block I/O (refer to communications utility, message system).

  Value range

  – **1st octet and 2nd octet:**
    Specify the date relative to 1.1.1984.
    Resolution=1 day
    0 days≤d≤65535 days

– **3rd octet to 6th octet:**
Specify the time between 00:00 and 24:00.
Resolution = 1ms
0 ms≤x≤86400000 ms
The first 4 bits are not assigned in the sixth octet

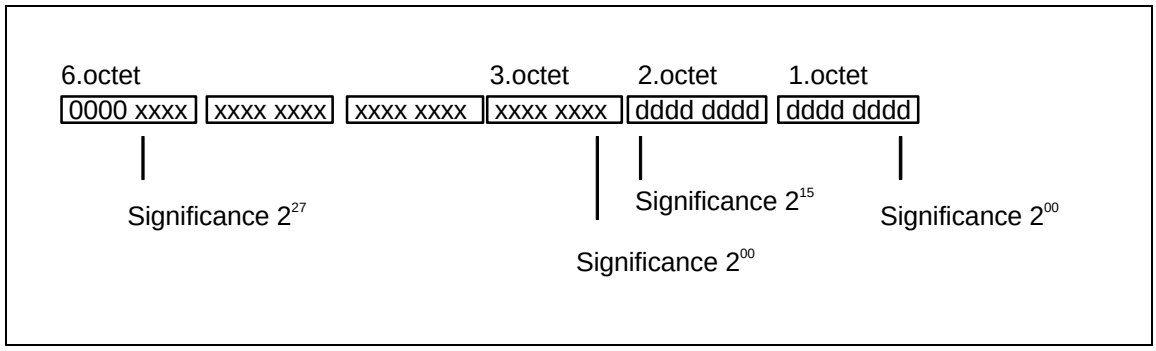


Fig. 3-7 Time and date

3.1.4.4 Number of coupling modules in a subrack

Overview

The number of CS coupling modules (CSH11, CS12/13/14, CS22 and CS7) are restricted by two system limits:

- subrack size
  The largest subrack in the SIMADYN D system has 24 slots. As a subrack must have at least one CPU, theoretically, 23 slots remain.
- available address space
  In practice, these limits are seldomly reached. For CS modules, the L- and C bus each have 1 Mbyte address space.

Assigned address space

The individual CS modules always occupy a constant address space on the backplane bus.

- **Example**
  CS7 always occupies 64 Kbyte on the L bus, independent of how many modules are configured.

Module type	Backplane bus	Occupied address space
CS12/13/14, CS22	C bus	128 Kbyte
CSH11	C bus	64 Kbyte
CS7	L bus	64 Kbyte

Table 3-16 Occupied address space

3.1.4.5 Reorganizing a data interface

General

A data interface can be re-formatted without having to interrupt the RUN condition or diminish performance.

Formatting the data interface

Several central coupling blocks have a CDV connection (Bool. data type). If there is a positive edge at the CDV input, the central coupling block inhibits the coupling, and after approx. 10 seconds, formats the data interface. The data interface is then enabled again.

During this inhibit time and while the data interface is being re-formatted, all transmitters/receivers go into a wait condition. After enabling, channels log-on (register) and synchronize just the same as when the system runs-up.

Example

The subrack coupling is an application. Here, data areas can be reserved which are not used.

- If individual subracks with a CS22 module are shutdown, and the number of transmitters or receivers is reduced due to a configuring change, the "earlier" reserved data areas on the CS12/13/14 are kept.
- For communications between CS22-CS22, the CS12/13/14 subracks are only used as data interface, not as coupling- or communications partner. The unused data areas are eliminated by re-organizing the CS12/13/14.

3.2 Couplings on the subrack

Overview

These couplings include:

- local CPU coupling
- communications buffer coupling
- coupling to EP3 modules

3.2.1 Local CPU coupling

General

The local CPU coupling does not require a coupling module. This coupling type can only be used by function blocks, which are located on the same CPU as the data interface. The data interface always lies on that CPU and is 16 kbyte.

Application

The coupling is mainly used for autonomous tasks (e. g. a closed-loop control) to provide defined interfaces. Thus, when configuring a project, it is simple if a CPU is "overloaded" to shift the complete task to another CPU without involving extensive configuring work. Communications can, for example, then be realized via the data interface in the buffer. Only the data at the CTS connection has to be changed at all communication function blocks.

Initialization and monitoring

The @CPN central blocks cyclically initialize and monitor the coupling. Thus, at the start of cyclic operation, the coupling is not enabled for all senders/receivers, but only after a delay of several operating cycles. The @CPN central block monitors the coupling after the coupling has been enabled.

Configuring

A @CPN central coupling block must be configured to initialize and monitor the coupling.

For the local CPU coupling, only the channel name has to be specified at the AT, AR or US connections of the send/receive blocks. Data for address stages 1 and 2 should not be configured. Transmitters and receivers with the same channel names communicate with one another.

3.2.2 Communications buffer coupling

General

The 16 kbyte data interface for the communications buffer coupling is located on a communications buffer.

The hardware consists of modules MM11, MM3 or MM4.

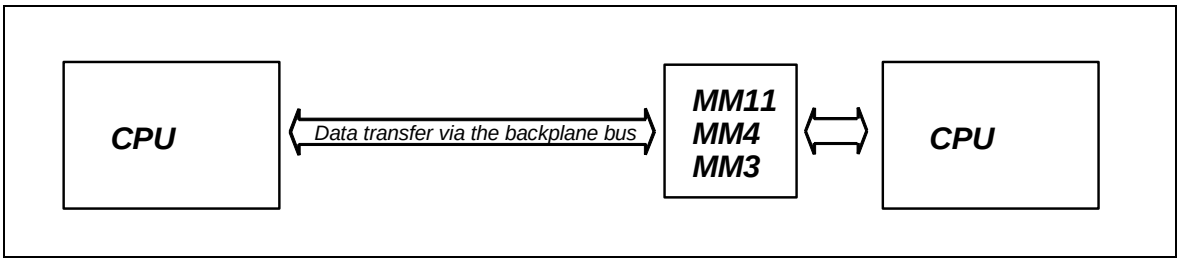


Fig. 3-8 Communications buffer coupling

Application

The communications buffer coupling is used to transfer data between various CPUs of a subrack. Contrary to $ signals, higher quantities of data are transferred more effectively.

Initialization and monitoring

A @CMM central block must be configured on any CPU of the subrack to initialize and monitor the coupling.

The @CMM central block cyclically initializes and monitors the coupling. Therefore, the coupling is not enabled for all transmit/receive blocks at the start of cyclic operation but only after a delay of several operating cycles. The @CMM central block monitors the coupling after the coupling has been enabled.

Configuring

The communications buffer coupling can only be used by send/receive blocks which are configured on the same subrack.

For the communications buffer coupling, only the channel name has to be specified at the AT-, AR- or US connections of the transmit/receive blocks. Address stages 1 and 2 do not have to be configured. Transmitters and receivers with the same channel names communicate with one another.

3.2.3 Coupling to EP3 modules

General

The coupling to EP3 modules is handled just like any other coupling. The data interface is located on the EP3 module (this module is not configured/parameterized with D7-SYS). The data interface is 16 kbyte.

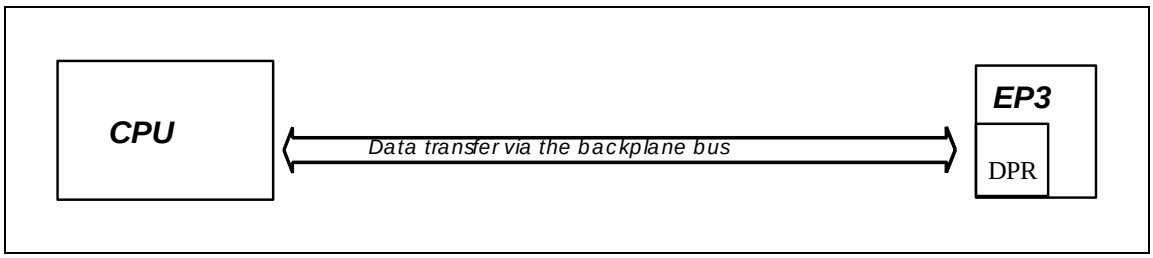


Fig. 3-9 Coupling to EP3 modules

Monitoring and initialization

A central block @CEP must be configured on any of the CPUs of a subrack to initialize and monitor the coupling.

The @CEP central blocks cyclically initialize and monitor the coupling. The coupling is therefore not enabled at the start of cyclic operation for all transmitters/receivers, but only after a delay of several operating cycles. After the coupling has been enabled, the @CEP central block monitors the coupling.

NOTE Only communication utility process data can be configured.

Configuring

- For the coupling to EP3 modules, only the channel name has to be specified at the AT- and AR I/O of the transmit/receive blocks. Address stages 1 and 2 do not have to be configured.
- For channel names, the EP3 modules only evaluate the 5th and 6th character of the channel name. All other characters can be selected as required.

3.3 Subrack coupling

General

A maximum of 9 SIMADYN D subracks with C-bus connection can be coupled with a fiber-optic cable subrack coupling.

The hardware uses CS12, CS13, CS14 and CS22 modules

The subrack which accommodates the CS12, CS13 or CS14 modules will be designated as the master subrack in the following.

The subrack in which the CS22 module is inserted, will be designated as the slave subrack.

Initialization and monitoring

One central block @CS1 or @CS2 must be configured on any CPU in each subrack for coupling initialization and coupling monitoring.

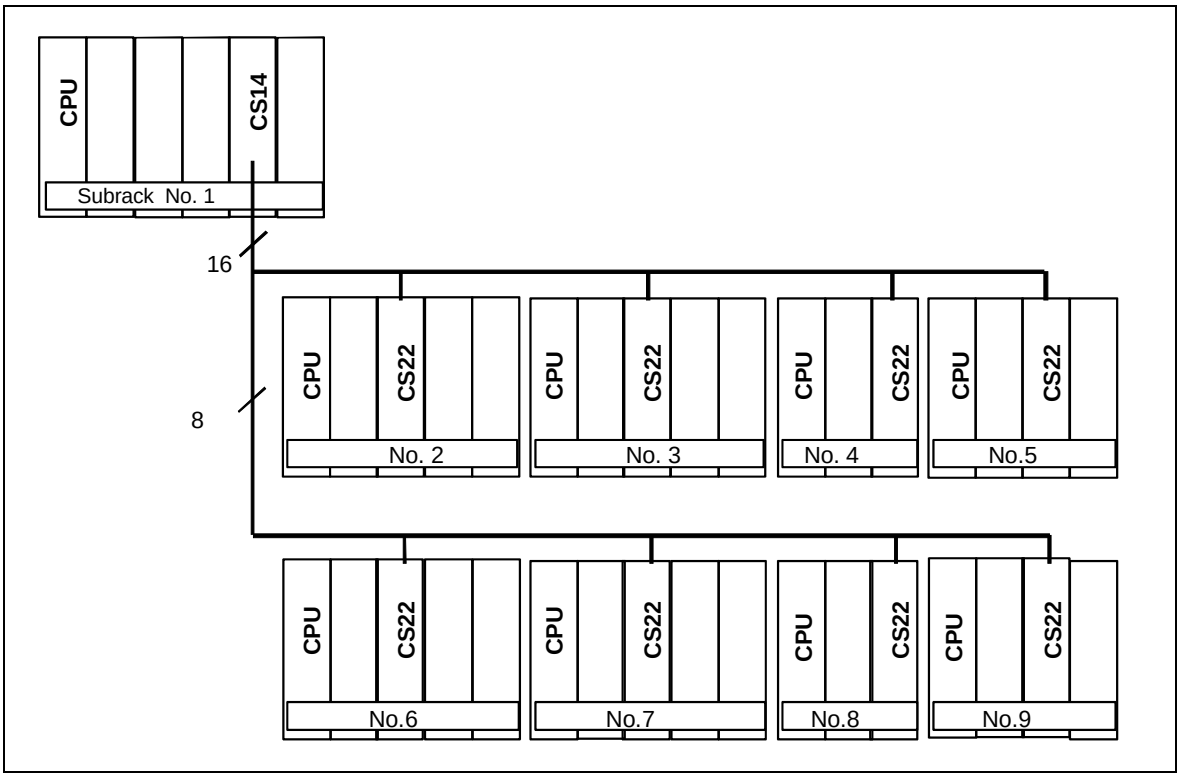


Fig. 3-10 Maximum configuration with CS14

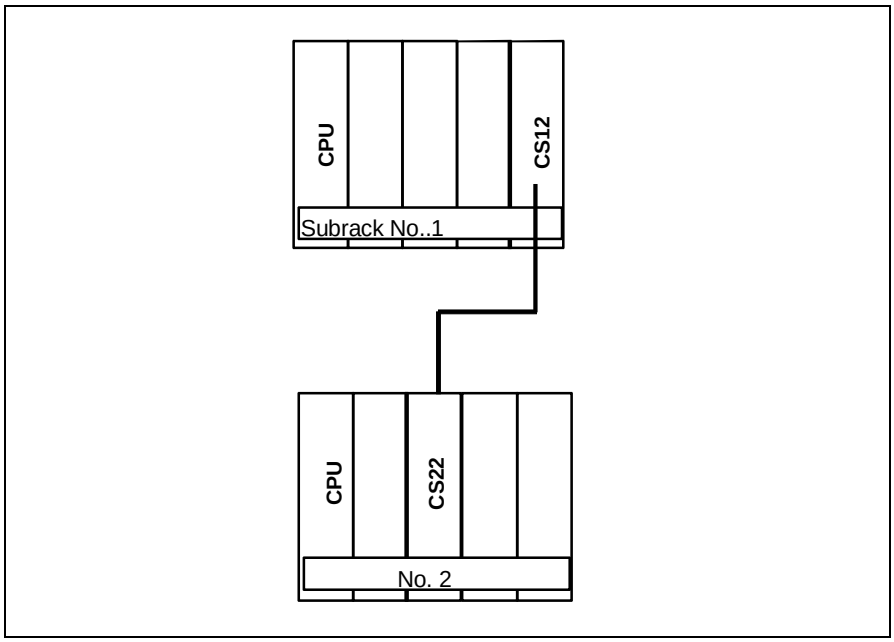


Fig. 3-11 Point-to-point coupling with CS12

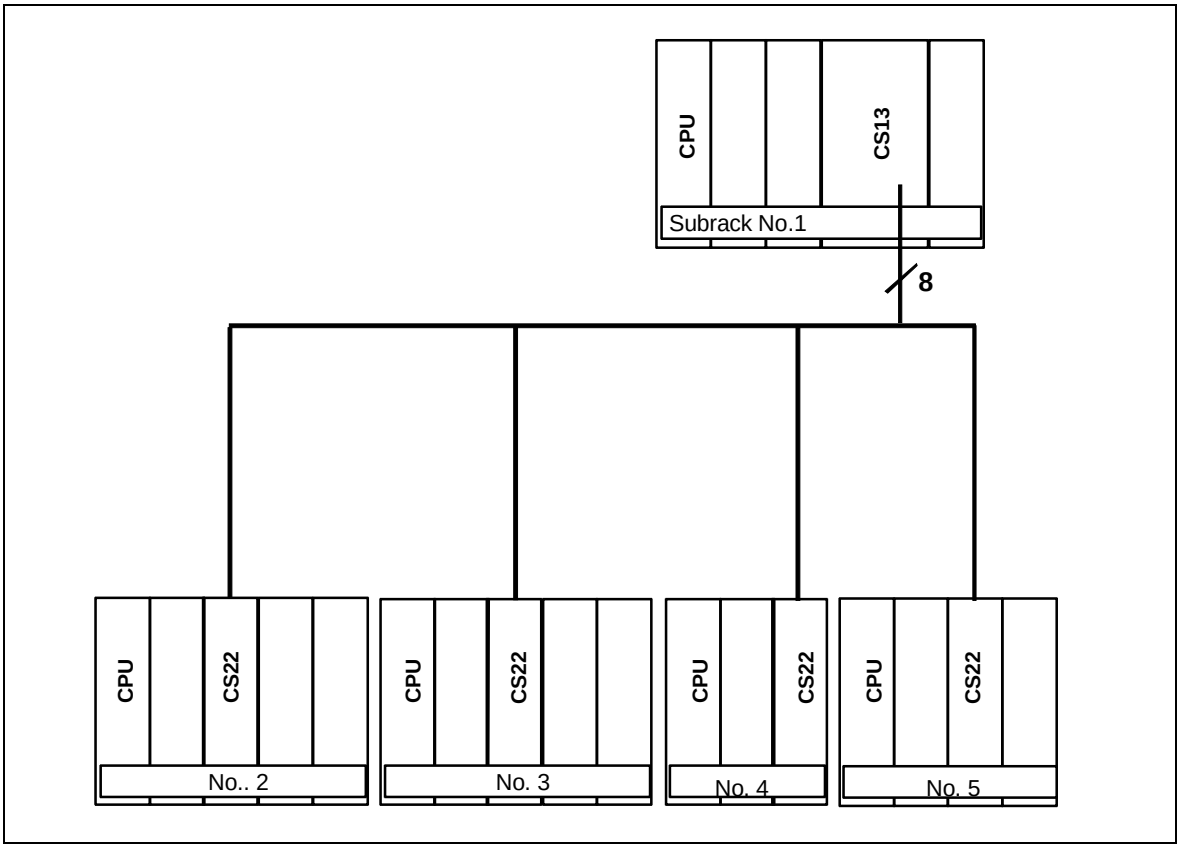


Fig. 3-12 Configuration for four slaves with CS13

3.3.1 Hardware structure

Overview

- Only subracks with C-bus connection can be coupled with one another (e. g. SR24).
- The master subrack, has, depending on the number of slaves to be connected, a CS12-, CS13 or a CS14 module. The slave subracks have a CS22 module.
- A subrack can accommodate several CS12/CS13/CS14/CS22 modules. Thus, several different subrack couplings can be configured in a subrack. The CS12/CS13/CS14/CS22 modules of a subrack coupling must all be configured in different subracks.

3.3.2 Scope of supply

Overview

All of the slave subracks are permanently coupled to the master subrack, as a slave subrack must continuously access the memory in the master subrack.

- The master/slave subracks can be powered-up in any sequence.
- All subracks can be powered-down and up again in continuous operation.
- If a slave subrack is powered-down and up again, then communications between the other nodes (master and a maximum of seven slaves) is not influenced.
- Slave subracks which are powered-down can be re-configured and powered-up again. The number of transmitters and receivers can also be changed (e. g. if one transmitter too little was configured).
- As soon as the slave partner, which was powered-down, is powered-up again, a new connection is established between the new partner which has been powered-up again and all other partners. This is also valid for slave-slave communications, i. e. if the CS12-, CS13- or CS14 module is only used as data transfer area and not as communications partner. Slave-slave communications are interrupted when the master subrack is powered-down.

NOTE It is not permissible to remove the fiber-optic cable during operation as this can result in a CPU crash.

3.3.3 Response when "shutting down" a coupling partner

Response of the master subrack

The master subrack is shutdown:

The @CS2 central block can no longer access the master subrack and prepares a restart (in addition, the CDM block output is set to "faulted", refer to @CS2 mask). The system then waits until the master subrack is powered-up.

All slave transmit/receive blocks can no longer access the master subrack and start a new channel log-on.

Response of the slave subrack

The slave subrack is shutdown:

The @CS1 central block and the maximum seven additional @CS2 central blocks decrement their particular NCP connection (i. e. the number of active slave subracks is reduced by one). Otherwise, there is no response, and the NCP connections are incremented again after the appropriate slave subrack runs-up again.
All of the configured transmit/receive blocks, whose coupling partner is located on the subrack which is shutdown, wait until the subrack has run-up again.

3.3.4 Response when "powering-up" the master subrack

Response

If the master subrack is powered-up again while the slave subracks are operational, it can be assumed, that for a short period of time, increased computation time will be required to establish the connection for CPUs to communicate via the subrack coupling. For already highly utilized CPUs, this can result in an 'E' being displayed at the 7-segment display (error in the task administrator).

3.3.4.1 Acknowledging

The 'E' can be acknowledged in two ways:

Manual acknowledge

When manually acknowledging, after the connection has been established, the 'E' can be acknowledged by depressing the red acknowledge button on the CPU.

Automatic acknowledgement

For automatic acknowledgement, the following must be configured on all CPUs in the slave subrack which communicate via the subrack coupling. Automatic acknowledgement can be implemented in two different ways using this particular configuration:

1. All YEV outputs, of the function blocks communicating via the subrack coupling are monitored using a software which has to be configured. If the value of all YEV outputs is less than 9 (i. e. initialization has been completed), then the input NOT.I is set to '1'. Using the CDM output of the @CS2 central block, it is ensured that the system is only automatically acknowledged if the master subrack has actually been powered-up. Using the time limit (input T at PCL), automatic acknowledgement has to be realized within a certain time. The 'E' on the 7-segment display is now automatically acknowledged using the SYF4 function block.
2. If not all of the YEV outputs can be monitored or should be monitored, input OR.I2 should be set to "1" and input NOT.I should not be connected at all. In this case, the CPU is only acknowledged within the time, set at connection T of the PCL after the master subrack has been powered-up (output of @CS2.CDM).

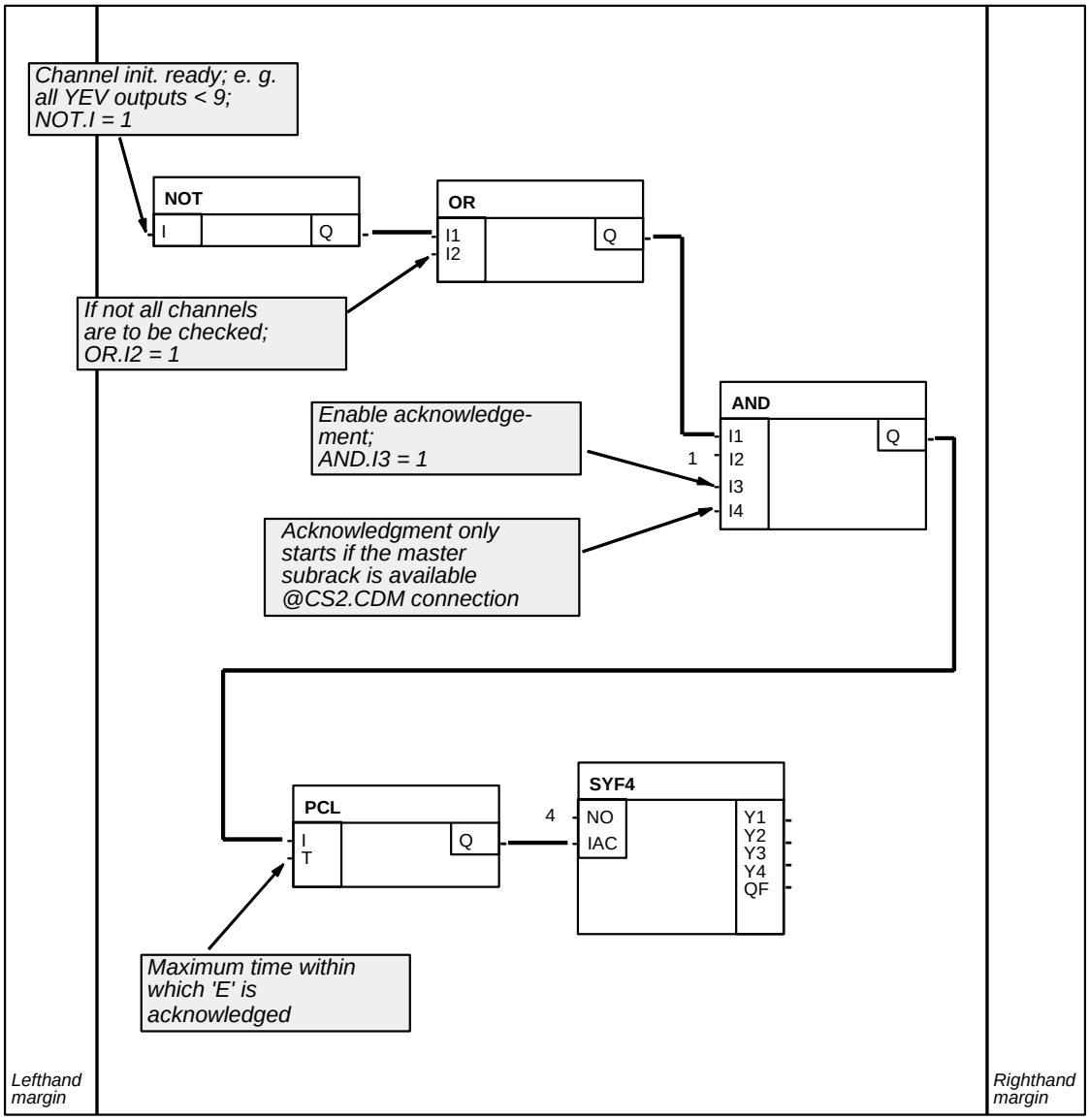


Fig. 3-13 Automatic acknowledgement of 'E'

3.3.5 Restart frequency

Synchronizing transmitters and receivers

An additional important communications feature for external communication interfaces is the restart frequency of transmitters/receivers. Transmitters/receivers always re-locate their old channel and re-synchronize with them.

Subracks can be powered-up and down again in any sequence. The transmitters/receivers of the subracks, in which the CS22 is inserted, synchronize themselves to the previous channelsat each restart (new run-up).

If a transmitter/receiver identifies the "right" channel at log-on, then it cannot identify

- if it had previously used this channel before.
- whether this channel is presently being used by another transmitter/receiver (or transmitter or receiver).

3.3.6 Configuring

Rules

- For a fiber-optic cable subrack coupling, all of the CS22 modules must have different names. If names have been assigned twice, then the appropriate central blocks log-off with multiple configuring (FB disable).
- All CS22 modules and the CS12-, CS13- or CS14 modules of a subrack must be inserted in different subracks.
- The sampling time range, 32 ms≤TA≤256 ms, valid for central coupling blocks, is also valid for the subrack coupling central blocks @CS1 and @CS2. It should also be observed that the @CS2 central blocks may only be configured, as maximum, in twice the sampling time as the @CS1 central block.
  The actual sampling time (in milliseconds) is decisive and not the cyclic task (T1, T2 etc.)
  - Example: If the @CS1 central block was configured in 100ms, the @CS2 central blocks can be configured in a sampling time up to 200ms (180ms, 150ms, 130ms, 50ms etc. are thus permitted).

Data interface

The data interface is located on the dual port RAM of the CS12-, CS13- or CS14 module. The available data transfer area is 128 kbytes.

Initialization and monitoring

The coupling initialization and monitoring is handled by the @CS1 and @CS2 central blocks in the RUN status. Thus, the coupling is not enabled at the start of cyclic operation for all transmit/receive blocks, but is delayed by several sampling cycles. The coupling is always first enabled in the master subrack and then in the slave subracks.

After the coupling has been enabled, central blocks @CS1 and @CS2 monitor the coupling. In this case, the number of active coupling partners is output at the central block outputs.

Names at the AT- and AR inputs

For the subrack coupling, only the channel name has to be specified at the AT- and AR inputs of the transmit/receive blocks. Names should not be configured for address stages 1 and 2. Transmitters and receivers with the same channel names communicate with one another.

3.4 Industrial Ethernet coupling (SINEC H1)

Overview

There are three versions for communications via SINEC H1:

- **Layer 2**
  The data are directly transferred via the Ethernet defined in the SINEC H1 protocol stack.
  The transfer is without physical connection and without any handshaking (acknowledgement). The communication partners are known as transmitters and receivers. data is packed in telegrams and transmitted or received. All SIMADYN D communication utilities can communicate via SINEC H1 in this way.

- **Layer 4**
  The data are transferred via the ISO Transport Layer, defined in the SINEC H1 protocol stack. The data transfer requires a physical connection and handshaking (acknowledgement). The communication partners are designated as transmitter and receiver. Data is packed into telegrams and transmitted or received. All SIMADYN D communication utilities can communicate via SINEC H1 in this way.

- **Layer 7 (STF), STF=SINEC technological functions**
  The data to be transferred are defined as variable (object) and are processed with STF utilities "Read variable", "Write variable". For STF utilities, there is always a client and a server. The server defines the variable and responds to utility requests; the client issues the utility requests. SIMADYN D communication utilities "Process data" and "Message system" can communicate via SINEC H1 in these ways.

NOTE

When using layer 4 or layer 7:

To configure the bus of the CSH11 coupling module (with integrated CP1470) the NML configuring tool is required, Order No. 6GK 1740-0AB00-0BA0!

Requirements of the bus nodes

Each bus node requires the following to allow it to operate on the bus:

- Ethernet address
  - is assigned when configuring in the CFC.
- Application associations (layer 7) and data transfer connections (layer 4 and layer 7)
- defined routes to transfer data between the bus nodes, which are configured using NML.
- Variables (layer 7) and telegrams (layer 2 and layer 4)
  - for SIMADYN D - are assigned when configuring in CFC.

Terminology for SINEC H1

- **STF (SINEC technological functions)**
  is the definition of SINEC H1 layer 7, defined in the "SINEC AP 1.0 Specification" from Siemens. The variable utilities used for SIMADYN D which are in conformance with MMS, are part of STF.

- **Client**
  The client issues the task to an STF utility and initiates communications.

- **Server**
  The server accepts an STF utility and is the responding party in the communications. The server defines objects, which a client can access using STF utilities.

- **Variable**
  A variable is a basic or complex object for a server. The client can access the variables using STF variable utilities.

- **Read variable**
  With this STF utility, a client reads the value of a variable at a server. The client sends the task "Read variable X"; the server sends, as response, the value of the variables.

- **Write variable**
  Using this STF utility, a client changes the value of a variable at a server. The client sends the task "Write variable X" together with the new values to the server; the server acknowledges this.

- **Data transport connection**
  The data transport connection is a defined communications path between two bus nodes at OSI layer 4. A data transport connection must be configured using NML. It must be configured so that it coincides for both bus nodes. When the bus nodes run up, the data transport connections are first established and only after that is data transfer possible.

- **Application association**
  The application association is a defined communications path between two bus nodes at OSI layer 7 (STF). An application relationship must be configured using NML. It must be configured so it coincides for both bus nodes.
  Application associations are based on a data transport connection.

3.4.1 Hardware and central coupling block

3.4.1.1 Hardware

Requirements

The following hardware is required for a SINEC H1 coupling:

- Subrack with C-bus connection
- CPU

- CSH11 communications module (this must also be configured in HWConfig)

The data transfer area (dual port RAM) between the CPU and CSH11 is 64 kbytes.

CSH11 LEDs

The red and green LEDs on the front panel of the CSH11 provide information regarding the status of the module:

green	red	Significance
dark	dark	Temporary intermediate status (CSH11 waits approx. 3 min. until the SIMADYN D has run-up) or the module has no power supply
lit	dark	Database and synchronization with SIMADYN D o.k.
flashing	dark	Database inconsistent; correct the NML software!
dark	lit	Not synchronized with SIMADYN D; (possible causes: A @CSH11 has not been configured, incorrect slot or incompatible firmware)
dark	flashing	Hardware fault
flashing	lit	Switch in the STOP or ADMIN setting

Table 3-17 LEDs on the front panel of the CSH11

ADMIN- and RESET switches on CSH11

The ADMIN switch on the CSH11 has three settings:

- RUN
  All of the data transfer connections have been established and data is being transferred.

- STOP
  Data transport connections have been established but there is no data transfer. The SIMADYN D blocks indicate that data transfer has been temporarily interrupted (e. g. at output YTS). The green LED flashes and the red LED is lit.

- ADM
  This is the same status as STOP; it is possible to reset the CSH11 using the RESET switch.

Using the ADMIN- and RESET switch, the database, loaded and saved in the non-volatile memory using NML, can be de-activated:

1. Set the ADMIN switch into the ADM setting
2. Depress RESET
3. Wait 30 seconds
4. Set the ADMIN switch into the RUN position

The module now runs with the minimum configuring; system operation is still not possible. After an additional reset, the module runs again with the database in the non-volatile memory.

3.4.1.2 Central coupling block @CSH11

Initialization

A @CSH11 function block must be configured to initialize the CSH11.

Information at input MAA

Input MAA is a SINEC H1 input.
The station address for the CSH11 is specified at this initialization input. The name comprises of precisely 12 characters. All hexadecimal characters are permitted.
Example: '080006010001'

Information at outputs ECL and ECO

Alarms and faults/errors are displayed at the ECL outputs (error class) and ECO (error code) of the central coupling block.

ECL	ECO	Explanation
0 (alarm)	0	o.k.
	1	Station address erroneous
	2	Station address does not match the database
	5	Coupling type incorrect
	6	No database or database incomplete
	7	CSH11 in the STOP condition
> 0 (error)	Any	Irreparable error; red LED flashes. Note the error class and -code and contact Siemens AG.

Table 3-18 Information at the outputs ECL and ECO

NOTE If ECO = 6 and simultaneously the green LED on the CSH11 is lit (the database is consistent), then the NML software should be corrected as follows:

- "CSH1 SINEC TF00" must be selected under the NML menu item **import FVT** ("System FVT00" is not required).

Under the NML menu item **application associations > FVT assignment**, the available (standard) application associations must be assigned to FVT "CSH1 SINEC TF00".

3.4.2 Communications via SINEC H1 layer 2

NOTE An NML configuring tool is not required when using layer 2!

General

When establishing communications via SINEC H1 layer 2, the address connections AT and AR are configured as follows.

Data entries at address connections AT, AR

When establishing communications via layer 2, the channel name and address stage 1 must always be specified at the address connection. When transmitting, address stage 2 must be specified. When receiving, address stage 2 information is optional.

Special features when entering data at address connection AT, AR when using SINEC H1 layer 2:

Please enter in the following sequence:
"Channel name.address stage 1.address stage 2"

- **Channel name**
  - maximum 8 characters
  - ASCII characters except "Point" and @
  - the channel name at a data interface must be unique.
  - the channel name does not have a specific significance for SINEC H1 layer 2.
- Enter "." after the channel name
- **Address stage 1:** "#2-ll"
  - **#2-**
    Reserved ID when using SINEC H1 layer 2.
  - **ll**
    Local Link Service Access Point (LLSAP). The LLSAP consists of two hexadecimal numbers and must be divisible by four.
    00 and 08 are not permitted.
    Each LLSAP can be simultaneously used bidirectionally - i. e. transmitting and receiving. Either one AT (transmit channel) and AR connection (receive channel) can use the same LLSAP or one US connection (transmit and receive channel).
- Enter "." after address stage 1
- **Address stage 2:** "Station address-rr"
  - must be available when transmitting and for bidirectional channels (US connection). When receiving, the entry is optional.
  - **station address**
    Specify the station address (twelve hexadecimal numbers) of the communications partner.
  - **-**
    The hyphen must be specified to separate the station address and RLSAP.
  - **rr**
    Remote Link Service Access Point (RLSAP). The RLSAP consists of two hexadecimal numbers, and must be divisible by four.
    00 and 08 are not permitted.

NOTE

- If address stage 2 is configured for the receiver, then only telegrams from the thus specified communications partner are accepted.
- If address stage 2 is not configured for the receiver, then all telegrams, specified by address stage 1, are accepted at the LLSAP ("open" LLSAP).

Examples for data entries at the address connection

- AT- 'Send.#2-44.0800060100AA-12'
  - transmits to partner with station address 0800060100AA, at its LLSAP 12, via LLSAP 44
- AR- 'Empf.#2-44.0800060100AA-12'
  - receives via the same route, as for the example for AT
- AR- 'Empf2.#2-48'
  - receives via an open LLSAP 48
- US- 'Service.#2-20.080006010002-20'
  - receives and transmits via LLSAP 20

In the example, the LLSAP 44 is simultaneously used from a transmitter and a receiver, i. e. bidirectional.

NOTE

- When transferring data, it should be observed that the lengths for the transmitters and receivers communicating with one another coincide. Otherwise data transfer is "transparent", i. e. the CSH11 transfers all data unchecked.
- Word (2 bytes) and double word(4 bytes) quantities are transferred in the Little-Endian format, i. e. the least significant byte at the beginning and then the most significant byte. When communicating with devices which deposit data in the Big-Endian format, then the user must adapt appropriately (e. g. for SIMADYN D using the SWB... conversion blocks).

3.4.3 Communications via SINEC H1 layer 4

NOTE

The data transfer connections must be configured using the NML configuring tool.
Additional information
on the NML configuring tool, refer to the User documentation "SINEC NML - CP141x, CP1470".

General

When communicating via SINEC H1 layer 4, the address connections AT and AR are configured as follows.

Data entries at address connections AT, AR, US

For layer 4 communications, the channel name and address stage 1 must always be specified at the address connection. Address stage 2 is not used.

Special features for data entries at the address connections AT, AR, US when using SINEC H1 layer 4:

Input sequence:
"Channel name.address stage 1"

- **Channel name**
  - max. 8 characters
  - ASCII characters except "Point" and @
  - the channel name at a data interface must be unique.
  - the channel name does not have a specific significance for SINEC H1 layer 4.
- Enter "." after the channel name
- **Address stage 1:** "#4data transport connection name"
  - **#4**
    Reserved ID when using SINEC H1 layer 4.
  - **data transport connection name**
    Max. 12 characters.
    The symbolic name refers to a data transport connection configured with NML. The data transport connection name is the only assignment between the SIMADYN D software and the NML software.
    Each data transport connection can be bidirectional, i. e. transmitting and receiving can be simultaneously used. Either one AT (transmit channel) and AR connector (receive channel) or precisely one US connector (transmit and receive channel) can refer to a data transport connection.

Examples for entries at the address connection

- AT- 'Send.#4TRAVERB1'
  - transmits via a data transport connection "TRAVERB1"
- AR- 'Empf.#4TRAVERB1'
  - receives via a data transport connection "TRAVERB1"
- US- 'Service.#4TRAVERB2'
  - receives and transmits via "TRAVERB2"

In the example, the data transport connection "TRAVERB1" is simultaneously used by a transmitter and a receiver, i. e. bidirectional.

NOTE

- When transferring data, it should be observed that the lengths for the transmitters and receivers communicating with one another coincide. Otherwise data transfer is "transparent", i. e. the CSH11 transfers all data unchecked.
- Word (2 bytes) and double word(4 bytes) quantities are transferred in the Little-Endian format, i. e. the least significant byte at the beginning and then the most significant byte. When communicating with devices which deposit data in the Big-Endian format, then the user must adapt appropriately (e. g. for SIMADYN D using the SWB... conversion blocks).

3.4.4 Communications via SINEC H1 layer 7 (STF)

General

Communications via SINEC H1 layer 7 is configured at address connections AT and AR.

NOTE

- The application associations are configured using the NML configuring tool.
  Further information
  on the configuring tool NML, refer to the User documentation "SINEC NML - CP141x, CP1470".
- When accessing defined complex STF variables (arrays, structures) defined in SIMADYN D, it is only permissible to access complete variables; partial access is not possible!

3.4.4.1 Address connections

Data entries at address connections AT, AR

Special features when making data entries at address connections AT and AR when using SINEC H1 layer 7 (STF):

Input sequence:
"Channel name.address stage 1. address stage 2"

- **Channel name**
  - max. 8 characters
  - ASCII characters with the exception of "Point" and @
  - the channel name on a data interface must be unique.
  - the channel name does not have a specific significance for SINEC H1 layer 7.
- If address stage 1 and address stage 2 are not specified, then SIMADYN D is a server as far as the associated STF utility is concerned and defines a local variable. The channel name is part of the associated variable name.
- Enter "." after the channel name
- **Address stage 1**
  - can only be used in conjunction with address stage 2.
  - max. 14 characters.
  - if address stage 1 and 2 are used, SIMADYN D is a client as far as the associated STF utility is concerned.
  - address stage 1 is interpreted as symbolic name of the application association, via which the STF utility is handled. Application associations are configured with SINEC NML; they define the communication paths between the applications. The application association name is the only assignment between the SIMADYN D software and the NML software.
- **Address stage 2**
  - max. 20 characters.
  - address stage 2 is the remote variable name for the communications partner (server).

STF variable name

If SIMADYN D is a server regarding an STF utility, then SIMADYN D defines a variable. The variable name has the following structure:

"Channelnamesubracknamepd"

- **Channel name**
  Channel name as configured at AT, AR, US (refer to the Chapter Connections of the communication blocks). It is precisely 8 characters long. If the configured channel name is shorter, then it is made up to 8 characters using "_".
- **Subrack name**
  Name of the subrack in which the SIMADYN D utility is configured. It is precisely 6 characters long. If the configured name is shorter, then it is made up to 6 characters using "_".

- **p**
  Number of the CPU on which the SIMADYN D utility is configured.
  Possible values: 1...8

- **d**
  Identification code for a SIMADYN D utility. This utility sets-up an object.
  Possible values:

  – P: For process data

  – M: For the message system

NOTE Using the STF utility "Interrogate name list", a client which has been removed can interrogate a list of the configured SIMADYN D utilities. The client receives information about the structure of the objects and how these objects are to be handled.

3.4.4.2 Communications utility, process data

General

Process data is transferred via SINEC H1 layer 7 (STF) by reading and writing data. SIMADYN D can be both a server as well as a client (CFC configuring). Process data have an open structure as far as SINEC H1 is concerned.

STF utility with SIMADYN D as server

- The channel name is specified at connection AR of the receive block. A remote client can execute the STF utility "Write" on this variable.
- The channel name is specified at connection AT of the transmit block. A remote client can execute the STF utility "Read" on this variable.
- The SIMADYN D utility ID at the end of the variable name is "P".

Address examples:

1. Subrack "BGT1", CPU No. 3, function block CRV is to be configured:
   – AR- 'PZDWRITE'
   – thus, the following variable name is obtained: PZDWRITEBGT1__3P
   – the variable can be written into.
2. Subrack "BGT3", CPU No. 7, function block CTV is to be configured:
   – AT- 'PZDREAD'
   – thus the following variable name is obtained: PZDREAD_BGT3__7P
   – the variable can be read.

STF utility with SIMADYN D as client

- The channel name, address stage 1 and address stage 2 are specified at connection AT of the transmit block. SIMADYN D executes the STF utility "Write" on the remote variable.

- The channel name, address stage 1 and address stage 2 are specified at connection AR of the receive block. SIMADYN D executes the STF utility "Read" on the remote variable.
- The addressed variable must be defined for the communications partner.

Address examples:

1. Entry at function block CTV:
   - AT: "PZD1.APPLBEZ1.PZDEMPF"
   - SIMADYN D writes into the remote variable, with the name "PZDEMPF" via the application association "APPLBEZ1".
2. Entry at function block CRV:
   - AR: "PZD2.APPLBEZ2.PZDREAD_BGT3__7P"
   - SIMADYN D reads the remote variable, with the name "PZDREAD_BGT3__7P" via the application association "APPLBEZ2".

STF variable structures

The structure of the process data objects is derived from the CFC configuring of the "virtual connections" (refer to the Chapter Communications utility, process data).

The SIMADYN D data types are converted into STF data types using the following table:

SIMADYN D data type	STF data type
Integer	Integer16
Double Integer	Integer32
Bool, Byte	Unsigned8
Word	Unsigned16
Double Word	Unsigned32
Real, SDTIME	Floating-Point

Table 3-19 Converting SIMADYN D data types into STF data types

- If precisely one connection is assigned for each transmit/receive block, then a basic STF variable is defined.
- If several connections, with the same STF data type, are assigned to each transmit/receive block, then an "Array" data type is defined. The number of array elements precisely corresponds to the number of connections.
- If several connections with different STF data types are assigned to each transmit/receive block, then a "Structure" data type is defined. The number of structure elements precisely corresponds to the number of connections.

Combination of arrays and structures (nesting level > 1) is not possible for SIMADYN D CSH11.

NOTE The variable structure, expected from the client must coincide with that defined for the server.

3.4.4.3 Communications utility, message system

General

Messages are transferred via SINEC H1 layer 7 (STF) by reading and writing data. SIMADYN D can act as both server and client (CFC configuring). Messages have a structure which is open as far as SINEC H1 is concerned.

STF utility with SIMADYN D as server

- The channel name is specified at connection AT of the message output block MSI.
- A remote client can execute the STF utility "Read" on this variable.
- The SIMADYN D utility ID at the end of the variable name is "M".
- The communications partner must read the object at specific intervals using the STF utility "Read". If a message was output via a message output block, the "Read" utility will positively respond and return this message, otherwise the response is negative.

Address example

- The configuring is to be in subrack "BGT1", CPU No. 3, function block MSI:
  - AT- 'MELD'
  - the following variable name is obtained: MELD____BGT1__3M
  - the variable can be read.

STF utility with SIMADYN D as server

- The channel name, address stage 1 and address stage 2 are specified at connection AT of the message output block.
- The addressed variable must be defined at the communications partner.
- SIMADYN D executes the STF utility "Write" on the remote variable.
- SIMADYN D writes into the remote variable each time that the message output block outputs a message.

Address example:

- Entry at function block MSI:
  - AT: "MELD.CHEF.EINGANGSKORB"

– SIMADYN D writes into the remote variable, with the name "EINGANGSKORB" via the application association "CHEF".

STF variable structure

The STF structure of the variables is derived when CFC is used to configure the message output block MSI; and more specifically from the data entries at connections SNV, STM, SSF (refer to the Chapter, communications utility, message system). Message variables always have a complex "Structure" data type.

NOTE The STC connection at message output block MSI must be set to "1".

SSF=1 (standardized format)			
	Contents	Message structure	STF structure
	Spontaneous ID	Unsigned8	Unsigned8
	Sequence number	Unsigned8	Unsigned8
	Message type description	1 Octet	Octet-String 2
	Message type	1 Octet	
Only available, if SNV=1	Prefix	Floating-Point	Floating-Point
	Suffix	Floating-Point	Floating-Point
	Measured value	Floating-Point	Floating-Point
	Measured value dimension text	8 characters	Visible-String 32 (if STM=0); Visible-String 92 (if STM=1)
	Message instant	24 characters	
Only available, if STM=1	Message text	60 characters	

Table 3-20 Message structure for SSF=1

SSF=0 (hexadecimal format)			
	Contents	Message structure	FMS structure
	Spontaneous ID	Unsigned8	Unsigned8
	Sequence number	Unsigned8	Unsigned8
	Message type description	1 Octet	Octet-String 2
	Message type	1 Octet	
Only available, if SNV=1	Prefix	Unsigned16	Unsigned16
	Suffix	Unsigned16	Unsigned16
	Measured value normalization factor	Unsigned32	Unsigned32
	Measured value	4 Octets	Octet-String 6
	Measured value connector type	2 Octets	

SSF=0 (hexadecimal format)			
	Measured value dimension text	8 characters	Visible-String 8
	Message instant	Time and Date	Time-Of-Day (6 bytes)
Only available, if STM=1	Message text	60 characters	Visible-String 60

Table 3-21 Message structure for SSF=0

NOTE The variable structure, expected from the client must coincide with that defined for the server.

3.4.5 System time

SIMADYN D system time

The CSH11 can be used as source for the SIMADYN D system time. The prerequisite is a SINEC time transmitter. The RTCM function block must be configured to distribute the time.

Further information
on the function block RTCM, refer to the user documentation "SIMADYN D, function block library".

3.4.6 Data quantities, sampling times

	Max. number / max. data quantity / sampling time
Number of SIMADYN D channels (low amount of net data) with MM4 communications buffer module	Approx. 400
Number of SIMADYN D channels (2048 bytes net data) with MM4 communications buffer module	29
Channel length (net data)	2048 bytes
Number of data transfer connections • A maximum of 46 per transmitter and per receiver from SIMADYN D can use layer 4 of the CSH11.	46 (CP1470 characteristics)
Fastest layer 4 sampling time (up to max. 512 bytes) • If, for example, 15 transmitters are configured, then the transmitters should be configured in a sampling time greater than 15 x 10 ms = 150 ms. The sampling time of the receiver should be shorter, as, when communicating via layer 4, the initiative always comes from the transmitter. • Receivers should be configured in a shorter sampling time than the associated transmitter (in the "Handshake" mode). If the transmitter and receiver are configured in the same sampling time and with the "Handshake" mode, then connections are automatically and continuously interrupted. Explanation: As the transmitter and receiver are not synchronized via SINEC H1, sometimes CP1470 can receive data at the receiver side but the associated SIMADYN D receive channel was still not read-out. In such a situation, CP1470 interrupts the connection (with the intention to flag the transmitter that the data was not able to be sent to the receiver; layer 4 does	10 ms

	Max. number / max. data quantity / sampling time
not have any other acknowledge mechanism (handshake mechanism)!).	

Table 3-22 Data quantities, sampling times

3.4.7 NML network management

General information

The configuring tool NML is required to configure the data transport connections and application associations, Order No. 6GK 1740-0AB00-0BA0.

Further information
on the NML configuring tool, refer to the user documentation "SINEC NML - CP141x, CP1470".

Configuring

- When configuring for layer 2 or layer 4, the "CSH11_E4_2000" profile should be used. If this is not available for the NML version supplied, then please contact Siemens AG who will then provide you with it.
  - profiles to be imported: "Mgt-Tbez.", "e4_handshake"
  - function distribution table to be imported: "CSH1 SINECTF00".
- For layer 4 operation, data transport (data transfer) connections must be configured. The "e4_handshake" is recommended as profile.
- Both layer 2 as well as also layer 4 operation must be assigned to the existing (standard) application associations of FVT "CSH1 SINEC TF00", under the menu item "Application associations" "FVT assignment"..

3.5 PROFIBUS DP coupling

Additionally required hardware and software

The following hardware and software are additionally required to configure and run the PROFIBUS DP coupling:

- COM PROFIBUS
  Order No. 6ES5 895-6SE12
- SS52load
  SS52load is included in COM PROFIBUS from V3.1.
- DP-capable PC card to download the COM database via COM PROFIBUS

Characteristics

SIMADYN D has the following characteristics on PROFIBUS DP:

- **Master**
  The SS52 communications module can be operated on PROFIBUS both alone (stand alone) and with other masters in multi-master operation.
- **Slave**
  In addition to the master functionality, there is also the slave functionality. Both of these functionalities can be used simultaneously or separately.
- **Shared input**
  Each slave connected to PROFIBUS DP is assigned just one master (the parameterizing master) and at first can only communicate with this master. Additional masters can read the slave input data using the ”Shared input”. SIMADYN D supports this functionality as master and slave.
- **SYNC and FREEZE**
  The outputs/inputs of several slaves can be read/written in synchronism using the SYNC and FREEZE utilities. SIMADYN D supports these utilities as master.
- **Data lengths**
  A maximum of 244 bytes can be transferred in each direction and for each slave.
- **Data transfer times**
  For short telegrams (up to 32 byte), only the SIMADYN D sampling time and the DP bus circulating time are included in the data transfer time. For longer telegrams, the software processing times of the SS52 communications module must also be included (max. 5 ms).
- **Consistency**
  Data within a telegram is always consistent.

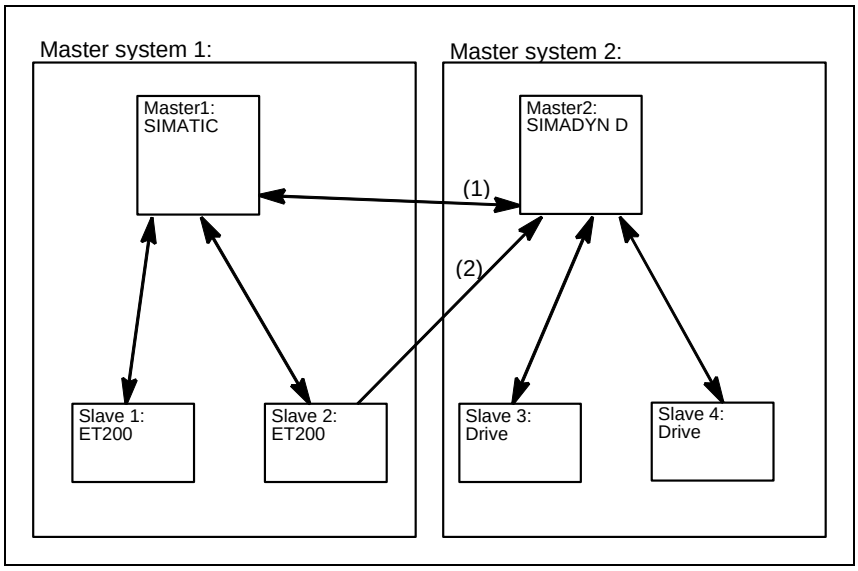


Fig. 3-14 Multi-master system with slave functionality (1) and shared input (2)

3.5.1 Configuring with D7-SYS

Function blocks

The following function blocks must be configured for a PROFIBUS DP coupling:

- A central coupling block @CSPRO
- A maximum of one transmitter- and receiver function block per slave station
- Maximum of one synchronizing function block SYNPRO can be configured
- A maximum of one diagnostics function block DIAL2A can be configured

Communications utility

The following communication utilities are permitted:

- Process data
- Parameter processing of variable-speed drives

Data transfer mode

Permitted data transfer mode:

- Refresh
- For receivers, optionally also multiple

3.5.1.1 Central coupling block

Baud rate and PROFIBUS address

The baud rate and PROFIBUS address are specified, on one hand by CFC (function block @CSPRO) and on the other hand by COM

PROFIBUS.
The following must be observed regarding the validity of these two parameters:

- If a COM database has still not been loaded, then
  - the parameters specified by CFC are valid.
  - the SS52 communications module waits for a COM database to be downloaded.
- If a COM database is loaded and the baud rate and PROFIBUS address are the same as those configured with the CFC, then
  - the COM database is activated.
  - communications module SS52 starts with net data transfer.
- If a COM database is loaded, but the baud rate or PROFIBUS address does not coincide with that configured in CFC, then
  - the parameters specified by CFC are valid.
  - the module waits for download. (the existing COM database can also be activated, by correcting the baud rate and PROFIBUS address at the central block of the COM configuring.)

3.5.1.2 Address connections AT, AR

Entries at address connection AT, AR

Special features when making data entries at address connection AT, AR when using PROFIBUS DP:

Input sequence:
"Channelname.Adressstage1.Addressstage 2"

- **Channel name**
  - max. 8 characters
  - ASCII characters except "Point" and @
  - channel names of all transmit- and receive blocks, which access the same SS52 communications module must be different (exception for the "Multiple" data transfer mode).
  - the channel name has no special significance for PROFIBUS DP.
- Input "." after the channel name
- **Address stage 1:**
  - the slave PROFIBUS address is specified as address stage 1.
  - the slave PROFIBUS address may only assigned once for each transmit- and receive channel.
  - value range: 0, 3 - 123

- 0: means that this channel itself is used as slave channel and can be addressed from another master.
- 3...123: addressing external slaves.

- Enter "." after address stage 1
- **Address stage 2:**
  - consists of a maximum of 2 characters.
  - **1st character:** Byte order

    "1": Standard PROFIBUS setting
    The data are transferred in the ”Motorola format” (most significant byte before the least significant byte).

    ”0”: Exception setting
    The data are transferred in the ”Intel format” (least significant byte before the most significant byte). This setting can be used for communication partners whose internal data administration uses the Intel format (e. g. SIMADYN D).
  - **2nd character:** Optional, only receiver
    "R":
    The access is realized as second master which reads data. ”R” can only be entered for receive channels. (”Shared input”)

    If a 2nd character is not specified, then the slave can be accessed as parameterizing master.

Examples for entries at the address connection

- AT- 'Setpoint.25.1'
  - the channel with the name **setpoint** transmits data to a **slave** with the PROFIBUS address **25**.
- AR- 'RECEIVE.117.0'
  - the channel with the **RECEIVE** name receives data from a **slave** with PROFIBUS address **117**. As an exception, data are transferred in the **Intel format**.
- AR- 'Input.33.1R'
  - the channel with the name **input** receives data from a **slave** with PROFIBUS address **33** as **(second) master which reads data**.
- AT- 'Slavelst.0.1'
  - the channel with the name **slavelst** transmits data as **slave** to a **DP master**.

3.5.1.3 SYNC/FREEZE commands

General

The SYNC and FREEZE commands synchronize the inputs and outputs of a group of slaves. The SYNPRO function block initiates these commands and supports the consistency checking process.

Consistency

The configuring engineer is responsible in guaranteeing that data is consistent. For the SYNC/FREEZE command, this involves consistency of data via all of the slaves involved. It goes without saying that the consistency of the input or output data of a slave is always guaranteed.

SYNC

After initiating a SYNC command, the DP master (SS52) waits for one DP bus circulating time, so that all of the slaves have received the new output values. The DP master then sends a SYNC broadcast telegram to the configured slave group. All slaves of this group then simultaneously update their buffered outputs.

FREEZE

Ensuring data consistency:
When configuring, it must be ensured that during a DP bus circulating time, after a SYNC command has been initiated, that the SIMADYN D CPUs do not change the data.

After initiating a FREEZE command, the DP master immediately transmits a FREEZE broadcast telegram to the configured slave group. All of the slaves of this group then simultaneously read their inputs and buffer them. This input data is then available for the SIMADYN D CPUs after a DP bus circulating time has expired.

Ensuring data consistency:
By suitably configuring, it should be ensured that during a DP bus circulating time, after the FREEZE command has been initiated, that the input data are not evaluated by the DP master.

3.5.1.4 Configuring versions of SYNC/FREEZE

General

The terminology involved with securing data consistency are explained and various configuring versions of SYNC/FREEZE are illustrated.

Terminology

- **Bus circulating time**
  Cycle, in which the DP master (SS52) addresses all of the slaves once. In multi-master systems, all of the masters poll their slaves. The bus circulating time is configured using COM PROFIBUS using the baud rate, number and type of the slaves, and is computed by COM PROFIBUS. It can be read-out there using the menu command **Bus parameters**, as ”Typical data cycle time”.

- **Sampling time**
  This is the cycle in which the SYNPRO function block and the transmit- and receive function blocks (on SIMADYN D CPUs) are calculated. The sampling time is configured using CFC.

NOTE Bus circulating time and sampling time are independent of one another.

- **Synccycle**
  Synccycle is a multiple integer of the sampling time. It can be configured at input CNX of function block SYNPRO. (Synccycle=CNX x sampling time).
  A Synccycle always starts with a sampling time. A synchronizing command is always initiated by the SYNPRO function block in the system mode at the start of a sampling time.

Configuring version 1

Configuring version 1 corresponds to most of the applications:

- Generating SYNC commands.
- The data consistency over all slaves is guaranteed.
- The Synccycle is at least twice as long as the sampling time (CNX>1).
  - the length of the transmit telegrams (outputs) for each slave may not be greater than 32 bytes.
  - all transmit blocks and the SYNPRO function block must be configured in the same sampling time.
  - the SYNPRO function block must be configured before all of the transmit blocks (sequence of execution).
  - output SOK of function block SYNPRO must be connected with the enable inputs of all transmit blocks (belonging to a slave group).
  - the bus circulating time must be shorter than the Synccycle minus 1 x sampling time. When operational, it should be checked as to whether the SOK output goes to “1“ once in each Synccycle, otherwise the Synccycle should be increased.

Example:

- Synccycle=3 x sampling time
- Bus circulating time=2 x sampling time
- Assumption: The SYNPRO function block calculates at the center of the sampling time (before all transmit blocks)

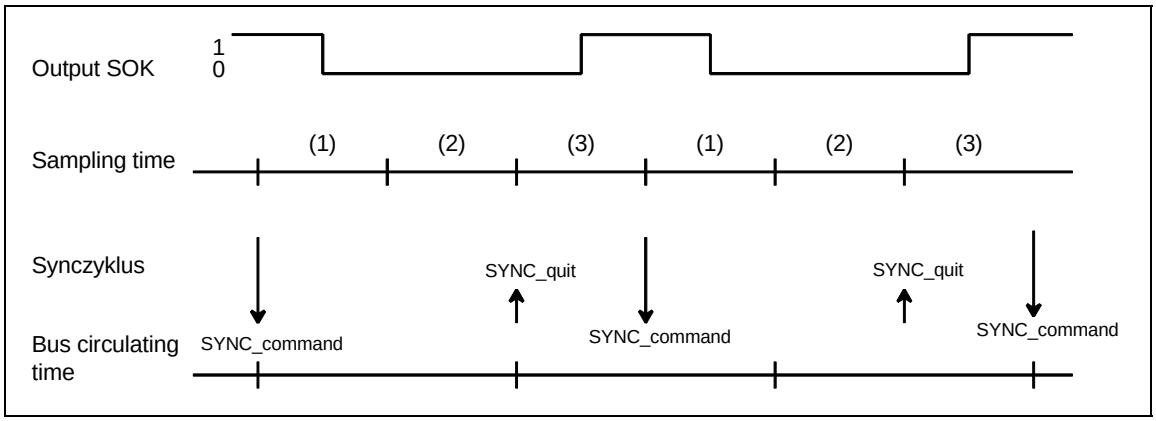


Fig. 3-15 Timing diagram, SYNC version 1

When initiating the SYNC command, the transmit blocks are inhibited (SOK=0) for two sampling times (one bus circulating time). The transmit blocks are enabled in the third sampling time after initiating the SYNC command (SOK=1).

Configuring version 2

Configuring version 2 has the highest SYNC performance:

- Generating SYNC commands.
- The data consistency over all slaves is guaranteed.
- Synccycle=sampling time (CNX=1)
  - the length of the transmit telegrams (outputs) for each slave may not be greater than 32 bytes.
  - all transmit blocks and the SYNPRO function block must be configured in the same sampling time.
  - high baud rate (>1.5 Mbaud). For lower baud rates, the time conditions can hardly be maintained.
  - the bus circulating time may only be a maximum of 50 % of the sampling time.
  - the bus circulating time must also be so low, that one sampling time expires from the start up to the calculation of the function block SYNPRO. This cannot be guaranteed, but must be checked when the system is operational.

Example:

- Synccycle=sampling time
- Bus circulating time=0,3 x sampling time
- Assumption: The SYNPRO function block calculates at the center of the sampling time (before all transmit blocks)

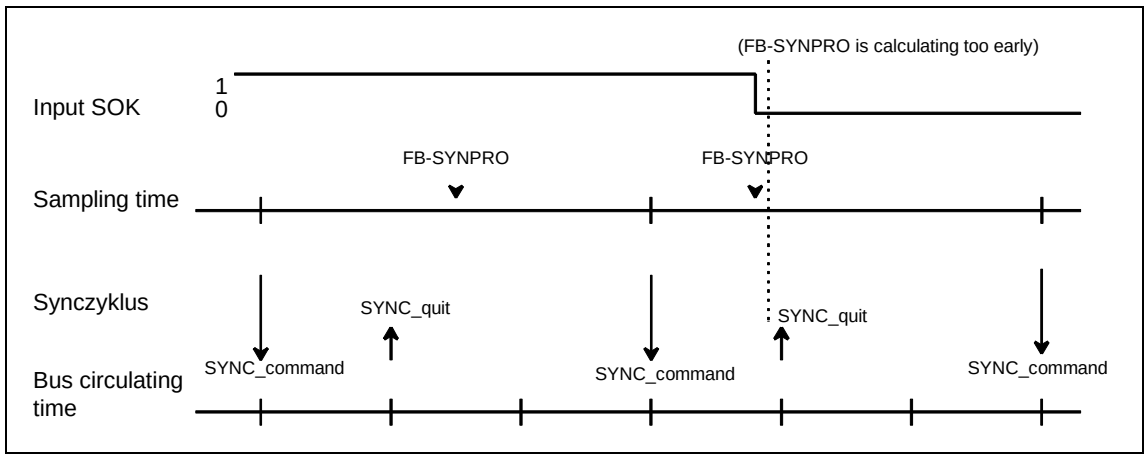


Fig. 3-16 Timing diagram, SYNC version 2

Normally, the transmit blocks are always enabled (SOK=1). If, due to time fluctuations, the SYNPRO function block is calculated before SYNC has expired (to the right in the diagram), the transmit data are not updated, but the values from the previous sampling time are transferred. The Synccycle and the data consistency are not influenced.

Instructions to achieve good SYNC functionality:

In addition to a low Synccycle, it is also necessary to have the lowest amount of jitter (time-based fluctuations) in the Synccycle. The following measures support this:

- Irregular data transfer along the DP bus should be prevented: Single-master operation; stations must not be temporarily switched-in.
- Alarm tasks should not be configured on the same SIMADYN D CPU. Sampling time overruns are not permissible; this would result in a SYNC command failure or a shift by a complete sampling time.
- Configure a high baud rate and short telegram lengths (the time to poll a slave is included in the jitter.).
- Configure the SYNPRO function block and all associated transmit blocks in T1=T0 (basic sampling time). The SYNC command is always initiated with the basic clock cycle interrupt. It is received with more accuracy (timing accuracy) as an interrupt, initiated in the system mode.

Configuring version 3

Configuring version 1 (3) is for generally less frequently used applications of FREEZE:

- Generating SYNC and FREEZE or only FREEZE commands.
- The data consistency over all slaves is guaranteed.
- The Synccycle is at least 300 % longer than the sampling time (CNX>1).
  - the length of the transmit- or receive telegram (inputs or outputs) may not exceed 32 bytes per slave.
  - all transmit- and receive blocks and the SYNPRO function blocks must be configured in the same sampling time (on the same CPU).
  - the SYNPRO function block is configured as the last function block in the processing sequence.
  - output SOK of function block SYNPRO should be connected with the enable inputs of all (belonging to the slave group) transmit- and receive blocks.
- The bus circulating time must be less than the Synccycle minus 2 x the sampling time. When the system is operational, it should be checked whether the SOK output goes to “1“ once per Synccycle; otherwise the Synccycle should be increased.

Example:

- Synccycle=4 x sampling time
- Bus circulating time=2 x sampling time
- Assumption:
  The SYNPRO function block calculates at the center of the sampling time (after all of the receive- and transmit blocks)

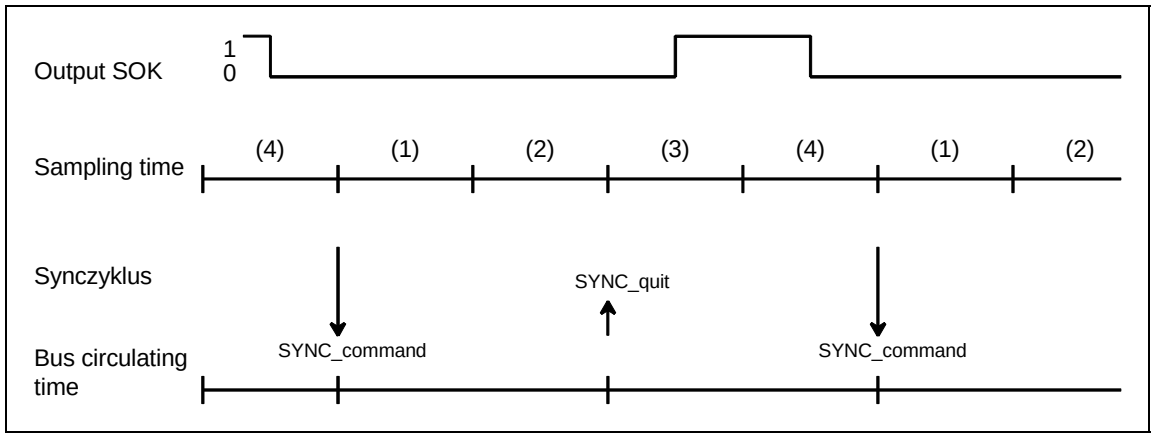


Fig. 3-17 Timing diagram SYNC version 3

After the SYNC command has been initiated, the transmit- and receive blocks are inhibited for three sampling times (one bus circulating time + one sampling time) (SOK=0). The transmit- and receive blocks are enabled in the fourth sampling time after the SYNC command has been initiated (SOK=1).

3.5.1.5 Diagnostics function block

General

Master- or slave-specific diagnostic information can be output from PROFIBUS DP using the DIAPRO function block.

The diagnostic data to be output are selected using input SEL. It is output at D01 to D08.

Further information
on the diagnostic data, refer to the User Documentation "COM PROFIBUS" or in the User Documentation for the individual slaves.

Overview, diagnostic data

SEL=0: No diagnostic data

- The block does not output any valid diagnostic data.

SEL=126: System diagnostics

- The system diagnostics provides an overview as to which slave has provided diagnostic data.

- The 8 words are bit-coded.
- Each bit is assigned a slave with its PROFIBUS address corresponding to the following table.
- If the bit for the associated slave is set, then the slave has provided diagnostics data.

Output	Bit 16	Bit 15	Bit 14	...	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
D01	15	14	13	...	4	3	(2)	(1)	(0)
D02	31	30	29		20	19	18	17	16
...	...								...
D07	111	110	109		100	99	98	97	96
D08	-	-	(125)	...	116	115	114	113	112

Table 3-23 Assigning system diagnostics/data transfer list to the slave PROFIBUS address

SEL=127: Data transfer list

- The data transfer list provides an overview of the slaves which were involved with data transfer within a configured time (COM PROFIBUS).
- The 8 words are bit-coded as for the system diagnostics.
- If the bit for the assigned slave is set, then data is being transferred.

SEL=128: Master status

- Outputs information specific to the master (for users, the low byte of D01 is relevant; the significance of the other outputs has been documented, but hasn't been explained in any more detail):

Output		Significance
D01	low byte	Status of the DP master: Stop (40h), Clear (80h), Operate (C0h)
	high byte	Ident No. SS52 (high byte)=80h
D02	low	Ident No. SS52 (low byte)=37h
	high	(irrelevant)
D03...D08		

Table 3-24 Information specific to the master

SEL=3 ... 123: Slave diagnostics

- Output of slave diagnostics data.
- The SEL data entry corresponds to the slave PROFIBUS address.

- The diagnostics data is dependent on the slave type.
- The first 16-byte slave diagnostic data are output.
- Additional slave diagnostic data can be output with SEL>1000.

Further information
on slave-specific diagnostics data, refer to the user documentation "COM PROFIBUS" and the User Documentation for the individual PROFIBUS slaves.

Diagnostics data of SIEMENS DP slaves

<table>
<tr><th colspan="2">Slave type</th><th>SPC slaves, general</th><th>ET 200U</th><th>ET 200B</th><th>ET 200K</th><th>SPM slave</th><th>ET 200C 8DE/8DA</th><th>DP stand. slaves</th><th></th></tr>
<tr><th colspan="2">Connection</th><th colspan="7"></th></tr>
<tr><td rowspan="2">D01</td><td>low</td><td colspan="7">Status 1</td><td rowspan="4">Diagnostics according to the standard 6 bytes</td></tr>
<tr><td>high</td><td colspan="7">Status 2</td></tr>
<tr><td rowspan="2">D02</td><td>low</td><td colspan="7">Status 3</td></tr>
<tr><td>high</td><td colspan="7">Master PROFIBUS address</td></tr>
<tr><td rowspan="2">D03</td><td>low</td><td colspan="7">Identification number, high byte</td><td rowspan="2"></td></tr>
<tr><td>high</td><td colspan="7">Identification number, low byte</td></tr>
<tr><td rowspan="2">D04</td><td>low</td><td colspan="7">Header, device-related diagnostics</td><td></td><td rowspan="10">Device-specific diagnostics</td></tr>
<tr><td>high</td><td colspan="2">Device diagnostics U</td><td>Device diagnos. B</td><td>0</td><td>0</td><td>0</td><td></td></tr>
<tr><td rowspan="2">D05</td><td>low</td><td colspan="2">Header identification-related diagnostics</td><td>0</td><td>0</td><td>0</td><td>0</td><td></td></tr>
<tr><td>high</td><td colspan="2">BG 7-0</td><td>0</td><td colspan="3">Channel 7-0</td><td></td></tr>
<tr><td rowspan="2">D06</td><td>low</td><td colspan="2">BG 15-8</td><td>0</td><td colspan="2">Channel 15-8</td><td>0</td><td></td></tr>
<tr><td>high</td><td colspan="2">BG 23-16</td><td>0</td><td colspan="2">Channel 23-16</td><td>0</td><td></td></tr>
<tr><td rowspan="2">D07</td><td>low</td><td colspan="2">BG 31-24</td><td>0</td><td colspan="2">Channel 31-24</td><td>0</td><td></td></tr>
<tr><td>high</td><td rowspan="3">Additional device-specific diagnostics</td><td colspan="6">Irrelevant</td><td></td></tr>
<tr><td>D08</td><td>low</td><td colspan="6">Irrelevant</td><td></td></tr>
<tr><td></td><td>high</td><td colspan="6">Irrelevant</td><td></td></tr>
</table>

Table 3-25 Overview of the structure of the diagnostics data for Siemens DP slaves

Bits, status 1, 2 and 3

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
Status 1 (D01 low byte)	S: Slave was parameterized from another master	S: Last parameter telegram was erroneous	M: Erroneous slave response	S: Requested function is not supported	S: Diagnostics entry in the specific diagnostics area	S: Config. data dont match	S: Slave still not ready for data transfer	M: Slave cannot be addressed on the bus
Status 2 (D01 high byte)	M: Slave entered as ”not active”	(not used)	S: Slave has received a Sync command	S: Slave has received the Freeze command	S: Response monitoring activated	S: 1 (fixed)	S: Diagnostic data must be retrieved	S: Parameterization and configuring required
Status 3 (D02 low byte)	S/M: Not all diagnostics data can be transferred	-	-	-	-	-	-	-

Table 3-26 Significance of the individual bits, status 1, 2 and 3

- **M:** Master identifies diagnostics data
- **S:** Slave identifies diagnostics data

Master PROFIBUS address

- PROFIBUS address of the master which had parameterized this slave.

If this slave is not parameterized, then FFh is used.

Identification number

- High/low byte:
  This identifies the slave type.

All additional diagnostic data are slave-specific.

Generally (standard DP slave) the diagnostic blocks follow: Device-related, identification-related and channel-related diagnostics. Not all slave-specific diagnostic blocks must be available.

Each block is preceded by a header byte. The diagnostics block is identified by bit 7 and bit 8:

Bit 7, 8 of the header byte	Significance
Bit 7, 8= 00	Device-related diagnostics
Bit 7, 8= 01	Identification-related diagnostics
Bit 7, 8= 10	Channel-related diagnostics

Table 3-27 Significance of bit 7 and bit 8 of the header byte

Bits 1 to 6 define the following:

- For device- and identification-related diagnostics the length of the diagnostic block including the header byte, value range 2...63.
- For channel-related diagnostics, the identification number, value range 0...63.

Output of additional slave diagnostics data

- Diagnostic bytes 17 to 32 of a slave are output with SEL=1002 to SEL=1123.

3.5.2 Configuring with COM PROFIBUS

General

COM PROFIBUS (Windows) should be used when configuring (it is also possible to use the earlier COM ET200 Version 2.1 for configuring). Using COM PROFIBUS you can define:

- The number and configuration of the nodes connected to the PROFIBUS DP bus system
- The baud rate
- Important parameters when using the PROFIBUS DP bus system

SIMADYN D-specific information on COM PROFIBUS:

- Configure the SS52 communications module as SIMADYN D SS52 station type ("SIMADYN" family).
- The input and output addresses should not be specified.
- After completing the configuring, the database is downloaded into SS52 via the DP bus using the menu command **File > Export > DP master**.
- Alternatively, it is also possible to download via RS232. The following menu command is used to start loading the SS52: **File > Export > SIMADYN Master**.

3.5.2.1 Harmonizing with data configured in CFC

Rules

The configured software should be harmonized with one another as follows:

- The baud rate and the actual PROFIBUS address must be the same.
- The slaves, configured in COM must each have, in the receive- and transmit directions, a CRV/CTV function block configured in the CFC. This is assigned via the PROFIBUS address (address stage 1 at the address connection).
- The length of the input- (receive-) and output- (transmit-) data per slave must coincide.

Error- and alarm information

The rules (syntax) are checked. Error- or alarm information is issued if these rules (syntax) are not observed:

- Communications error field (flashing "C" on the CPU module), or output YTS at function block CRV/CTV
- Output ECO at function block @CSPRO

NOTE

The following rules /syntax) are not checked:
The net data structure of the communication partners must be the same.

If this is not observed, the data could be incorrectly interpreted (e. g. bytes could be interchanged within a data word) between the communication partners.

Net data structure

For SIMADYN D, the net data structure with CFC is specified by configuring the virtual connections (refer to the Chapter Communications utility, process data).

- For most of the PROFIBUS slaves, the net data structure is specified using COM PROFIBUS by entering identification codes in the "Configuring" window.

3.5.2.2 SS52 as PROFIBUS slave

Configuring

The SS52 communications module can be configured as pure slave or combined as master and slave:

- SS52 as pure slave does not require COM to be configured:
  Input SLA should be set to 1 or 2 at function block @CSPRO. A function block CRV and/or CTV should then be configured next to it. The address stage 1 at connection AR/AT should be set to "0".
- SS52 combined as master and slave
  Input SLA at function block @CSPRO should be set to "0" (default value).

- The bus is configured using COM PROFIBUS. A database ("master system") is created for each PROFIBUS master. This is used to download the particular master.
- If the master is configured using another tool, when configuring the SS52 slave, a fictitious master must be configured in COM PROFIBUS. It should be ensured that the bus parameters are correctly set: It is recommended to increase the number of active stations and the token rotation time in both configuring tools.

3.5.2.3 Loading the database

Versions

There are two ways to load the database:

Loading via PROFIBUS DP

- Loading via PROFIBUS DP is the version which is the more user friendly.
  However, certain restrictions must be observed.
- A DP-capable PC card is required (currently available cards can be requested from the product support)
- The driver for the PC card is installed together with COM PROFIBUS. Loading is realized in COM PROFIBUS using the menu command **File > Export > DP master**.

Loading via RS232

- Using the "SS52LOAD" program, a database, generated from the COM PROFIBUS is loaded as binary file into the SS52 module via the RS232 interface.
- SS52LOAD is integrated in COM PROFIBUS (from Version 3.1).
- Restriction:
  If the Sync function block SYNPRO is configured, then the synchronous mode must be disabled (enable input EN=0), so that the download functions.
- The binary file (*.2bf) is generated in COM PROFIBUS using the menu command **File > Export > Binary file**.
- Loading is realized with SS52LOAD with the menu command **File > Download** .
- The RS232 interface is located together with the PROFIBUS interface on the 9-pin connector of the SS52 module. The customer must assemble his own cable to establish the connection to the COM port of the PC.
  RS232 assignment at SS52 (no standard):
  - 2 - TxD
  - 7 - RxD

CAUTION There is a danger of interchanging connections for the RS232 assignment.

3.5.3 Start-up/diagnostics

3.5.3.1 LEDs

Yellow LED Contrary to the other communication modules, for the SS52 communications module, the yellow LED does not directly indicate the bus activity.

Green LED The green LED provides general information about the SS52 communications module and about synchronization with function block @CSPRO from SIMADYN D. The yellow LED provides information about the DP bus and the COM database.

LED	Green	Yellow
Dark	CPU not running	No bus operation (during run-up).
Flashes quickly (every 0.2 s)	Fatal error • Remedy: Read-out the error class and -code at function block @CSPRO and inform Siemens AG.	Bus error (e. g. short circuit) • Remedy: Check the cable and the other bus nodes.
Flashes (every 1 s)	Wait and synchronize to the SIMADYN D-CPU • Remedy: Check the configuring of function block @CSPRO.	COM database not available or not activated (also during download) • Remedy: Load the database.
Flashes slowly (every 2 s)	-	CFC- and COM configuring do not match 100%. Only restricted bus operation is possible • Remedy: Adapt the CFC- and COM configuring so that they match.
Steady	Communications module SS52 and synchronization to SIMADYN D CPUs OK.	Bus operation with activated COM database OK.

Table 3-28 Significance of the LEDs of the SS52 communication module

Behavior at run-up

- After power-on, both diodes are briefly lit and then go dark again.
- Only the green LED is lit during the run-up time (approx. 5 seconds).
- When the system is OK, the yellow LED is lit after the run-up time has expired.
- After a reset, both LEDs initially stay in the last condition until the software again controls the LEDs.

Characteristics at download

- During download, the yellow LED flashes (this is extremely short at high baud rates).
- After this, the behavior is the same as for run-up.

The LEDs do not provide information as to whether all of the slaves are available at the bus and have been correctly parameterized. If data transfer with a slave is not OK, then this is flagged at the associated function block (YEV=0x0002 or YTS=0x6014) using a ”break” ID. Information regarding the current status of individual slaves is obtained using the diagnostics function block DIAPRO.

3.5.3.2 Error class (ECL) and error code (ECO)

Outputs ECL, ECO

Significance of the outputs ECL, ECO at function block @CSPRO:

- **Error class=0:** An alarm is present. In some cases this alarm can be removed without a SIMADYN D reset. If there are several alarms, then the alarm of the lowest number is displayed.
- **Error class>0:** An error is present. Function block @CSPRO issues a communications error (flashing ”C” on the CPU module). After the error has been removed, the SIMADYN D subrack must be reset.

Error class	Error code	Significance
0 (alarm)	0	O.K.
	1	COM database present, but not activated as the baud rate and the PROFIBUS address with connections BDR and MAA do not match. • Remedy: Harmonize the baud rate and PROFIBUS address in the CFC and COM configuring.
	2	No COM database available. • Remedy: Load the database.
	3	The COM database is presently being downloaded with subsequent start-up.
	4	The channels to DP nodes, configured with CFC, which are configured in the COM database, are missing. This status can also temporarily occur after a SIMADYN D run-up. The DP nodes are not addressed. • Remedy: Harmonize the CFC- and COM configuring.
	5	(not used)
	6	There is at least one channel configured with CFC which does not match the COM database. The associated SIMADYN D FB has issued a communications error (flashing ”C”). • Remedy: Harmonize the CFC- and COM configuring.
	7	There is at least one channel configured with CFC, which essentially does not match the COM database. The associated SIMADYN D-FB has issued a communications error (flashing ”C”). • Correct the CFC configuring.
	8	Resource bottleneck. Not all of the CFC channels are processed. • Remedy: Reduce the CFC configuring (communication channels).
	9	There are two channels, which wish to transmit data to the same slave or receive data from it. The SIMADYN D-FB which is associated with the channel which addressed the slave later, has issued a communications error (flashing ”C”). • Remedy: Correct the CFC configuring.
	10	Bus operation temporarily faulted. • Remedy: Check the cable and bus nodes.
>1 (internal error)	(any)	• Remedy: Note the error class and error code and inform Siemens AG.

Table 3-29 Significance of the error class and error code

3.5.3.3 Application example, PROFIBUS DP coupling

General

The application example describes a typical configuration consisting of:

- SIMOVERT 6SE70
- ET200U
- ET200B
- SIMATIC S5

It is assumed that you are knowledgeable about configuring SIMADYN D as well as the CFC configuring language.

NOTE Only those activities are described in detail which are of significance for this particular configuration. Versions or additional components are touched-on but not discussed in detail. In the text, these positions are identified with the symbol located on the right.

The following subjects are discussed in this application example:

- **Typical configuration**
  Description of a typical configuration for SIMADYN D connected to PROFIBUS DP with the associated system requirements.
- **Configuring under CFC**
  Grouping of the PROFIBUS DP specific blocks and their configuring in the typical configuration.
- **Configuring the SS52... communications module**
  Configuring the SS52 communication module using the COM PROFIBUS 3.0 parameterizing software and the download tool "SS52load".

3.5.3.4 Typical configuration and system requirements

General

The following systems and devices are selected as typical configuration, whereby the specified PROFIBUS addresses were randomly defined:

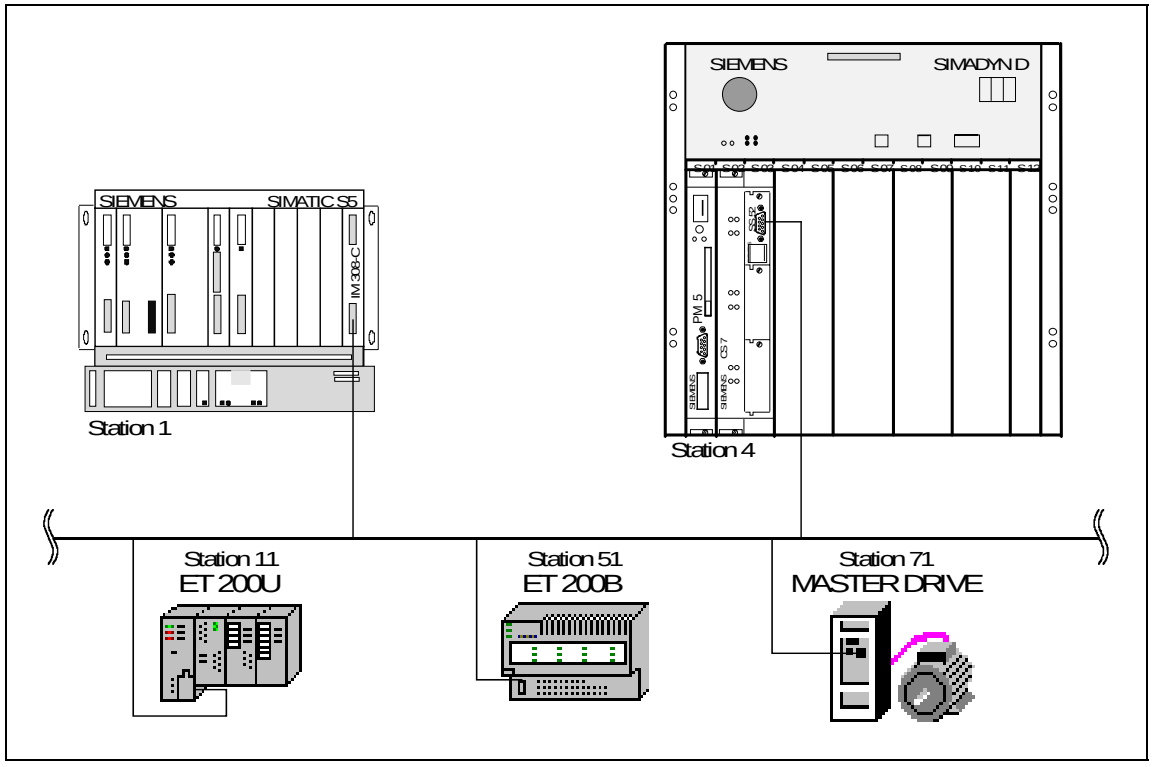


Fig. 3-18 Typical configuration

Communications partner

The SIMADYN D communication partners (station 4) are as follows:

- **SIMATIC S5-105U (station 1) as master to SIMADYN D:**
  The SS52 has a master (S5) which polls the SIMADYN D. Data transfer (quantity and amount of process data) between the two controls can be freely configured. The following was defined:
  - S5 ⇨ SIMADYN D: Three words (input/output), one word (input), one byte (input), one byte (input)
  - SIMADYN D ⇨ S5: Three words (input/output), one word (output), one byte (output)
- **SIMOVERT MASTER DRIVE with CB1 (station 71) as slave:**
  Five defined PPO types are available for data transfer with this node. PPO: Parameter process data object structure of the net data for variable-speed drives. There is net data, which either consists of parameter ID values (PKW) and process data (PZD) (PPO types 1,2,5) or only process data (PPO types 3,4).
  In this configuring example, PPO type 3 is configured. In this case, two words (control word and main setpoint) are transmitted and two words (status word and main actual value) received.
- **ET 200 B (station 51) as slave:**
  When using this slave type, a precise type must be selected which then automatically defines data transfer. For 8DI/8DO types, one byte is output and one byte is read-in.
- **ET 200 U (station 11) as slave:**
  For this ET 200 U configuration (three digital output modules and a digital input module) three bytes are output and one byte is read-in.

3.5.3.5 Check list of the required hardware and software components for SIMADYN D

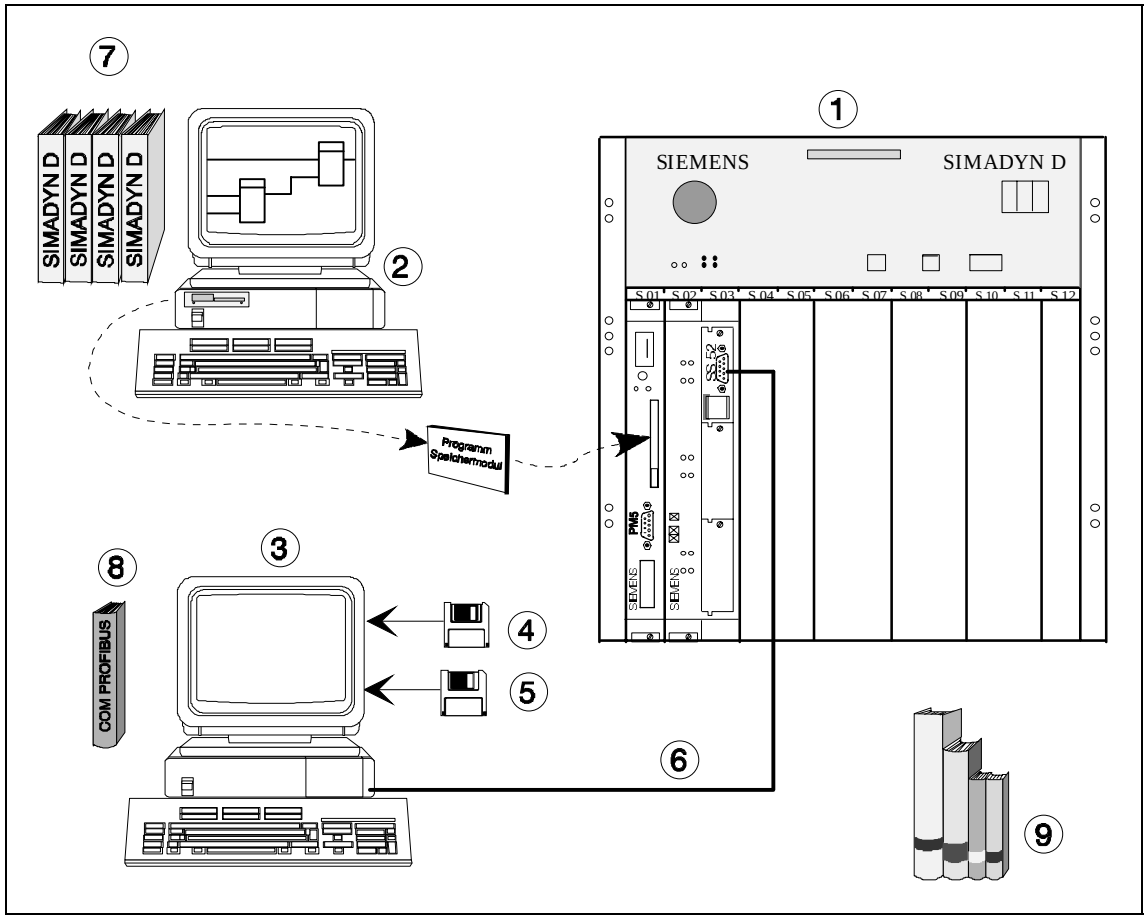


Fig. 3-19 Hardware and software components for SIMADYN D

Legend

1	SIMADYN D unit consisting of at least: Subrack, CPU, program memory sub-module, communications module CS 7 and communications sub-module SS52
2	CFC configuring device: PC with Windows 95/NT as operating system, STEP 7 software, option package D7-SYS and PCMCIA drive
3	PC to operate "COM PROFIBUS" and "SS52load" (this can be the same PC as for CFC), with: 3.5" floppy disk drive, one serial interface, Windows 3.1x or Windows 95 operating system
4	"COM PROFIBUS 3.0" parameterizing software: Software to generate the PROFIBUS DP bus configuration
5	Download software "SS52load": Software to transfer the DP configuration generated with "COM PROFIBUS" to SS52 via the COM port (RS 232) of a PC.
6	RS232 line: Connection between the SS52 (in the 9-pin connector of the SS52, in addition to the RS485 of the Profibus, there is also an RS232: 2-TxD; 7-RxD) and a PC COM port (RS232). This cable must be assembled according to the specifications (refer to Chapter Downloading the COM database onto the SS52) as the RS232 of the SS52 is not standard! If data is downloaded via the bus (RS 485), using a communications processor CP 5411 (additional plug-in card in the PC), then the "SS52load" tool and the RS232 line are not used. However, the CP 5411 is not included in this documentation.
Supplementary literature (for emergency situations and additional applications!):	
7	User Documentation SIMADYN D
8	Manual on the COM PROFIBUS parameterizing software
9	Manuals of the other nodes: SIMATIC S5, ET 200U, ET 200B, SIMOVERT Master Drives

Table 3-30 Legend, hardware and software components for SIMADYN D

3.5.3.6 Configuring under STEP 7 CFC

General

In order to simplify unified configuring of a "PROFIBUS DP coupling" under CFC, the bus-specific CFC blocks are now grouped together and the relevant syntax explained.

When configuring an SS52 communications sub-module under CFC, the following should be observed:

- Precisely one central block @CSPRO must be used for each SS52 communications sub-module

- A maximum of one transmitter- and/or one receiver block per communications partner
- Permitted communication utilities:
  - process data
  - parameter processing of variable-speed drives
- Permitted data transfer mode: Refresh (for receivers, also multiple)
- A maximum of one synchronization function block SYNPRO per SS52 communications module
- A maximum of one diagnostics function block DIAPRO per SS52 communication module

Function blocks

Central block PROFIBUS DP coupling @CSPRO

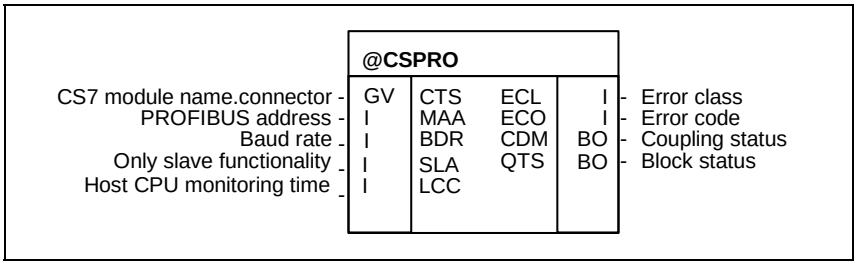


Fig. 3-20 Central block, PROFIBUS DP coupling @CSPRO

- **Use**
  This function block initializes and monitors the PROFIBUS DP coupling (CS7 with SS52). It may only be configured in a sampling time of 32 ms ≤ TA ≤ 255 ms.
- **I/O**
  ECL, ECO, CDM, QTS and YTS are service- and diagnostics I/O which are generally used for SIMADYN D start-up (commissioning). They are not used for configuring.

Further information
on the I/O of the central block PROFIBUS DP coupling @CSPRO, refer to the User Documentation "SIMADYN D, function block library".

CTS	The configured name of the CS7 module (identical with the entry in the master program, actual: D04) and the designation of the CS7 slot where the SS52 is located (X01, X02 or X03, actual: X02) is specified at this initialization input.
MAA	Just like all of the other bus nodes, the SS52 module has a station address. This must be specified at this connector (a number between 1 and 123, actual: 4).
BDR	The baud rate, which the SS52 uses on the bus, is set using this connector. This value must be specified in a code: 0=9,6 kbaud ; 1=19,2 kbaud ; 2=93,75 kbaud ; 3=187,5 kbaud ; 4=500 kbaud ; 5=1,5 Mbaud ; 6=3 Mbaud ; 7=6 Mbaud ; 8=12 Mbaud ; (actual: 5).
SLA	Initialization input, only for slave functionality: 0: SS52 operates as PROFIBUS master and/or slave. A COM PROFIBUS database must be loaded. 1 or 2: SS52 operates as pure PROFIBUS slave without COM PROFIBUS database 1: Slave with either inputs or outputs, 2: Slave with inputs and outputs (actual: 0)
LCC	Initialization input for the time in which the SS52 module monitors the SIMADYN D host CPU: <0: No monitoring 0...10: Monitoring time=1s (default) >10: Monitoring time in 1/10 s (actual: 0)

Table 3-31 I/O of the central PROFIBUS DP coupling block

3.5.3.7 Using transmit- and receive blocks

General

The function blocks of the communications utility, process data must be configured for PROFIBUS DP.

The address connections AT and AR of those blocks, which access the SS52 data interface, must have the following syntax (rules):

AT/AR- 'Channelname.Addressstage1.Adressstage2'

Channel name

- Must be unique, corresponding to the general communication rules (the channel names of all transmit- and receive blocks, which access the same SS52 communications module, must be different)
- It may consist of a maximum of 8 characters
- It has no special significance for PROFIBUS DP

Address stage 1

- The PROFIBUS address of the communication partner is specified in this address stage.
- Using address 0, this channel goes to the slave and is called-up by other bus masters.
- External slaves can be addressed using addresses 3..123.

- A PROFIBUS address may only be used once for each transmit-/receive channel.

Address stage 2
This address stage is configured with one or two characters:

- **1st character:** Defines the byte order to transfer word quantities for various communication partners.
  - **1=Motorola format** (high byte before the low byte)
    Thus, it corresponds to the telegram structure of the PROFIBUS standard, and should be used as standard, especially when transferring single word quantities to standard bus nodes (analog I/O, SIMOVERT, SIMATIC etc.)
  - **2=Intel format** (low byte before the high byte)
    Can be used for data transfer to devices where data is processed according to the Intel format just like in SIMADYN D (e. g. second SS52)

Coupling partner	1st character
SIMOVERT Master Drives with CB 1 (standardized bus nodes)	1
ET200 distributed periphery (standardized bus nodes)	1
SIMATIC (IM 308 C,...) (standardized bus nodes)	1
SIMOREG 6RA24	1
MICRO / MIDI Master (standardized bus nodes)	1
SIMADYN D (SS52) (the coupling partner must also have the same setting)	0

Table 3-32 Byte order for various communication partners

- **2nd character** (optional, only for receivers):
  When an "R" is entered at a receive channel, the SS52 is authorized to read other slaves (shared input).

3.5.3.8 Configuring the typical configuration in CFC

General

In this case, it does not just involve process data processing, but mainly in implementing the listed communication paths to the other bus nodes.

A CFC chart with explanations shows how to configure the PROFIBUS DP. The CFC chart does not purport to include all details.

The following are to be configured:

- CPU PM5 in slot S01 under the name D01_P1:
- Communications module CS7 at slot S02, designation D02
- Communication sub-module SS52 (D042) on CS7 connector X01

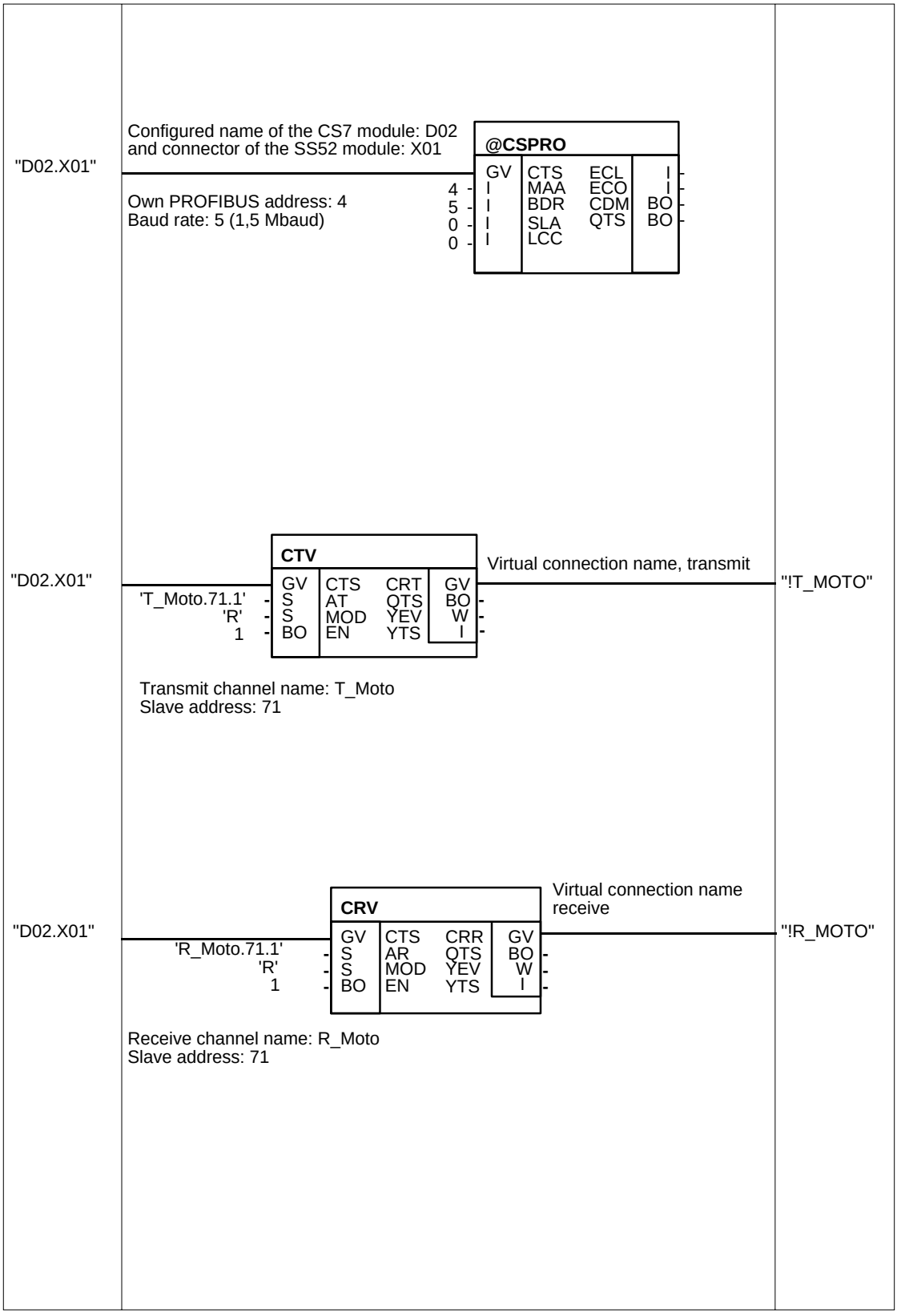


Fig. 3-21 CFC chart (Part 1) of the typical configuration

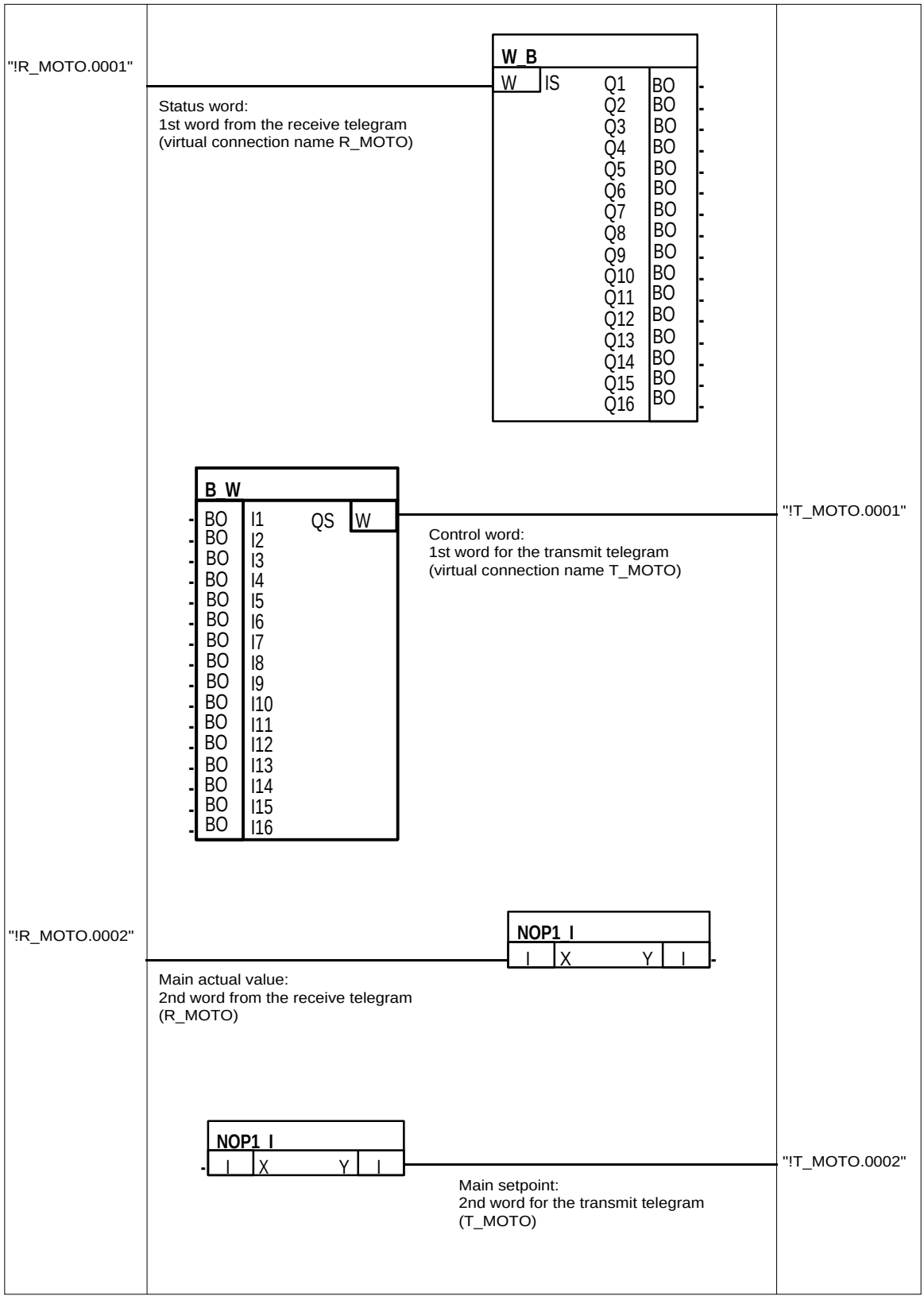


Fig. 3-22 CFC chart (Part 2) of the typical configuration

3.5.3.9 Configuring the SS52 communications module with COM PROFIBUS

General

If the SS52 communications module is inserted at one of the three slots of the CS7 (currently: X01) and was configured, then values are transferred between the transmit- or receive blocks and the bus connector on the SS52 communications module. As SIMADYN D is a freely-configurable system, the following logical communication structures must be assigned:

- Bus parameters defined (baud rate, ...)
- The communication associations between the nodes defined (who communicates with whom, and in which function?)
- The communication objects must be defined (communication objects are useful (net) data. For SIMADYN D they consist of the process- and device data. However, for the typical configuration, communications only involves the process data.)

This data (in the following, designated as COM database) is saved on the SS52 in a permanently integrated memory and are changed and adapted by downloading via the 9-pin sub-D connector of the module.

3.5.3.10 Generating the COM database with COM PROFIBUS

Procedure

Master and slaves of a bus structure are configured using a graphic user interface and a list of communication partners which are supported..

At the start, all communication associations of the typical configuration are defined by selecting the nodes involved.

Parameterizing the 1st host system

1. After the program start, the first master system is set-up using the menu command **File > New**.

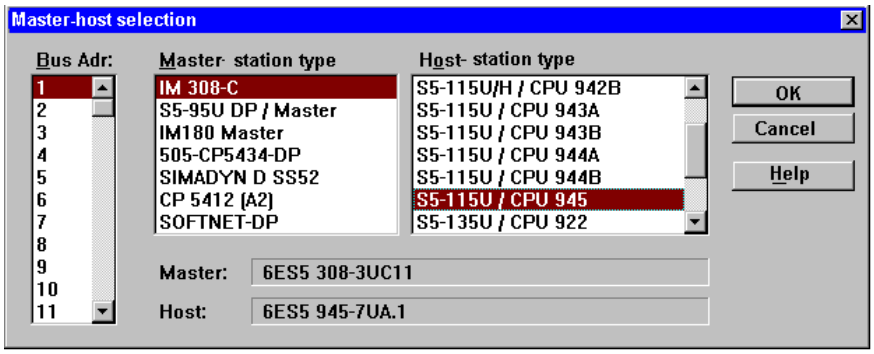


Fig. 3-23 Dialog box, "Master-host selection"

2. After buffering the data (**File > Save under...**) using any name (current: "Typical"), a first host system is generated with the name "Mastersystem <1>". The code number (current: 1) is identical with the selected PROFIBUS address. This first step defines who has the “say“ on this host system.

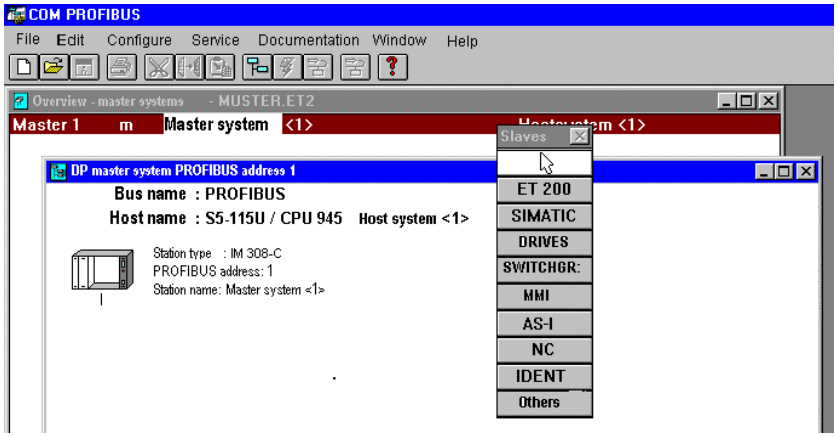
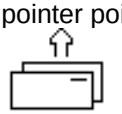


Fig. 3-24 Window "DP master system PROFIBUS address 1"

3. After selecting the button "ET200" in the "Slaves" menu, the mouse pointer points to an empty box with an arrow upwards.



This allows slaves to be assigned to the S5 station, by positioning the mouse pointer under the station symbol and then clicking on the mouse.

4. After interrogating the PROFIBUS address (current: 4) the communications partner can be selected in an additional selection window.

Fig. 3-25 "PROFIBUS address" window

— The majority of the setting possibilities in the "Slave characteristics" window are of now significance for the typical configuration. The standard settings can be used. Only the family (current: SIMADYN), the station type (current: "SS52 master/slave") and the "Configuring..." button are important.

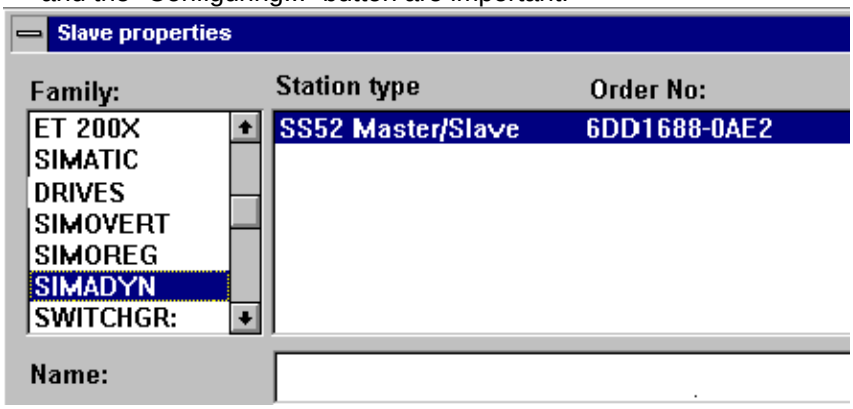


Fig. 3-26 Dialog box, "Slave characteristics"

6. However before configuring starts, the specified settings must be acknowledged with OK in a dialog box "Master-host selection".

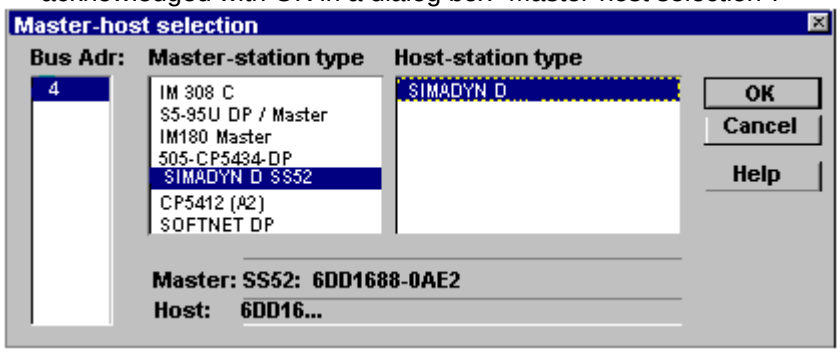


Fig. 3-27 Dialog box, "Master-host selection"

7. The bus node is now actually configured.
   For the SS52 communications module, this configuration window is at first completely empty. The net data structures must now be entered in the list in the dialog box "Configuring: SIMADYN D slave ...".

NOTE S5 is the master in this "Master system <1>" so that the transmit- and receive mode must be considered from its perspective (I/O addresses of the S5).

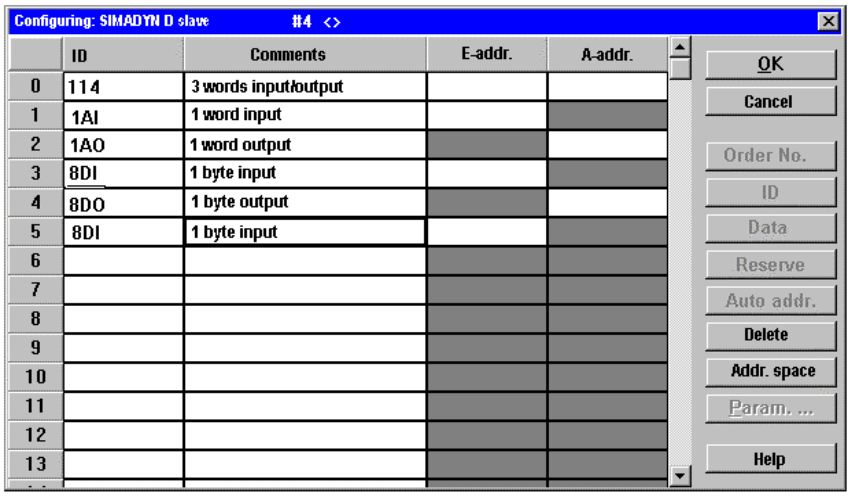


Fig. 3-28 Dialog box, "Configuring: SIMADYN D slave ..."

8. All of the data types are entered in the "ID" column. In this case, the associated dialog box must be activated. You can achieve this by either double clicking on a cell, or after highlighting the cell, depressing the "ID" button.
   The following parameters can now be specified:

- **Type**
  Select between:
  - input, output
  - input/output
  - empty location
  - special format
- **Length**
  1 to 16
- **Format**
  Select either single-word- or byte format

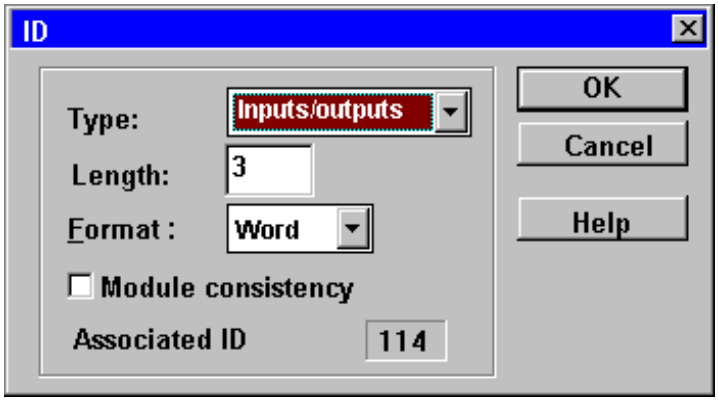


Fig. 3-29 Dialog box, "ID"

9. After terminating the dialog with OK, the appropriate ID is entered in the list. The sequence of the process data in the telegram is defined by the position at which the ID is entered in the input or output address ranges (fields with a grey background are not taken into account). Entries into the comments column are optional and can be freely configured. The address settings ("I-Adr." and "O-Adr.") are not required for the SIMADYN D database.
   Thus, the first host system has been generated in which the SIMADYN D is slave to the S5. Parameterization has now been completed. It should be observed, that this involves the configuring data for the IM308 (S5); therefore these no longer have to be processed, as they are not relevant for the SS52.

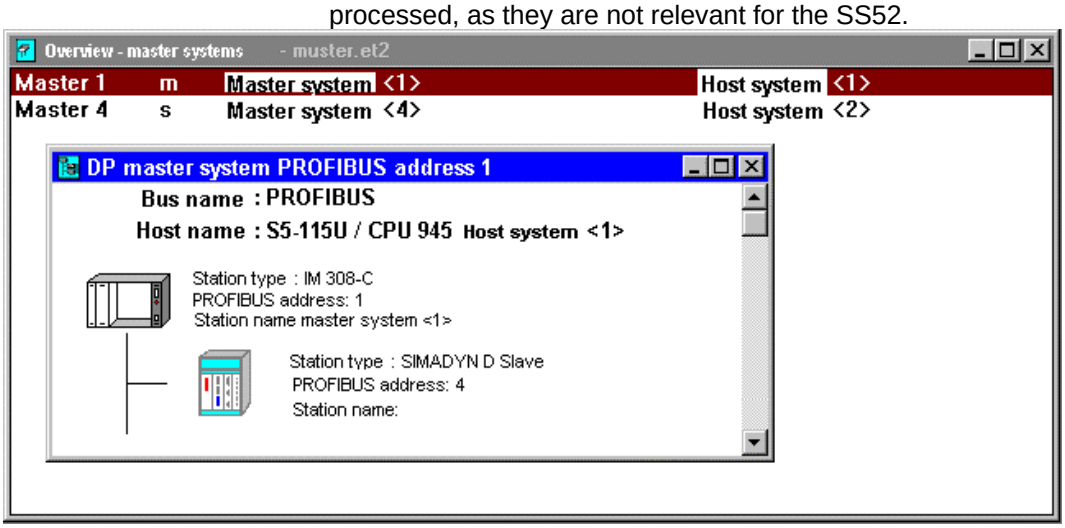


Fig. 3-30 Window, "DP master system PROFIBUS address 1"

Parameterization of the 2nd host systems

1. The first host system is closed by double clicking on "Master 4" and the second host system is made accessible so that the SS52 master can be parameterized.

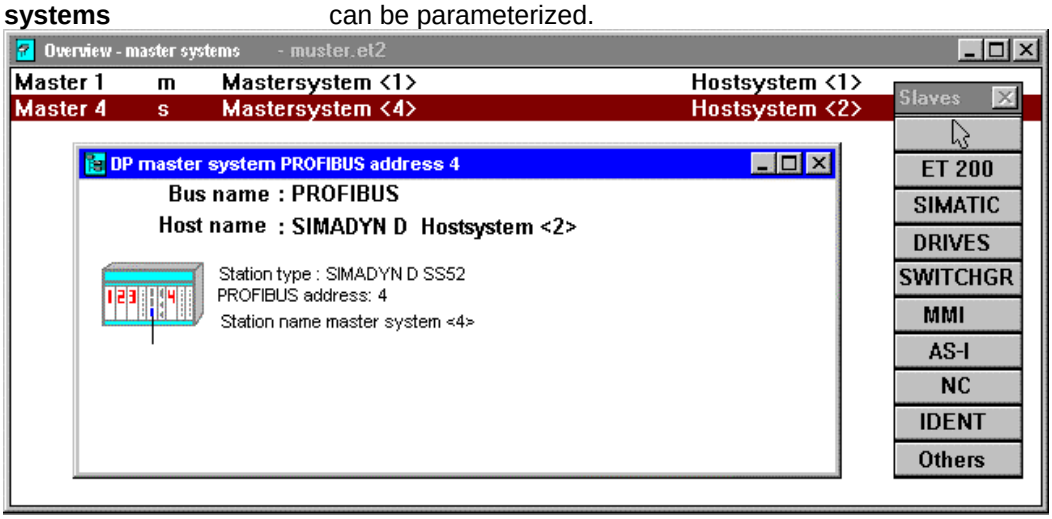


Fig. 3-31 Dialog box, "Overview, master systems"

2. By double clicking on the symbol "SIMADYN D" it can be seen how important it is to first set-up the SS52 as slave in the "Host system <1>". The complete telegram structure is automatically transferred into the SS52 configuration with the difference that the telegrams lie interchanged in the address ranges: The output of S5 becomes the input for SIMADYN D and vice-versa.

   The data identification (by configuring...) now has a grey background and, for this communication, can no longer be changed from the present host system (identification and comment belong to the S5). The data are acknowledged with "OK". Thus, communications to the S5 have been set-up.

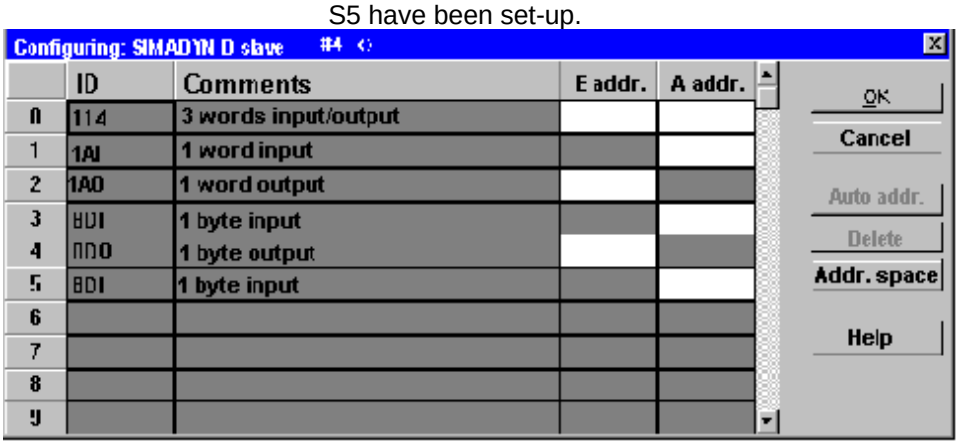


Fig. 3-32 Dialog box, "Configuring: SIMADYN D slave"

3. The master functions of SS52 can be configured. To realize this, you must return to the DP master system window, PROFIBUS address 4. After the slave menu has been re-activated (the mouse pointer changes), ET 200 U, ET 200 B and SIMOVERT Master Drive are coupled one after the other. Each time a component is called-up, you are prompted for the PROFIBUS address. The "Slave characteristics" window then automatically opens, in which, as already described, the necessary settings can be made using **Configuring...**.

4. As the field devices are pure slaves, depending on the function, type of construction and "Intrinsic intelligence" they can only be parameterized with some restrictions.
   The individual configurations are as follows:
   - **ET 200 U**
     Modular structure with three output modules (each with 8 digital outputs) and one input module (8 digital inputs): Three bytes must be transmitted and one byte must be received.

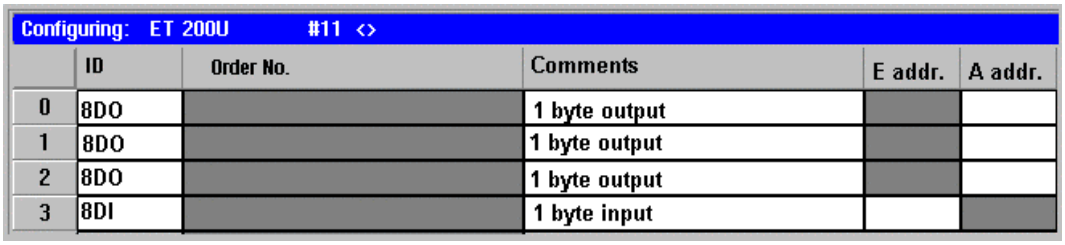


Fig. 3-33 "Configuring" window

– **ET 200 B**
Compact type of construction with eight digital outputs and eight digital inputs: One byte in the transmit telegram and one byte in the receive telegram. The IDs are specified by the module selection.

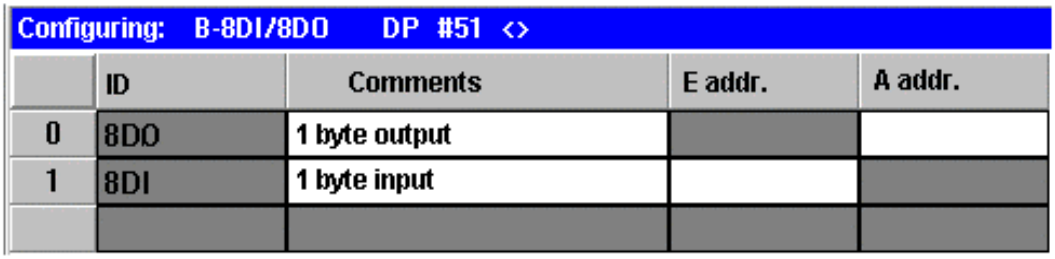


Fig. 3-34 "Configuring" window

– **SIMOVERT Master Drive**
Slave with intrinsic intelligence: Depending on the drive converter setting, five different telegram structures (PPO types) are permitted. These must be defined when configuring and can no longer be changed. (Fields have a grey background and are therefore inactive)

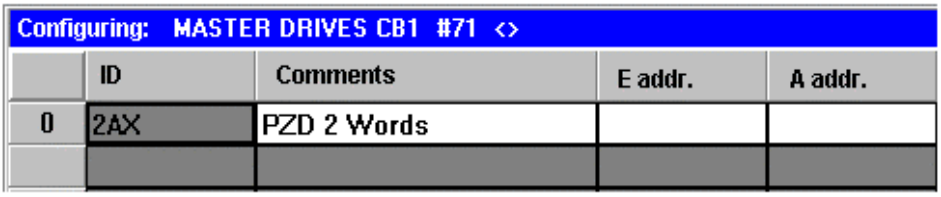


Fig. 3-35 "Configuring" window

5. After configuring has been completed, the display should look like this:

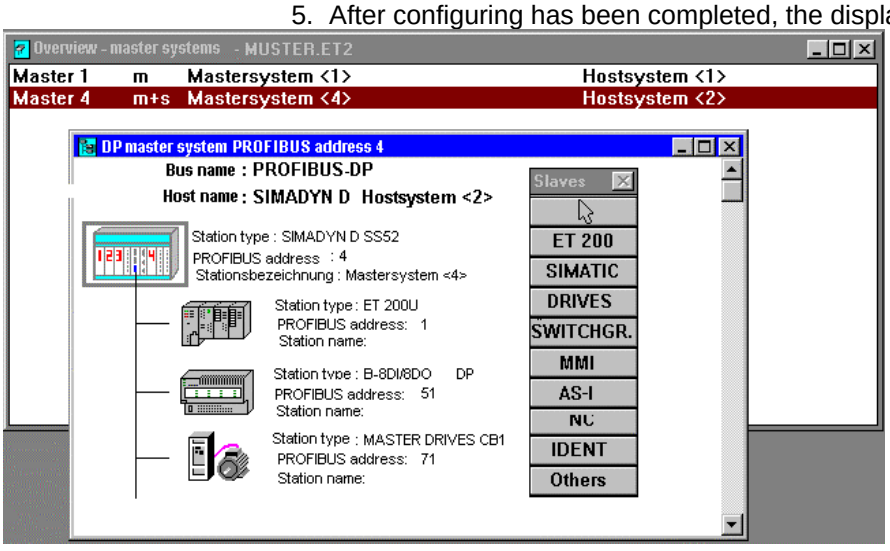


Fig. 3-36 Window, "DP master system, PROFIBUS address"

Changing the slave configuration

The configuration of the individual slaves can be subsequently changed and adapted.

1. Select the particular symbol in the display above by clicking on it twice with the mouse. You can return to the configuration dialog boxes via the "Slave characteristics" window.
2. To complete parameterization, the bus parameters must be set as a final step. A dialog window is opened under **Configuring > Bus parameters...** In this window only the bus profile (PROFIBUS-DP) and the baud rate are of importance for this typical configuration. The baud rate must coincide with that specified in the CFC, and in our example is limited by the ET 200 U and the CB1 communications module of the SIMOVERT Master Drive (currently: 1.5 Mbaud).

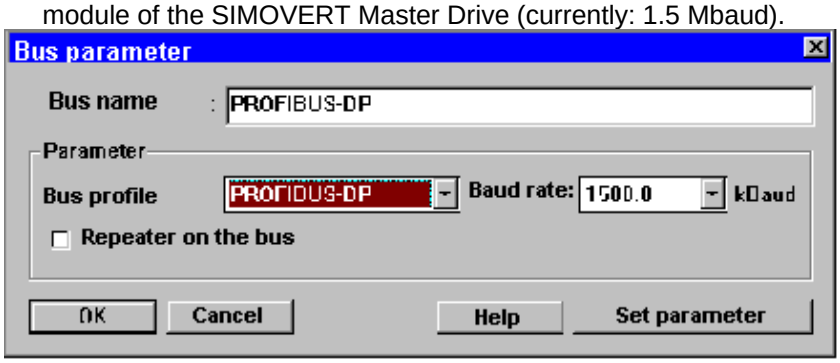


Fig. 3-37 Dialog box, "Bus parameters"

3. This completes the configuration of the SS52 for this typical configuration, and it can now be saved.

Transferring the configured software into the SS52 memory

The next step when setting-up the SS52 configuration is to transfer this configured software into the memory of the SS52 communication module. There are two ways to do this:

- Transfer data via a second module interface (RS232) which is located on the same 9-pin sub-D connector as for the RS485.
  - Data transfer via RS232 can be executed using a standard PC interface (COM 1 or COM 2) whereby a special transfer program named "SS52load" downloads data into the SS52 memory.
  - This download requires the "2bf" file format. This is why the marked "Host system <2>" must be converted into the correct format via the menu command **File > Export > Binary file...** (the host systems must be separately handled for this operation). The SS52 configuration file is thus now located in the root directory of the COM PROFIBUS program in the directory "\progdat" for transfer to the module.
- Transfer data via the PROFIBUS interface RS485 (is directly supported by COM PROFIBUS).
  - Transfer via RS485 is not discussed, as a special PC interface card (e. g. CP 5411) is required in this case.

3.5.3.11 Downloading the COM database into the SS52

Hardware required

The following hardware is required to download the COM database onto the SS52:

- RS232 connection between the PC and SS52
  - In addition to the RS485, an additional RS232 interface is also integrated on the 9-pin sub-D connector.
    Further information
    on the sub-D connector, refer to the User Documentation "SIMADYN D, hardware description".
  - A special cable (TxD to RxD) must be assembled as the pin assignment of this connector does not correspond to any specific standard.

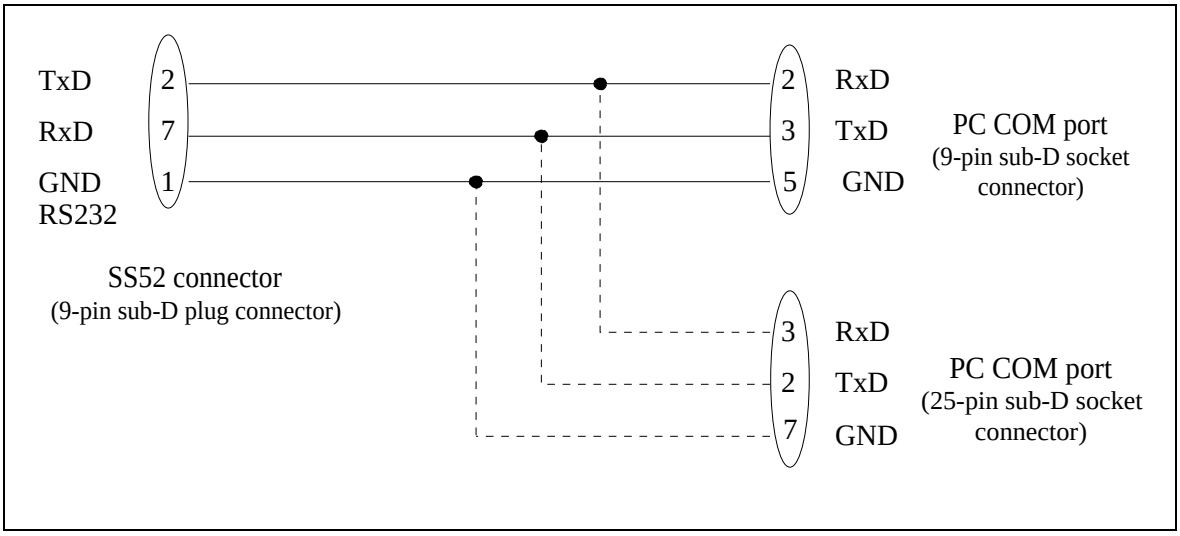


Fig. 3-38 RS232 interface

3.5.3.12 Working with the "SS52load" download tool

SS52load

SS52load is integrated in COM PROFIBUS (from Version 3.1).

The user interface offers the following functions:

- **Option comport:** Defines the COM port to be used
- **File download:** Selects the required file and downloads it

3.5.3.13 Behavior of the SS52 during and after the download

General

In order to successfully download, the different behavior patterns of SIMADYN D and the SS52 communication modules should be known before, during and after this operation. General system conditions are output via a green and a yellow LED, which are provided at each of the CS7 slots.

These LEDs only provide information as to whether the SIMADYN D as self-contained autonomous system is functioning correctly, or if there are faults/errors. Bus activities or communications with other bus nodes are not evaluated.

LED statuses when SIMADYN D runs-up

- When the power is applied, both LEDs briefly light-up (approximately half a second).
- The yellow LED then goes dark, so that only the green LED is lit during the remaining run-up time (approx. five seconds). Downloading is not possible during this time.
- After the run-up phase has been completed, the operating status of the SS52 is displayed.

3.6 PROFIBUS FDL coupling (SINEC L2 FDL)

General

- An additional configuring tool (COM, NML) is not required for the PROFIBUS FDL coupling (Fieldbus Data Link).
- PROFIBUS FDL (FDL=Fieldbus Data Link) is a bus system in accordance with EN50170 (DIN 19245 Part 1).
- Both PROFIBUS FDL as well as PROFIBUS FMS nodes can be connected to the same bus cable.

Bus access is realized using token passing with a subordinate master-slave technique:

- Masters are active nodes, which pass-on the token and which can transmit.
- Slaves are passive nodes, which can only transmit when directly requested to by a master.

Three FDL utilities are defined in the standard:

1. SDA (send data with acknowledge) for master-master communications
2. SDN (send data with no acknowledge) for broadcast
3. SRD (send and receive data) for master-slave communications

As far as FDL is concerned, SIMADYN D is always a master and exclusively uses the FDL utility SDA. Other FDL masters can be considered as communication partners. The process data and message system utilities can use the PROFIBUS FDL coupling as SIMADYN D communications utility.

3.6.1 Hardware and central coupling block

3.6.1.1 Hardware for PROFIBUS FDL

Hardware

The following hardware is required for the PROFIBUS FDL coupling:

- Subrack
- CPU
- CS7 module with SS5 communications module (this must also be configured in HWConfig)

The data interface between the CPU and SS5 has 16 kbytes.

CS7 LEDs

The significance of the green (H10/H20/H30) and yellow (H11/H21/H31) LEDs on the CS7 front panel are as follows:

Green	Yellow	Significance
Dark	Dark	Wait to synchronize to SIMADYN D
Flashing (fast)	Dark	Intermediate status when synchronizing to SIMADYN D
Dark	Lit	Temporary status when the SS5 module is used for the first time with FDL
Lit	Dark	Temporary intermediate status at run-up; the node waits to be accepted on the bus.
Lit	Lit	Run-up error-free, no bus activity
Lit	Flickering	Run-up, error-free, with bus activity

Table 3-33 LEDs on the CS7 front panel

3.6.1.2 Central coupling block @CSL2L for the PROFIBUS FDL coupling

Initialization

A @CSL2L function block must be configured to initialize the SS5 interface module with PROFIBUS FDL.

Data entries at connection BDR

Values between 0 and 5 can be specified at the BDR connection for the baud rate.

Value at BDR	Baud rate in kbaud
0	9.6
1	19.2
2	93.75
3	187.5
4	500
5	1500

Table 3-34 Data entries at connection BDR

Data entries at connection MAA

Values between 1 and 126 can be specified at connection MAA for the PROFIBUS address. Its own PROFIBUS address is set.

Data entries at connection AST

The number of active stations is specified at connection AST. Values between 1 and 126 can be specified. All PROFIBUS masters, which are connected to the same bus cable, are active stations. This parameter is used to approximately calculate the token circulation time. The entry should approximately represent that value met in practice.

Data entries at outputs ECL and ECO

Alarms and errors are indicated at the ECL (error class) and ECO (error code) outputsof the central coupling block.

ECL	ECO	Explanation
0 (alarm)	0	o.k.
	1	PROFIBUS address incorrect
	5	Incorrect coupling type
	6	o.k.
> 0 (error)	Any	Irreparable error condition; can only be exited with a reset; note the error class and -code and notify Siemens AG.

Table 3-35 Data entries at outputs ECL and ECO

3.6.1.3 Communications via PROFIBUS FDL

Data entries at address connections AT, AR

Address connections AT and AR are configured as follows for communications via PROFIBUS FDL.

For communications via PROFIBUS FDL, at the address connection, the channel name and address stage 1 must always be specified. When transmitting (sending), address stage 2 must be additionally specified. Address stage 2 is optional for receivers.

Special features for entries at address connection AT, AR when using PROFIBUS FDL:

Input sequence:
"**Channelname.Addressstage1.Addressstage 2"**

- **Channel name**
  - max. 8 characters
  - ASCII characters with the exception of "Point" and @
  - the channel name on the data interface must be unique.
  - the channel name has no specific significance for PROFIBUS FDL.
- Enter "." after the channel name
- **Address stage 1:** "#2-ll"
  - **"#2-"**
    Reserved ID when using PROFIBUS FDL.
  - **"ll"**
    Local Service Access Point (LSAP). The LSAP is a decimal number, value range from 2...50.
- If address stage 2 is specified, then after address stage 1, enter ".".

- **Address stage 2:** "nnn-rr"
  When transmitting, address stage 2 must be present. This entry is optional for receivers. Address stage 2 consists of:

  – **"nnn"**
  The PROFIBUS address of the communications partner (receiver) is a decimal number,
  value range 0...126.

  – **"-"**
  The hyphen must be entered and is used to separate the station address from the RLSAP.

  – **"rr"**
  Remote Service Access Point (RSAP). The RSAP is a decimal number, value range 2 ... 62.

NOTE

- If address stage 2 is configured for the receiver, then only telegrams from the thus specified communications partner, are accepted.
- If address stage 2 is not configured for a receiver, then all telegrams are accepted at the LSAP, specified by address stage 1 ("open" LSAP).
- Each LSAP can only be used once, i. e. either for transmitting or for receiving. Bidirectional use is not possible.

Examples for data entry at the address connection

- AT- 'Send.#2-44.2-12'
  – Transmits via LSAP 44 to partner with PROFIBUS address 2 at its LSAP 12.
- AR- 'Rec.#2-10.2-13'
  – Receives via LSAP 10 from the partner with PROFIBUS address 2 from its LSAP 13.
- AR:- 'Rec.f2.#2-48'
  – Receives from non-specified partner via "open“ LSAP 48.

NOTE

- When transferring data it should be ensured that the lengths coincide for the communicating transmitters and receivers. Otherwise data transfer is "transparent", i. e. the SS5 communications module passes through all data unchecked.
- Word- (2 byte) and double word- (4 byte) quantities are transferred in the Little-Endian format; this means that the least significant byte is sent before the most significant byte. When communicating with devices which use the Big-Endian data format, the user must appropriately adapt (e. g. for SIMADYN D by using conversion blocks SWB...).

3.6.2 Data quantities, sampling times

	Max. number / max. data quantity / sampling time
Number of SIMADYN D channels (low net data quantity)	Approx.100
Max. number of SIMADYN D channels (242 bytes of net data)	40
Max. channel length (net data)	242 bytes
Fastest cycle, transmitting or receiving The SS5 communications module requires a specific processing time for each transmit- and receive telegram. This processing time must be taken into account when configuring. The specified value is the shortest sampling time where error-free operation is still guaranteed. For example, if 8 transmit channels are configured, then the SIMADYN D sampling time, in which these channels are configured, should not fall below 8 x 10 ms = 80 milliseconds. For receive channels, the cycle of the transmitting communications partner should be calculated.	10 ms

Table 3-36 Data quantities, sampling times

3.7 PROFIBUS FMS coupling (SINEC L2-FMS)

PROFIBUS FMS terminology

- **FDL (Fieldbus Data Link)**
  Is the definition of PROFIBUS layer 2, defined by EN 50170 (DIN 19245 Part 1)

- **FMS (Fieldbus Message Specification)**
  Is the definition of PROFIBUS layer 7, defined by EN 50170 (DIN 19245 Part 2). FMS defines objects, which are processed using utilities.

- **Client**
  The client generally issues a task to a utility.

- **Server**
  The server generally accepts a utility task.

- **Object directory**
  The object directory is a list of all objects and their descriptions of a station which, as server have access for processing using the FMS utilities. Objects are for example: Data types, variables. Each object is uniquely identified by a number, the PROFIBUS index. The data type, possibly an object name, authorization access and possibly a structure description are included in an object description. The objects relevant for SIMADYN D communications are variables, which are processed using the FMS utilities read, write or information report.

- **Read**
  Using the "Read" FMS utility, the client reads the value of a variable available in the server object directory. The client sends the "Read variable X" task to the server; the server sends the value of variable X as response.

- **Write**
  Using the FMS utility "Write", the client changes the value of a variable which is available in the server object directory. The client sends the task "Write variable X", together with the new value, to the server; the server sends a conformation as response.

- **Information report**
  Using the FMS utility "Information report", the server sends the client, unrequested, the value of a variable which is present in his object directory (of the server). For this utility, the server is an initiator which is an exception. The client does not acknowledge this. Using this utility, a server can simultaneously transmit data to several clients (broadcast mode).

- **Get OV**
  The FMS utility "Get OV" supplies the client the description of the objects available in the server object directory. The client sends the "Get OV object X" task to the server; the server sends the description of object X as response.
  SIMADYN D, as client, generally executes the "Get OV" utility for a variable once before it executes the first read or write operation. The

description of the variable is in this case checked for consistency with the expected description.

- **Addressing**
  An object can be uniquely addressed using its index in the OV (addressing per index) or using its (optional) name (addressing per name or symbolic addressing).
  All of the objects in SIMADYN D-OV can be optionally addressed per index or per name (if available). The configuring engineer defines whether an object is to be addressed via its index or its name. SIMADYN D, as client, addresses in the productive phase (read, write utilities) the variables per index. If the configuring engineer addresses the variables per name, then SIMADYN D first executes a "Get OV" with addressing per name, in order to receive the index of the variables.

- **Communications association:**
  A communications relationship defines the route and type of communications between the associations. For two stations, which communicate with one another per FMS, a communications association must be configured which corresponds with that of the other. For connection-oriented communication associations, a connection is first established before an FMS utility can be realized using it; communication associations such as these are only possible between two stations. For communication associations without connection, several stations can communicate with one another (broadcast associations).

Communications reference
Number, which refers to a communications association.

General

The SIMADYN D communications utilities, process data and message system, are realized on PROFIBUS layer 7 (FMS).

Realized on FMS

What does implemented on FMS mean?: All of the data to be transferred are defined as object and processed using the FMS utilities, essentially with the "Read" and "Write" FMS utilities. Instead of "A sends data to B", "A (client) writes into an object in B (server)" or alternatively with interchanged roles "B (client) reads an object in A (server)".

For FMS utilities, there is always one client and one server. A data object is always defined in the server and must be available in its object directory (OV).

Open implementation

What does open implementation mean?: The structure of the data object is open, i. e. it can be read via the FMS utility "Get OV". The SIMADYN D utilities, process data and message system, are implemented as open utilities.

Requirements

Each bus station requires the following to function on the bus:

- **Bus parameters**
  These include baud rate, PROFIBUS address and other parameters which influence the bus speed. Baud rate and PROFIBUS address are specified using CFC. All of the other bus parameters are set using COMSS5.

- **Communication associations**
  Defined routes for data transfer between the bus stations.
  They are configured using COMSS5.

- **Object directory**
  For SIMADYN D, are specified by the CFC configuring.

Restrictions The maximum net data length is approx. 230 byte. The maximum value is dependent on the configuring of the communication **associations**. With the specification above, one lies on the safe side.

3.7.1 Hardware and central coupling block

3.7.1.1 Hardware for the PROFIBUS FMS coupling

Hardware The hardware required for the PROFIBUS FMS coupling:

- Subrack
- CPU
- CS7 module with SS5 communications module (this must also be configured in HWConfig)

LEDs on CS7 Significance of the green (H10/H20/H30) and yellow (H11/H21/H31) LEDs on the CS7 front panel:

Green	Yellow	Significance
Dark	Dark	Waiting to synchronize to SIMADYN D
Dark	Lit	Without database at the bus; COMSS5 configuring required!
Dark	Flickering	Without database at the bus with bus activity; COMSS5 configuring required!
Flashing (slow)	Dark	Database erroneous; after a subrack reset, run-up without database; correct the COMSS5 configuring!
Flashing (fast)	Dark	Intermediate status for synchronizing with SIMADYN D
Lit	Dark	Temporary intermediate status at run-up
Lit	Lit	Run-up error-free, no bus activity
Lit	Flickering	Run-up error-free, with bus activity;

Table 3-37 LEDs on the CS7 front panel

3.7.1.2 Central coupling block @CSL2F for PROFIBUS FMS coupling

Initialization A @CSL2F must be configured to initialize the interface module.

Data entries at connection BDR Values between 0 and 5 are specified at connection BDR for the baud rate.

Value at connection BDR	Baud rate in kbaud
0	9.6
1	19.2
2	93.75
3	187.5
4	500
5	1500

Table 3-38 Data entries at connection BDR

Data entries at connection MAA

At connection MAA, values from 1 to 126 can be specified for the PROFIBUS address. Their own PROFIBUS address is set.

Data entries at outputs ECL and ECO

Alarms and errors are indicated at the ECL (error class) and ECO (error code) outputs of the central coupling block.

ECL	ECO	Explanation
0 (alarm)	0	o.k.
	1	PROFIBUS address erroneous
	2	PROFIBUS address does not match the database
	5	Incorrect coupling type
	6	No database or database incomplete
>0 (error)	Any	Irreparable error status; this can only be exited using a reset; note the error class and -code and notify Siemens AG.

Table 3-39 Data at outputs ECL and ECO

NOTE

Error class >0 can occur, if the CFC configuring does not match the COMSS5 database. When error class >0 occurs, one should first check the configuring! Possible error cause: FMS utility, configured by CFC refers to a communications association, which is not permitted for this FMS utility (e. g. FMS utility "Read" via "Broadcast" association; FMS utility "Information report" via cyclic association).

3.7.2 Communications via PROFIBUS FMS

Data entries at address connection AT, AR and US

The address connections AT, AR and US are configured as follows for communications via PROFIBUS FMS.

Special issues when making entries at address connections AT, AR and US when using PROFIBUS FMS:

Input sequence:
"Channelname.Addressstage1.Addressstage2"

- **Channel name**
  - max. 8 characters
  - ASCII characters with the exception of "Point" and @
  - the channel name at a data interface must be unique.
  - if address stage 1 and address stage 2 are not available in addition to the channel names, then SIMADYN D is server as far as the associated FMS utility is concerned and creates an object in the object directory. The channel name is part of the associated variable name.
    If the channel name starts with a number, then it is interpreted as index for the local object directory (permissible range: 6000...6199), otherwise as part of the variable name.
- If address stage 1 is specified, then after the channel name enter ".".
- **Address stage 1:** "nnmm"
  - can be present or not present.
  - if present, then it must always be precisely 4 characters long. "nn" and "mm" must represent numbers, which are interpreted as communication references (KR). A communications reference refers to a communications association which must be configured using COMSS5. If address stage 1 is present and address stage 2 not, then the configured SIMADYN D utility is realized on the FMS utility "Information report". This is practical for process data (broadcast functionality).
  - **"nn"**
    Communications association via which the FMS utility "Get OV" is executed. If "00" is specified here, no "Get OV" is executed.
  - **"mm"**
    Communication association via which the productive utility "Read", "Write" or "Information report" is executed.
- If address stage 2 is specified, then after address stage 1, enter ".".
- **Address stage 2**
  - can only be used together with address stage 1.
  - maximum of 20 characters long.

- if address stage 2 is present, then SIMADYN D is client as far as the associated FMS utility is concerned. Address stage 2 is the variable name or index of the object for the communications partner. This object must be available in the object directory of the communications partner and its description must be able to be read using "Get OV".
  If address stage 2 starts with a number, then it is interpreted as index, otherwise as variable name. If no "Get OV" is executed on the remote object, then the object is addressed per index.

Variable name

If SIMADYN D is a server as far as an FMS utility is concerned, then SIMADYN D creates a variable object in the FMS object directory.

If a number in the value range "6000"..."6199" is configured as channel name (only these numbers may be configured as channel name!), then the channel name is interpreted as index and the object is created in the object directory under this index. In this case the object does not receive a variable name. A remote client can address this object under the index.

If the channel name starts with a letter, the object is created in the object directory under an automatically assigned index. In this case, the object receives a variable name. A remote client can address this object under the variable name (only possible for communication partners which support "Addressing with names".).

The variable name, using the SIMADYN D syntax has the following structure:

"ChannelnameSubracknameCPUutility"

- **Channel name**
  Configured just like at AT, AR, US, precisely 8 characters long; if the configured channel name is shorter, then it is supplemented by "_" so that it is 8 characters long.

- **Subrack name**
  Name of the subrack in which the SIMADYN D utility is configured; it is precisely 6 characters long and if the configured name is shorter, then it is supplemented with "_" so that the total length is 6 characters.

- **CPU**
  Number of the CPU on which the SIMADYN D utility is configured, precisely 1 character: "1"..."8".

- **Utility**
  Identification for the SIMADYN D communications utility which creates the object; precisely 1 character. The following IDs are possible:

  - "P": process data

  - "M": message system.

NOTE The SIMADYN D name syntax allows an external client to obtain a listing of the utilities configured in SIMADYN D using the FMS utility "Get OV". In this case, the client not only receives information about the structure of the objects, but also information on how these objects are to be handled.

3.7.3 SIMADYN D communications utility

General

The communications utilities, process data and message system, are realized, independent of the configuring on the FMS utilities "Read", "Write" or "Information report".

3.7.3.1 Process data

General

Process data are transferred via PROFIBUS FMS using Read, Write or Information report. In this case, SIMADYN D can be both server as well as client. Process data have a specific structure which is open as far as PROFIBUS is concerned.

FMS utility with SIMADYN D as server

- The channel name is specified at address connection AR of the receive block. A remote client can execute the FMS utilities "Get OV" and "Write" on this object.
- The channel name is specified at address connection AT of the transmit block. A remote client can execute the FMS utilities "Get OV" and "Read" on this object.
- The SIMADYN D utility ID at the end of the object name is "P".

Address example

1. Subrack "BGT1", CPU No. 3, function block CRV is to be configured:
   - AR- 'PZDWRITE'
   - the object name is derived from this: PZDWRITEBGT1__3P
   - the object can be written into.
2. Subrack "BGT1", CPU No. 3, function block CTV is to be configured:
   - AT- '6050'
   - thus, the object is saved under FMS index 6050 and can be addressed.
   - the object can be read.

FMS utility with SIMADYN D as client

- The channel name, address stage 1 and address stage 2 are specified at connection AT of the transmit block. The object must be available in the object directory of the communications partner. SIMADYN D executes the FMS utility "Get OV" (optional) and "Write" on the remote object.

- The channel name, address stage 1 and address stage 2 are specified at connection AR of the receive block. SIMADYN D executes the FMS utility "Get OV" (optional) and "Read" on the remote object.

Address example

1. Function block CTV:
   - AT- 'PZD1.0017.33500'
   - SIMADYN D writes, via communications association 17, into the remote object with the FMS index 33500. A "Get OV" is not executed.
2. Function block CRV:
   - AR- 'PZD1.0404.actual value'
   - SIMADYN D reads the external object with the "Actual value" name via communications association 4. Before this, a "Get OV" is executed on the object using the same communications association.

Broadcast transmitter

- The channel name and address stage 1 are specified at the address connection of the transmit block:
  - AT- 'channel name.00mm'
- SIMADYN D is server, and transmits the value of this object using the (unconfirmed) FMS utility "Information report" via the communications association "mm". This communications association must be the "Broadcast transmitter" type.
- When transmitting using "Information report", the FMS index of the object is supplied. If a symbolic name is configured as channel name, then the index is automatically assigned, and is therefore not visible to the user.

NOTE

If the object index is known to the receiver in the Information report, then it must be explicitly configured as channel name (range: "6000" to "6199").

Broadcast receiver

- The channel name and address stage 1 are specified at the address connection of the receive block.
  - AR- 'channel name.00mm'
- SIMADYN D is a client and receives the contents of the remote object using the (unconfirmed) FMS utility "Information report" via the communications association "mm". This communications association must be the "Broadcast receiver" type.

NOTE Correct communications for broadcast functionality must be exclusively ensured by configuring the communication association. It should be especially noted, that only one utility can be executed via the communications association.

Address example

1. Function block CTV
   - AT: "6111.0007"
   - SIMADYN D transmits an object with the FMS index 6111 via communications association 7 (broadcast transmitter) using the FMS utility "Information report".
2. Function block CRV:
   - AR: "receiver.0008"
   - SIMADYN D receives data via communications association 8 (broadcast receiver) using the FMS utility "Information report".

FMS structure

The structure of the process data objects is obtained from the CFC configuring of the "Virtual connections" (refer to the Chapter, Communications utility process data).

SIMADYN D data types are converted into FMS data types according to the following table:

SIMADYN D data type	FMS data type
Integer	Integer16
Double Integer	Integer32
Bool, Byte	Unsigned8
Word	Unsigned16
Double Word	Unsigned32
Real, SDTIME	Floating-Point

Table 3-40 Converting SIMADYN D data types into FMS data types

- If precisely one connection is assigned for each transmit/receive block, then the associated FMS object is the "Simple variable" object type.
- If several connections are assigned the same FMS data type for each transmit/receive block, then the associated FMS object is an "Array" object type. The number of array elements precisely correspond to the number of connections.
- If several connections with different FMS data types are assigned to each transmit/receive block, then the associated FMS object is the "Record" object type. The number of record elements precisely correspond to the number of connections.

NOTE The maximum number of record elements is 76.

If SIMADYN D is a client, and the FMS utility "Get OV" is executed (depending on address stage 1), then the object in the server must have exactly the same structure SIMADYN D expects (data transfer security!). If SIMADYN D does not execute "Get OV", then at least the net data length for both communication partners must be the same.

Example process data, array

- Transmit block CTV:
  - CRT- '!ARRAY' (virtual connection "ARRAY")
  - AT- '6123' (FMS object with index 6123)
- Connections with virtual "ARRAY" connection:
  - Y I- '!ARRAY.0001' FMS structure element 1: Integer16
  - Y I- '!ARRAY.0002' FMS structure element 2: Integer16
  - Y I- '!ARRAY.0003' FMS structure element 3: Integer16
  - Y I- '!ARRAY.0004' FMS structure element 4: Integer16

The object with index 6123 is an "Array" object type with 4 elements.

Example process data, record

- Transmit block CTV:
  - CRT- '!RECORD' (virtual connection "RECORD")
  - AT- '6000' (FMS object with index 6000)
- Connections with virtual "RECORD" connection:
  - Y I- '! RECORD.0001' FMS structure element 1: Integer16
  - Y I- '! RECORD.0002' FMS structure element 2: Integer16
  - Y I- '! RECORD.0003' FMS structure element 3: Integer16
  - Y I- '! RECORD.0004' FMS structure element 4: Integer16
  - Y R- '! RECORD.0005' FMS structure element 5: Floating Point

The object with index 6000 is a " RECORD" object type with 5 elements.

3.7.3.2 Message system

General

Messages are transferred via PROFIBUS FMS using Read or Write operations. SIMADYN D can be both server as well as client. Messages are structured, which are open as far as PROFIBUS is concerned.

FMS utility

The subordinate FMS utility is obtained from the message output block MSI configured using CFC and, more precisely by the entry made at connection AT.

FMS utility with SIMADYN D as server

The channel name is specified at the address connection. The object can be read with the FMS utility Read.

AT- 'channel name'

The SIMADYN D utility ID at the end of the object name is "M".

The communications partner must read the object at certain intervals using the FMS utility Read. If a message was also output via the message output block, then the Read operation is positively acknowledged when this message is returned, otherwise negatively acknowledged.

Address example

- The configuring is to be made in subrack "BGT1", CPU No. 3, function block MSI:
  - AT- 'MELD'
  - thus the following object name is obtained: MELD____BGT1__3M
  - the object can be read.

FMS utility with SIMADYN D as server

The channel name, address stage 1 and address stage 2 are specified at the address connection. The object must be available in the object directory of the communications partner. SIMADYN D writes into the external object using the FMS utility Write.

AT- 'Channelname.Adressstage1.Addressstage2'

SIMADYN D writes into the external object each time the message output block outputs a message.

Address example

- Function block MSI
  - AT- 'MELD.0404.33500'
  - SIMADYN D writes into the external object with FMS index 33500 via communications association 4.

FMS structure

The FMS structure of the objects is obtained from message output block MSI configured using CFC, and more specifically from the entries made at connections SNV, STM, SSF. Connection STC must be set to "1"!

Message objects are always "Record" type objects. The structures are shown in the following tables:

NOTE Connection STC at message output block MSI must be set to "1".

SSF=1 (standardized format)			
	Contents	**Message structure**	**FMS structure**
	Spontaneous ID	Unsigned8	Unsigned8
	Sequence number	Unsigned8	Unsigned8
	Message type description	1 Octet	Octet-String 2
	Message type	1 Octet	
Only available,	Prefix	Floating-Point	Floating-Point
if SNV=1	Suffix	Floating-Point	Floating-Point
	Measured value	Floating-Point	Floating-Point
	Measured value dimension text	8 characters	Visible-String 32 (if STM=0);
	Message instant	24 characters	Visible-String 92
Only available, if STM=1	Message text	60 characters	(if STM=1)

Table 3-41 SSF=1 (standardized format)

SSF=0 (HEX format)			
	Contents	**Message structure**	**FMS structure**
	Spontaneous ID	Unsigned8	Unsigned8
	Sequence number	Unsigned8	Unsigned8
	Message type description	1 Octet	Octet-String 2
	Message type	1 Octet	
Only available,	Prefix	Unsigned16	Unsigned16
if SNV=1	Suffix	Unsigned16	Unsigned16
	Measured value normalization factor	Unsigned32	Unsigned32
	Measured value	4 Octets	Octet-String 6
	Measured value connector type	2 Octets	
	Measured value dimension text	8 characters	Visible-String 8
	Message instant	Time and Date	Time-Of-Day (6 Byte)
Only available, if STM=1	Message text	60 characters	Visible-String 60

Table 3-42 SSF=0 (HEX format)

3.7.4 Tables

3.7.4.1 Address parameters, FMS utilities

Explanations on the table

Data to be configured:

- kkkkkkkk:
  Channel name, max. 8 characters, the first character must be a letter.
- nnnnn:
  - PROFIBUS index, max. 5 characters
  - permissible value range for local objects (channel name):
    6000..6199
  - permissible value range for remote objects (address stage 2):
    17..65535
- nnmm:
  - two communication references, each 2 digits
  - value range: 02..99
  - 00 may also appear at the first position

Generated data:

- kkkkkkkkbbbbbbpd: local object name, comprising:
  - kkkkkkkk:
    Channel name, supplemented to 8 character by underline
  - bbbbbb:
    Subrack name supplemented to 6 characters with underline
  - p:
    CPU number, 1 digit: 1..8
  - d:
    SIMADYN D communications utility, 1 letter:
    P: Process data
    M: Message system

SIMADYN D configuring: Address parameters =>					SINEC L2 FMS: Utility and object		
Block	Connection	Channel name	Address stage 1	Address stage 2	FMS utility	Object location	Object name and index
CTV	AT	Not relevant	nnmm	Any	Client Write.req	Remote	=address stage 2
MSI		kkkkkkkk	-	-	Server Read.ind	Local	kkkkkkkkbbbbbbpd
		nnnn					nnnn
		kkkkkkkk	00mm	-	Server Information-Report.req	Local	kkkkkkkkbbbbbbpd
		nnnn					nnnn
CRV	AR	Not relevant	nnmm	Any	Client Read.req	Remote	=address stage 2
		kkkkkkkk	-	-	Server Write.ind	Local	kkkkkkkkbbbbbbpd
		nnnn					nnnn
		Not relevant	00mm	-	Client Information-Report.ind	Remote	Not relevant

Table 3-43 Address parameters

3.7.5 Data quantities, sampling times

	Max. number / max. data quantity / sampling time
Number of SIMADYN D channels (low amount of net data)	Approx.100
Number of SIMADYN D channels (230 bytes of net data)	40
Max. channel length (net data)	230 byte
Max. number of communication associations The maximum number of communication associations and SIMADYN D channels could be limited by the RAM memory size.	>30
Fastest read/write cycle via a non-cyclic master-master association	30 ms
Fastest read/write cycle via a cyclic master-slave association	50 ms
Fastest information report cycle via a broadcast association	30 ms

Table 3-44 Data quantities, sampling times

NOTE The SS5 communications module requires a specific processing time for each FMS task, which must be taken into account when configuring. The values specified in the table are nominal values for the fastest possible sampling times, in which error-free execution can be guaranteed. For instance, if 10 client channels are configured for master-master communication associations, then the SIMADYN D sampling time in which these channels are configured, should not fall below 10 x 30 ms = 300 milliseconds.

3.7.6 COMSS5

General

The COMSS5 configuring tool with firmware and the PROFIBUS PC plug-in card CP5412 are required to configure the SS5 module.

COMSS5 can run on a PG under S5 DOS or with S5 DOS emulation or COM adapter on any IBM-compatible PC under DOS.

COMSS5 provides the bus parameters and the communication association masks for configuring, which the configuring engineer then has to complete. The "database" is loaded into the EEPROM of the SS5 communications module via PROFIBUS when configuring has been completed.

Order No.

- Order No. COMSS5: 6DD1881-0AA0
- Order No. CP5412, card and firmware (refer to Catalog ST PI):
  - SINEC CP 5412 (A2): 6GK1541-2BA00
  - SINEC PG-5412 / MS-DOS, Windows: 6GK1702-5PA00-0EA0

Additional bus components for PROFIBUS are listed in SINEC Catalog ST PI as well as possible network configurations.

Files

The configured data are saved in files. There are:

- One **network file** per bus, in which the bus parameters are saved; (file: xxxxxNCM.NET and xxxxxNCM.BPB)
- One **path file** per bus, in which several communication paths are located between COMSS5-PC and the SS5 communications module or other Siemens FMS modules; (file: xxxxxAP.INI)
- One **database file for each bus station**; (file name: Vxxxxxxx.xxx)

Starting the program

Program start is dependent on the software environment (STEP 5 or COM adapter, stage 5 or stage 6).

After the software environment has been started, the "Interface" "SINEC L2" must first be selected. This is required in order to load the database.

The "SINEC NCM" package should be selected and called-up corresponding to the software environment.

3.7.6.1 Menu structure

General

For many entries, there is a selection of values which have already been entered, which are called-up with F8. F7 is used to transfer a completed mask.

Menu level 1	Menu level 2	Explanation
Init	Editing	Selects CP, database file, etc.
	Path definitions	Pre-selects the path between the PC and CP (SS5) to load the database
	End	Terminates NCM
Editing	CP Init	Enters bus station address and network file
	Network parameters - global	Edits common bus parameters for all bus stations
	Network parameters - local	Edits individual bus parameters for a bus station (optional)
	Communication associations	Edits communication associations
	Documentation	Printer output
Generating	Network setting	Transfers global network parameters locally
Loading	CP start/stop, database transfer	Loads the database
Tools	Bus selection	Defines paths to load database

Table 3-45 Menu structure

Procedure

1. Select "Init" - "Edit". A mask is displayed with entries for:
   - TYPE OF CP: Enter "CPSS5"
   - STATUS: Enter "OFFLINE FD"
   - DATABASE FILE: Database file name (for CPSS5 this must start with "V")
   - PATH DEFINITIONS: Enter the name for the path and path file
2. Select "Edit" - "CP Init". A mask is displayed with entries for:
   - L2 - ADDRESS: L2 address of the SS5 communication module (this must correspond to the SIMADYN D configuring at function block @CSL2F!)
   - NETWORK FILE: The name of the file which contains the global network parameters (the first five characters can be freely selected, followed by ".....NCM.NET")
   - generation date: Can be freely edited
   - system name: Can be freely edited
3. "Edit" - "Network parameters" (refer to the Chapter Bus parameters)
4. "Edit" - "Communication associations" (refer to the Chapter Communication associations)
5. "Tools" - "Bus selection" (refer to the Chapter Loading the database)
6. "Loading" (refer to the Chapter Loading the database)

3.7.6.2 Bus parameters

Editing

The bus parameters are edited in three steps:

1. "Edit" - "Network parameters - global":
   The global bus parameters for all stations are edited. This step must be executed once per bus. The global bus parameters are saved in the network file. Each station, which had selected this network file ("Edit" - "CP Init"), accepts the bus parameters.
2. "Generate" - "Network setting":
   The global bus parameters, edited in the first step, are transferred into the databases of all of the stations, which use the selected network file. In so doing, the data is checked for consistency. This step can be made once when editing the last station.
3. "Edit" - "Network parameters - local":
   This step changes the global bus parameters for a certain station. Generally, this is not necessary.

"Network parameters - global" mask

						SIMADYN D SS5
Edit network parameters - global			Source: NETZ1NCM.BPB			
Most active L2 station addresses in the network file					:	11
Additive topology data :						
Number of active remote stations	:	10	Highest station address (HSA)		:	31
Bus parameter data :						
Baud rate			:	500000		Baud
Default SAP			:	57		
Number of telegram retries (max. retry limit)			:	1		
Medium redundancy			:	No redundancy		
Bus parameter data:						
Slot-Time (TSL)	:	1000	bit times		2.0000	msec
Setup-Time (TSET)	:	80	bit times		.16000	msec
Lowest station delay (min TSDR)	:	80	bit times		.16000	msec
Highest station delay (max TSDR)	:	360	bit times		.72000	msec
Target-Rotation-Time (TTR)	:	60000	bit times		120.0	msec
GAP update factor (G)	:	30	bit times			

Table 3-46 Mask: "Network parameters - global"

NOTE The user can edit the highlighted fields.

Explanations for the fields which can be edited

- The number of masters connected to the bus is specified using "Number of active remote stations". This information is important to calculate the "Bus parameter data".
- "Highest station address" is entered corresponding to the number of stations; stations with higher addresses are not entered in the bus.
- "Baud rate": 500 kbaud is recommended
- "Default SAP", "Max. retry limit" and "Medium redundancy": Use the default values.

After entering this data and depressing the F1 key, the "Bus parameter data" are computed. When required, the user can still change them (generally not necessary).

3.7.6.3 Communication associations

Selecting the communications association

After selecting the menu item "Edit" - "Communications association", the application type of the communications association should first be selected. A list of the various possibilities is obtained with F8. The application-type specific mask is then obtained using F4.

NOTE

A communications association is uniquely identified by the communications reference. Numbers 2 to 99 can be used for the communications reference. It should be observed that the numbers, from number 2, must be used consecutively, i. e. without gaps. Otherwise, the SS5 communications module will not correctly run-up after the database has been loaded.

Rules

The communication associations via which two stations communicate with one another, must also correspond with one another. The following rules must be maintained:

- "Association type" must coincide.
- "Local LSAP" can be freely selected in the value range 2..50. Each local LSAP may only be used once per SS5 communications module.
- "Remote addresses" address the other stations. For a pure server, 255 can also be entered and then the association is open for any station.
- "Remote LSAP" must correspond to the local LSAP of the other station. For a pure server, 255 can also be entered and then the association is open for any local LSAP of the other station.
- The maximum length of the transmit PDU is defined using "Max. PDU length".
  For SIMADYN D SS5, the receive PDU is always set to the highest possible maximum value of 245. The following is valid: The maximum length of the receive PDU of a partner must be higher or equal to the maximum length of the transmit PDU of the other partner.
- The "Monitoring interval" must be the same for non-cyclic communication associations for two partners. A value of "0" corresponds to no monitoring. For a monitoring interval not equal to "0", idle telegrams are exchanged between the partners.
- The "Multiplier" is only relevant for clients for cyclic connections.
- "Password", "Group" and "Profile", are data, which the client must transfer when establishing a connection. They are used for access protection. In most cases, the default values (="0") are sufficient (if the other partner does not request other data).
- Up to five utilities (GET OV (detailed version), Read, Write, Information report, symbolic addressing) can be selected under "Supported utilities".
  The following is valid: If a partner is an initiator or requester (".req")

when it comes to a utility, then the other partner can respond to the flag or indication (".ind") of this utility.

- "Max. No. of parallel tasks" is used to define how many tasks can be simultaneously executed via this communications association. The "Transmit" data of a partner must be lower or the same as the "Receive" data of the other partner. The "Transmit" and "Receive" data refer to the tasks, not the net data! The "Transmit" data should correspond to the number of communication function blocks from the CFC configuring, which use this communications association as client.

Non-cyclic server

Features:

- Non-cyclic data transfer
- SIMADYN D is exclusively a server.
- (At least one) connection must be configured for each remote client.
- Remote client establishes the connection and initiates data transfer
- The remote client can access each object in the SIMADYN D object directory.
- Several utilities are possible in parallel

Application:

- All SIMADYN D utilities, where SIMADYN D is a server.

Communications reference	:		Type :	Non-cyclic server			
Association type	:	MMAZ		Local LSAP	:		
External address	:			Remote LSAP	:		
Max. PDU length	:	241		Monitoring interval	:	0 s	
Supported utility	:						
Read	:	.ind		Write	:	.ind	
Get OV (detailed version)	:	.ind		Information report	:	no	
				Symbolic addressing	:	.ind	
Max. No. of parallel tasks:							
Transmitting	:	0		Receiving	:	1	
				Designator :			

Table 3-47 Mask, "Non-cyclic server"

Rules:

- The communications reference is as required within the framework of the general rules.
- Local LSAP must be the same as the "Remote LSAP" of the remote client.
- The remote address and remote LSAP can be entered, defined, but then only the appropriately selected client can establish a connection (access protection!); or both values can be set to 255, and then the association is open for all.
- Max. PDU length should only be changed, if a remote client cannot handle the specified length.
- The monitoring interval must coincide with the remote client.
- The Read, Write, Get OV(detailed version) utilities and symbolic addressing are always supported from SIMADYN D servers as responder (".ind"). The information report utility is not required.
- The maximum number of parallel "Receive" tasks must be set at least as high as the maximum number of "Transmit" tasks of the partner.

Non-cyclic client

Features:

- Non-cyclic data transfer
- SIMADYN D is exclusively a client.
- A connection (minimum) must be configured for each remote server.
- SIMADYN D establishes the connection and initiates data transfer.
- The objects, which SIMADYN D accesses in the remote server, are defined by the CFC configuring (address stage 2 at the address I/O).
- Several utilities can run in parallel

Application:

- All SIMADYN D utilities, where SIMADYN D is a client.

•

Communications reference	:		Type :	Non-cyclic client		
Association type	:			Local LSAP	:	
Remote address	:			Remote LSAP	:	
Max. PDU length	:	241		Monitoring interval	:	0 s
Password	:	0		Group	:	0
Profile	:	0 0				
Supported utility	:					
Read	:	no		Write	:	no
Get OV (detailed version)	:	no				
				Symbolic addressing	:	no
Max. No. of parallel tasks:						
Transmitting	:	1		Receiving	:	0
				Name :		

Table 3-48 Mask, "Non-cyclic client"

Rules:

- The communications reference must correspond with the CFC configuring (address stage 1 at address I/O).
- "MMAZ" is the association type when establishing a connection to a master (e. g. SIMADYN D or SIMATIC) or "MSZY" when establishing a connection to a slave.
- Local LSAP is uncritical, if the server association is "open" otherwise it must correspond with "Remote LSAP" for the server.
- Remote address and remote LSAP uniquely address the server.
- Max. PDU length should only be changed if the server cannot handle the specified length.
- The monitoring interval must correspond with that of the server.

- The read, write, Get OV (detailed version) utilities and symbolic addressing should be selected (as requester ".req") as they are required.
  - Read should be selected if a receive block as client uses this association.
  - Write should be selected if a transmit block uses this association as client.
  - Get OV (detailed version) and symbolic addressing should be selected if the server supports these utilities.
  - If SIMADYN D is the remote server, all utilities can be selected.
- The maximum number of parallel tasks "Transmit" should correspond to the number of transmit- and receive blocks, configured using CFC, which use this communications association (as client). It should be ensured that for a remote server, the maximum number of parallel "Receive" tasks correspond to at least this number.

Cyclic server

NOTE As a result of the time characteristics of the SS5 communication module, the "Cyclic server" communications association should not be used.

Features:

- Cyclic data transfer
- SIMADYN D is used exclusively server.
- An association must be configured for each object, which the remote client accesses.
- The remote client establishes the connection and initiates data transfer.
- The client can access any object in SIMADYN D-OV.

Application:

- Process data, with SIMADYN D as server

Communications reference	:		Type:	Cyclic server		
Association type	:	MSZY		Local LSAP	:	
Remote address	:			Remote LSAP	:	
Max. PDU length	:	241				
Supported utility	:					
Read	:	.ind		Write	:	.ind
				Name :		

Table 3-49 Mask, "Cyclic server"

Rules:

- The communications reference is as required within the framework of the general rules.
- Local LSAP must coincide with the "Remote LSAP" of the remote client.
- The remote address and remote LSAP can be entered, defined, but then only the appropriately selected client can establish a connection (access protection!); or both values can be set to 255, and then the association is open for all.

Cyclic client

Features:

Cyclic data transfer with slaves

- SIMADYN D is exclusively client.
- An association must be configured for each object which SIMADYN D accesses in the remote server.
- SIMADYN D establishes the connection and initiates data transfer.
- The object, which SIMADYN D accesses in the remote server is defined by appropriate CFC configuring (address stage 2 at the address input).

Application:

- Process data, with SIMADYN D as client.

Communications reference	:		Type:	Cyclic client		
Association type	:	MSZY		Local LSAP	:	Poll-SAP
Remote address	:			Remote LSAP	:	
Max. PDU length	:	241		Monitoring interval	:	10 s
Multiplier	:	1				
Password	:	0		Group	:	0
Profile	:	0 0				
Supported utility	:					
Read	:	no		Write	:	no
				Name :		

Table 3-50 Mask, "Cyclic client"

Rules:

- The communications reference must correspond with the CFC configuring (address stage 1 at the address connections).
- The local LSAP is always the "Poll SAP" = SAP 58.
- The remote address and remote LSAP uniquely address the remote server.
- Max. PDU length should only be changed if the server cannot handle the specified length.
- The monitoring interval can be freely selected, however it must be greater than "0".
- The "Cyclic client" associations can be assigned priorities on an SS5 using the multiplier. Value range: 1 (low priority) ... 4 (high priority). The number specifies the ratio as to how often the utility, executed via this association, can be executed within a "poll cycle".
  A poll cycle is the time which a PROFIBUS master requires to address all of the slaves corresponding in its poll list. This time is generally a multiple of the token circulating time.
- The read and write utilities should be selected (as requester ".req") as they are required.
- Read should be selected if a receive block uses this association as client.
- Write should be selected if a transmit block is to use this association as client.

General information, broadcast associations

For broadcast, there is one transmitter and several receivers. The transmitter addresses **all** stations connected to the bus with the "remote address" 127 (this is the broadcast address). The transmitter addresses a unique communications association for the receivers by specifying the "remote LSAP". The broadcast telegram only receives the stations where such a communications association is configured. ("Local LSAP" of the receiver = "remote LSAP" of the transmitter).

LSAP 63 is the broadcast LSAP and should only be used if all of the stations on the bus are to receive the broadcast telegram. Generally, a multicast LSAP is used (all LSAPs not equal to 63).

Only non-acknowledged FMS utilities can be transferred via broadcast associations (no handshaking). The non-acknowledged FMS utility, used for SIMADYN D SS5, is the information report. For information report, contrary to the read or write FMS utilities, the server initiates data transfer. The server sends the value of its object to one or several clients. **The client does not return an acknowledgement**.

Broadcast receiver

Features:

- SIMADYN D is client (receiver)
- The remote server (transmitter) initiates data transfer.
- An association must be configured for each object which is to be received.
- There is no connection established between the communication partners; the transferred data is not acknowledged (no handshaking)

Application:

- Process data, with SIMADYN D as receiver.

Communications reference	:		Type:	Broadcast receiver		
Association type	:	BRCT		Local LSAP	:	
Remote address	:			Remote LSAP	:	
Supported utility	:					
				Information report	:	.ind
				Name :		

Table 3-51 Mask, "Broadcast receiver"

Rules:

- The communications reference must correspond with that configured in the CFC (address stage 1 at the address input).
- The local LSAP with the entry "remote LSAP" must correspond to the remote transmitter.
- Remote addresses can be entered, defined, but then only telegrams of the appropriately selected transmitter are received (access protection!); or the value can be set to 255, and then the association is open for all. Recommendation: A "broadcast receiver" association should always be defined, as this is the only possibility to provide access protection for broadcast applications.
- The remote LSAP can be edited, but is however not evaluated (corresponds to the value 255).
- The maximum PDU length should only be changed if the client cannot handle the specified length.

Broadcast transmitter

Features:

- SIMADYN D is server (transmitter)
- SIMADYN D initiates data transfer
- An association must be configured for each object which is to be transmitted.
- A connection is not established between the communication partners; transferred data is not acknowledged

Application:

- Process data, with SIMADYN D as transmitter.

Communications reference	:		Type:	Broadcast transmitter		
Association type	:	BRCT		Local LSAP	:	
Remote address	:	127		Remote LSAP	:	
Max. PDU length	:	241				
Supported utility	:					
				Information report	:	.req
				Name :		

Table 3-52 Mask, "Broadcast transmitter"

Rules:

- The communications reference must correspond with that configured in CFC (address stage 1 at the address connection).
- The local LSAP must correspond to the "Remote LSAP" data at the remote receivers.
- The broadcast LSAP 63 or another LSAP is the remote LSAP (multicast LSAP)
- The maximum PDU length should only be changed if a receiver cannot handle the specified length.

Non-specified

Features:

- Freely-configurable communications association
- SIMADYN D can be both server as well as also client

Application:

- Communications association, where both communication partners are client and server.

Communications reference	:		Type:	Unspecified		
Association type	:			Local LSAP	:	
Remote address	:			Remote LSAP	:	
Max. PDU length	:	241		Monitoring interval	:	0 s
Multiplier	:					
Password	:	0		Group	:	0
Profile	:	0 0				
Supported utilities	:					
Read	:	No		Write	:	No
Get OV (detailed version)	:	No		Information report	:	No
				Symbolic addressing	:	No
Max. number of parallel tasks:						
Transmitting	:	1		Receiving	:	1
				Name :		

Table 3-53 Mask, "Unspecified"

Rules:

- Communications reference must correspond with that configured with CFC (address stage 1 at the address connections).
- "MMAZ" is recommended as association type (the subsequent information/explanations assume this).
- The local LSAP must correspond with the "remote LSAP" of the remote communication partner.
- The remote address addresses the remote communication partners
- Remote LSAP must correspond with the "local LSAP" of the remote communications partner.
- The maximum PDU length should only be changed if a remote communications partner cannot handle the length.
- The monitoring interval must correspond with that of the partner.
- The multiplier is only relevant for the association type "MSZY" (refer to the communication associations).
- The Read, Write, Get OV (detailed version), Information report utilities and symbolic addressing should be selected as requester (".req") and/or responder (".ind"), as they are required.
  - only select read.req if a receive block uses this association as client.
  - select read.ind if a transmit block is addressed as server via this association.
  - select write.req if a transmit block as client uses this association.
  - select write.ind if a receive block is addressed as server via this association.
  - information report.req is not used.
  - select get OV (detailed version) and symbolic addressing if the partner supports this utility.
- The maximum number of parallel "Transmit" tasks should correspond to the number of transmit- and receive blocks configured using CFC which also use this communications association (as client). It should be observed that for the partner, the maximum number of parallel "Receive" tasks should correspond to this minimum number.
- The maximum number of parallel "Receive" tasks must be set as high as the maximum number of "Transmit" tasks for the partner.

3.7.6.4 Loading the database

Tool - bus selection

Paths are edited and tested using this menu item.

Editing (F1):

1. The path from the PG to the SS5 communications module SS5 is saved in a path file. Select F1 "Edit" after a path and a path file have been specified.
2. "PG/CP-L2" should now be selected as start station in the mask which is now displayed. If this is not possible, then the CP5412 driver is missing or the driver has not been started.
3. Select "CP-L2" as the only additional station and enter the station address of the SS5 communications module to be addressed. This must correspond with the SIMADYN D configuring (function block @CSL2F).
4. A path must be edited once for each SS5 communications module. Several paths can be saved in the same path file.

Active (F4):

This utility is used to test the connection to the SS5 communications module.

The PG-L2 module CP5412 is initialized under this menu item and the connection via PROFIBUS to the SS5 communications module created via a "Path".

1. The currently entered path is activated by selecting F4 "Active". The following steps should now be executed in the mask which is displayed.
2. Select F3 "Next K."; the following is displayed: "Direct PC connection established". Thus, the connection between COMSS5 and CP5412 has been established.
3. Depress F3 "Next K." again; the connection to the SS5 communications module is now established.

NOTE If this does not function, then the baud rate and station address of CP5412 (configuration file) and SS52 (central coupling block @CSL2F) should be checked.

4. Return to the main menu with 2x F8

Loading

All of the actions executed under this menu item refer to the SS5 communications module, which is addressed by the path, set under **Init path definitions**.

1. First select **CP Stop** under the **Load** menu item, and then **CP database transfer** with menu sub-item **FD > CP**. Database loading is displayed.
2. Select **CP Start**: The database is transferred into the EEPROM and then communication module SS5 is re-started (warm start). This can take up to 2 minutes. This procedure can be identified as the two LEDs on the SS5 communications module briefly go dark and then light up again.
   - If the loaded database is inconsistent, the green diode flashes. In this case, the SS5 communications module must be reset (SIMADYN D subrack reset). The SS5 communications module then runs-up without database.
   - Uploading the database (**CP database transfer - CP - > FD**) is not possible!

3.7.7 Examples

General

Only the relevant information for the examples is provided. At the function blocks, only inputs AT/AR are specified and possibly length information. All of the examples require that a CS7 module has been configured with an SS5 communications module as well as the @CSL2F central block.

3.7.7.1 Example 1: Process data between two SIMADYN D stations

Description

- SIMADYN D notation: Station 1 transmits data to station 2.
- FMS notation: Station 1 writes into an object in station 2.

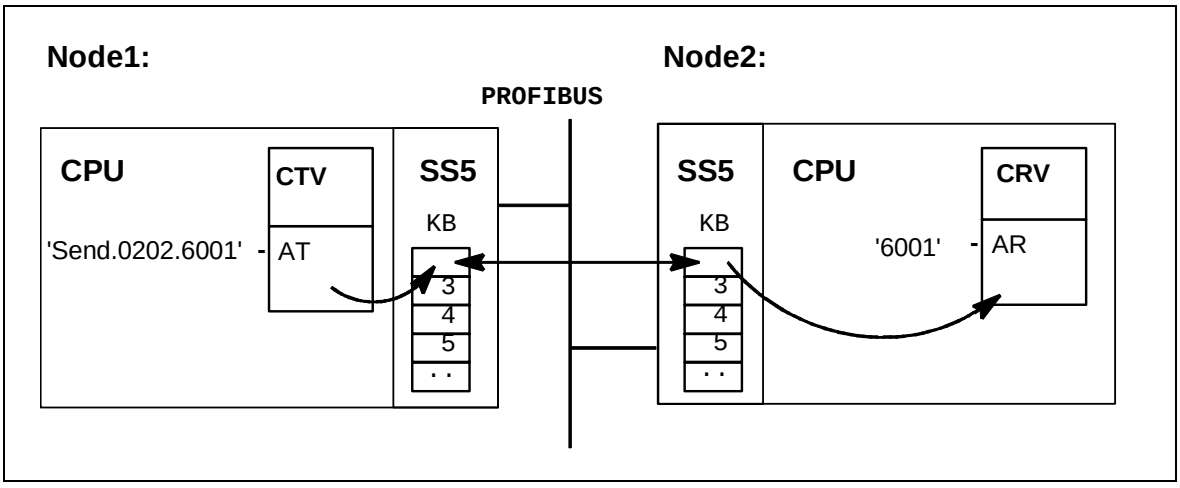


Fig. 3-39 Example 1

Explanation

- The transmit block CTV in station 1 is the client: In addition to the channel names, address stage 1 and address stage 2 are also specified at input AT.
- The receive block CRV in station 2 is the server: Only the channel name is specified at input AR.
- The object is in station 2 (the server) and has the PROFIBUS index 6001.
- Station 1 (the client) writes into the object, with index 6001, in station 2.
- Station 1 sends the write task via its communications association 2.
- Station 2 receives the write task via its communications association 2.
- Communications association 2 in station 1 is a "Non-cyclic client" application type; the connection to station 2 and its communications association 2 is defined there.
- Communications association 2 in station 2 is a "Non-cyclic server" application type.

Comments

- Additional objects can be interchanged via the same connection (station 1 with KB2 and station 2 with KB2).
- Instead of SIMADYN D stations, external systems (e. g. SIMATIC) can be used for station 1 or station 2.
- For station 1, with address stage 1, reference is made twice to the same "02" communications association; once for the FMS utility "Get OV", and the other, for the FMS utility "Write". For non-cyclic connections, this can and should always be the case.
- In the above (basic) example, the object is directly assigned a PROFIBUS index using configuring. In addition, for SIMADYN D it is also possible (as server) to assign a name to the object or (as client) to address an object using a name. However, this only functions between SIMADYN D stations and external devices which have the same functionality (not for example, SIMATIC or drive converters).

Communication associations

Communication associations are configured using COMSS5 (refer to Chapter COMSS5).

Station 1, communication association 2:

Communications reference	:	2	Type :	Non-cyclic client		
Association type	:	MMAZ		Local LSAP	:	10
Remote address	:	2		Remote LSAP	:	12
Max. PDU length	:	241		Monitoring interval	:	0 s
Password	:	0		Group	:	0
Profile	:	0				
Supported utilities	:					
Read	:	No		Write	:	.req
Get OV (detailed version)	:	.req		Information report	:	No
				Symbolic addressing	:	.req
Max. number of parallel tasks:						
Transmitting	:	1		Receiving	:	0
				Name :		CLI WRITE 2

Table 3-54 Mask, "Non-cyclic client"

Explanations:

- Station 1 is the client so that the "Non-cyclic client" mask is selected here.
- "Communications reference" 2 corresponds to the data entry made in address stage 1 at input AT of the SIMADYN D transmit block.
- The "Association type" is non-cyclic, master-master, as both stations (SIMADYN D) are master.
- "Local LSAP", "Remote address" and "Remote LSAP" define the communications path between the two stations.
- The default values were used for the fields "Max. PDU length", "Monitoring interval", "Password", "Group", "Profile".
- The "Get OV (detailed version)" and "Write" utilities are supported and more specifically as requester. A client is always a requester as far as this utility is concerned.
  - "Write" must be supported, because the transmit function block is appropriately configured.

- "Get OV (detailed version)" is supported, because the SIMADYN D communications partner always supports this utility as server thus achieving a high degree of data security.
- "Symb. addressing" does not have to be supported here as the object is accessed per index (6001).

- The "Max. number of parallel transmit tasks" is equal to "1", because precisely one (write) task is defined by the SIMADYN D software.

Station 2, communications association 2:

Communications reference	:	2	Type:	Non-cyclic server		
Association type	:	MMAZ		Local LSAP	:	12
Remote address	:	1		Remote LSAP	:	10
Max. PDU length	:	241		Monitoring interval	:	0 s
Supported utilities	:					
Read	:	.ind		Write	:	.ind
Get OV (detailed version)	:	.ind		Information report	:	No
				Symb. addressing	:	.ind
Max. number of parallel tasks:						
Transmitting	:	0		Receiving	:	1
				Name :		SERV 1

Table 3-55 Mask, "Non-cyclic server"

Explanations:

- Station 2 is server thus, the "Non-cyclic server" mask is selected here.
- The "Communications reference" data for the server has absolutely no reference to the CFC configuring, and, within certain limits, can be freely-selected.
- "Local LSAP", "Remote address" and "Remote LSAP" must correspond to the data entered for station 1.
- For the remaining fields, the default values were selected, and the values are permanently assigned.

Comment:

- The communication references must be consecutive (without any gaps) starting with "2". For instance, if five communication associations are configured, communication references 2 to 6 should be used.
- "Association type" must be identical for both stations.
- The monitoring interval for non-cyclic communication associations should be the same for both stations.
- For servers, the value "255" can be entered for "Remote address" and "Remote LSAP". In this case, the communications association is "open", i. e. any client can establish a connection here.
- For a client, "Remote address" and "Remote LSAP" must always be defined; the client then establishes the connection to the specified partner.

3.7.7.2 Example 2: Process data between three SIMADYN D stations

Description

- SIMADYN D notation: Station 1 transmits data to station 2 and sends data and receives data from station 3.
- FMS-notation: Station 1 writes into an object in station 2 and reads and writes into objects in station 3.

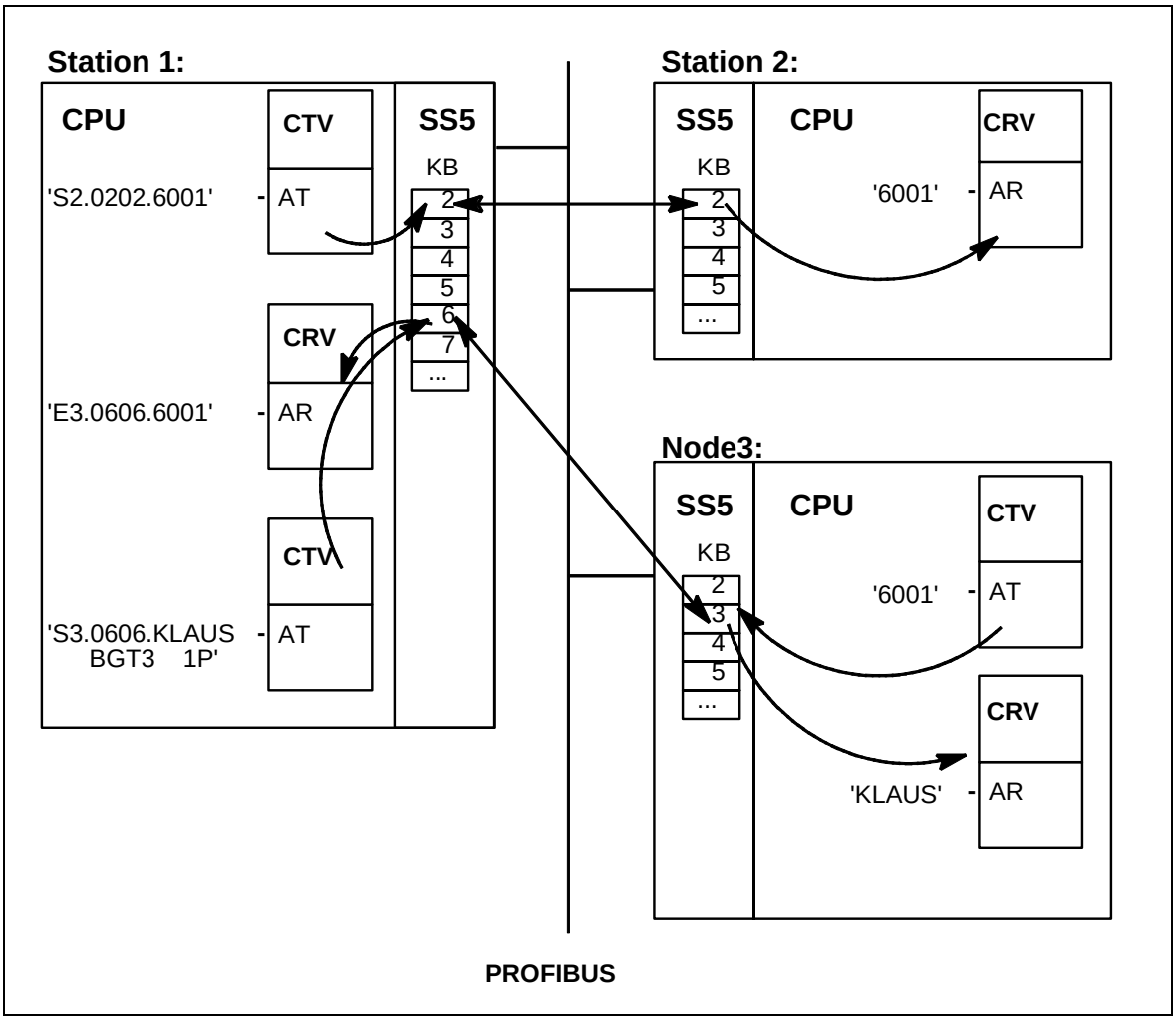


Fig. 3-40 Example 2

Explanations

- Station 1 is client, station 2 and station 3 are servers.
- An object with PROFIBUS index 6001 is configured at station 2 and can be written into.
- A communications connection is established between station 1 and station 2 as well as between station 1 and station 3.
- An object, with the PROFIBUS index 6001 is configured at station 3, and it can be read. Next to it is an object with the name "KLAUS___BGT3__1P" which can be written into. The SS5 firmware generates a name for this object taken from the configured channel name "KLAUS", the (assumed) subrack names "BGT3", process number "1" and the utility ID "P" for process data. The channel name is made up to eight characters by adding "_", and the subrack name to six characters, also using "_" (separator).

- Station 1 writes into the object at station 2 with the index 6001, via its communications association 6.
- Station 1 reads the object with PROFIBUS index 6001 at station 3 via its communications association 6. Station 1 writes into the object with the name "KLAUS___BGT3__1P" using the same communications association.

Comment

- The SS5 firmware at station 3 assigns a PROFIBUS index to the object "KLAUS___BGT3__1P". The SS5 firmware in station 1 first retrieves the PROFIBUS index of this object using the "Get OV" FMS utility. All other write accesses are realized per index to save time.

Communication associations

Station 1, communications association 2 and station 2, communications association 2 (refer to example 1: Process data between two SIMADYN D stations).
This is supplemented by:

- Station 1, communications association 6
- Station 3, communications association 3

Station 1, communications association 6

Communications reference	:	6	Type :	Non-cyclic client		
Association type	:	MMAZ		Local LSAP	:	11
Remote address	:	3		Remote LSAP	:	12
Max. PDU length	:	241		Monitoring interval	:	30 s
Password	:	0		Group	:	0
Profile	:	0				
Supported utilities	:					
Read	:	.req		Write	:	.req
Get OV (detailed version)	:	.req		Information report	:	No
				Symb. addressing	:	.req
Max. number of parallel tasks:						
Transmitting	:	2		Receiving	:	0
				Name :		CLI REA/WRI 3

Table 3-56 Mask, "Non-cyclic client": Station 1, communications association 6

Explanations:

- "30 s" was selected as "Monitoring interval".

- In addition to the "Get OV (detailed version)" and "Write" utilities, the "Read" and "Symb. addressing" utilities are supported. Symbolic addressing is required here as an object is addressed using names.

- "Transmit max. number of parallel tasks" has the value "2", as a read- and a write task is defined as a result of the SIMADYN D configuring.

Station 3, communications association 3

Communications reference	:	3	Type:	Non-cyclic server		
Association type	:	MMAZ		Local LSAP	:	12
Remote address	:	1		Remote LSAP	:	11
Max. PDU length	:	241		Monitoring interval	:	30 s
Supported utilities	:					
Read	:	.ind		Write	:	.ind
Get OV (detailed version)	:	.ind		Information report	:	No
				Symb. addressing	:	.ind
Max. number of parallel tasks:						
Transmitting	:	0		Receiving	:	2
				Name :		SERV 1

Table 3-57 Mask, "Non-cyclic server": Station 3, communications association 3

Explanation:

- The entries are selected, so that they correspond with those of station 1, communications relationship 6.

Comment:

- For station 1, communication associations 3, 4 and 5 (possibly, only as dummy) must be defined as well as for station 3, communications association 2.

3.8 DUST1 coupling

Application

The DUST1 coupling is a basic serial point-to-point connection. The communication utilities, service and process data can use the DUST1 coupling.

The main application of the DUST1 coupling is to establish communications with CFC or the basic service tool to commission a configured software package.

The DUST1 coupling is available in two versions:

- With CS7 coupling module and SS4 communications module
  - communication utilities, service or process data, can be configured.
  - the coupling can be accessed from all CPUs.
- With a local X01 interface on the CPU (this versions is not described in any further detail here)
  - the communications utility service is always available and does not have to be configured.
  - only one single CPU can be controlled via this service interface.

3.8.1 Hardware structure

Required hardware

The following hardware is required for the DUST1 coupling:

- CS7 communications module with a SS4 communications module

Cable interface

The cable interface uses RS232, but can also be changed-over to 20 mA or RS485 by inserting SS2 or SS3 interface sub-modules.

Generally, RS232 is used when connecting CFC or the basic service tool.

3.8.2 Configuring

General

For the serial DUST1 coupling, the telegram lengths are restricted to 256 bytes per channel (and therefore per function block).

Central coupling block

Central block @CSD01 is available to configure DUST1 via a communications module SS4 in a communications module CS7. This block has the task to initialize and parameterize the data interface on a communications module. The CS7 communications module can be accessed from all CPUs.

Transmit/receive blocks

The channel name and address stage 1 are specified at the AT-, AR- and US inputs of the transmit- and receive blocks. A unique number between 0 and 255 should be specified in address stage 1. At system run-up, it is identified whether a number has been assigned a multiple number of times for several blocks. Address stage 2 does not have to be configured.

3.8.3 Configuring example, service to CFC

Description

- A CS7 communications module with SS4 communications module must be available in the subrack.
- All of the subrack CPUs can be addressed from the CFC via CS7/SS4.
- Service utility and DUST1 central block coupling on CPU 3 (slot 6).

NOTE CFC online addresses the CPU via the slot number (address stage 1 at input US=slot number 6)

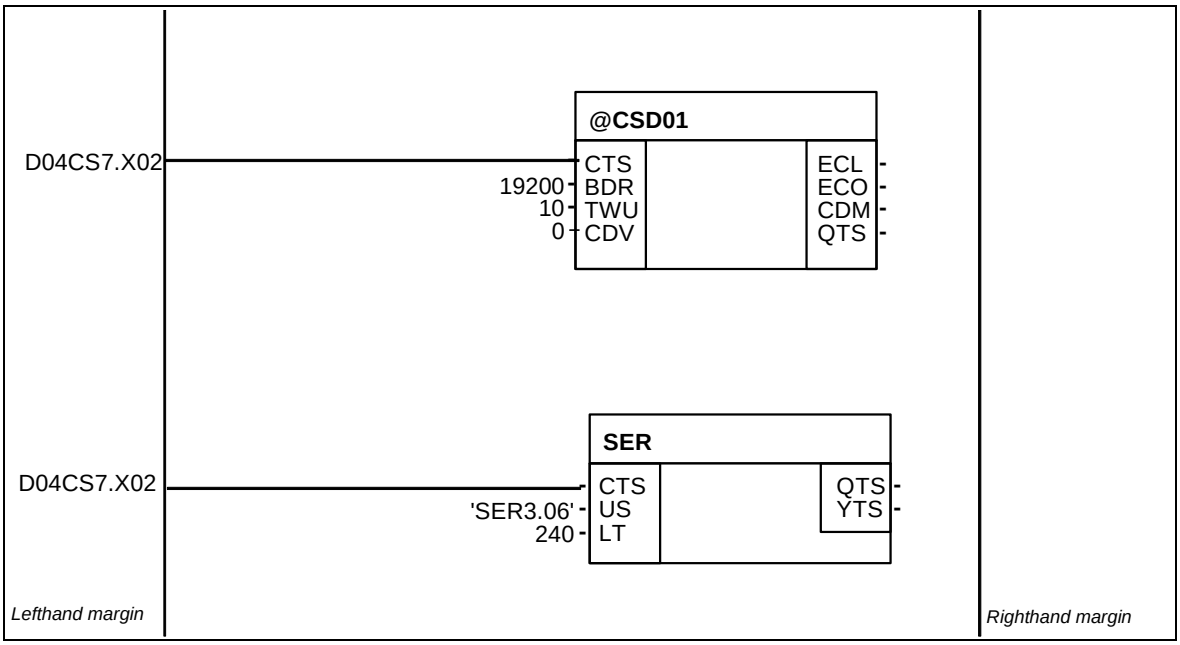


Fig. 3-41 DUST1 with service

3.8.4 Configuring example, process data between SIMADYN D subracks

Description

- A CS7 communications module with SS4 communications module must be available in both subracks.
- Only the transmit- and receive blocks of the communications utility, process data, can be used for data transfer between the CPUs of various subracks via DUST1.

3.8.4.1 Subrack 1

Description The DUST1 central coupling block and 1 transmit- and 1 receive block are configured on CPU 4 of subrack 1.

(In this case, CS7 is called "D06CS7", communications module SS4 is inserted at the 2nd connector).

The data entries at inputs AT, AR of CTV/CRV must match those on subrack 1, otherwise data will not be able to be transferred.

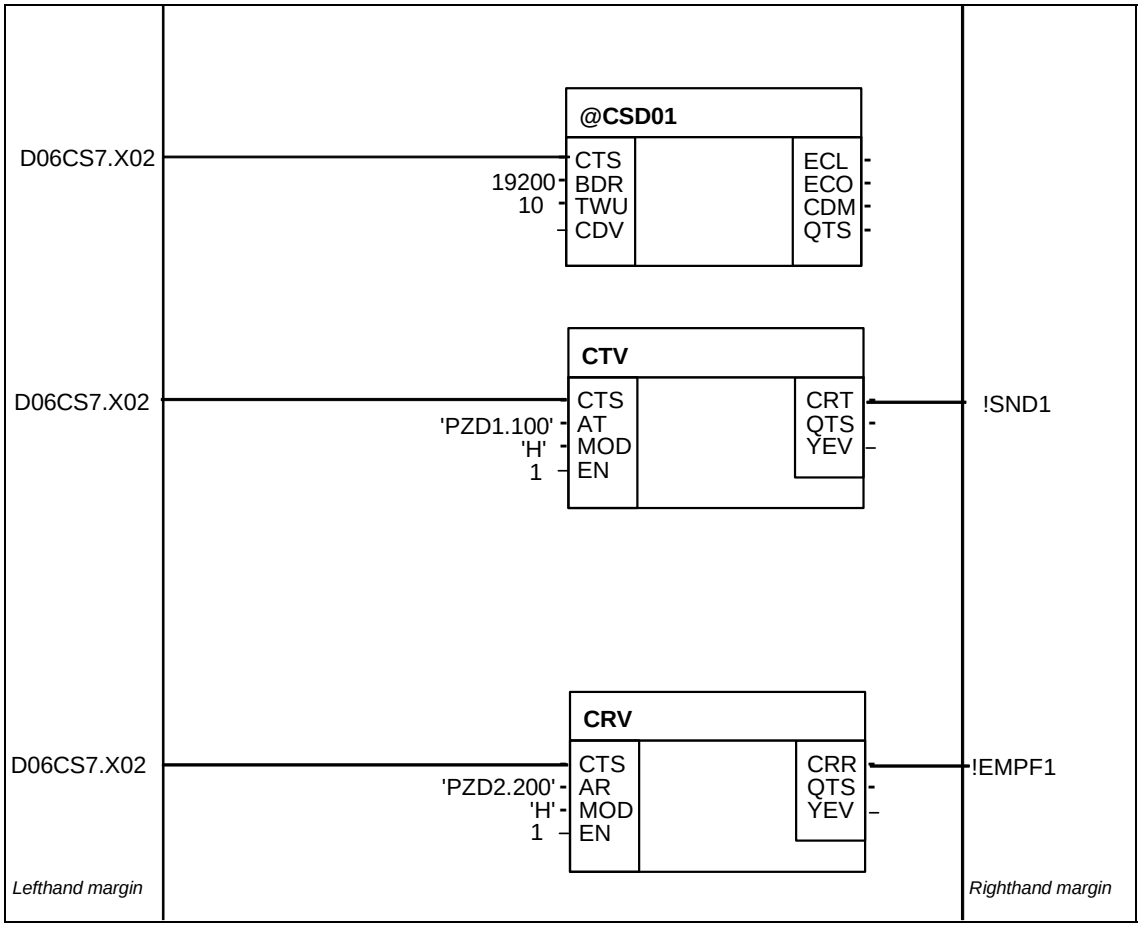


Fig. 3-42 Configuring example: Subrack 1

3.8.4.2 Subrack 2

Description

The DUST1 central coupling block as well as 1 transmit- and 1 receive block are configured on CPU 3 of subrack 2. (in this case, CS7 is called "D10CS7", communications module SS4 is inserted at connector X03).

Address stage 1 must be the same for blocks which communicate with one another:

- Subrack 1, transmitter=subrack 2, receiver=100
- Subrack 1, receiver=subrack 2, transmitter=200

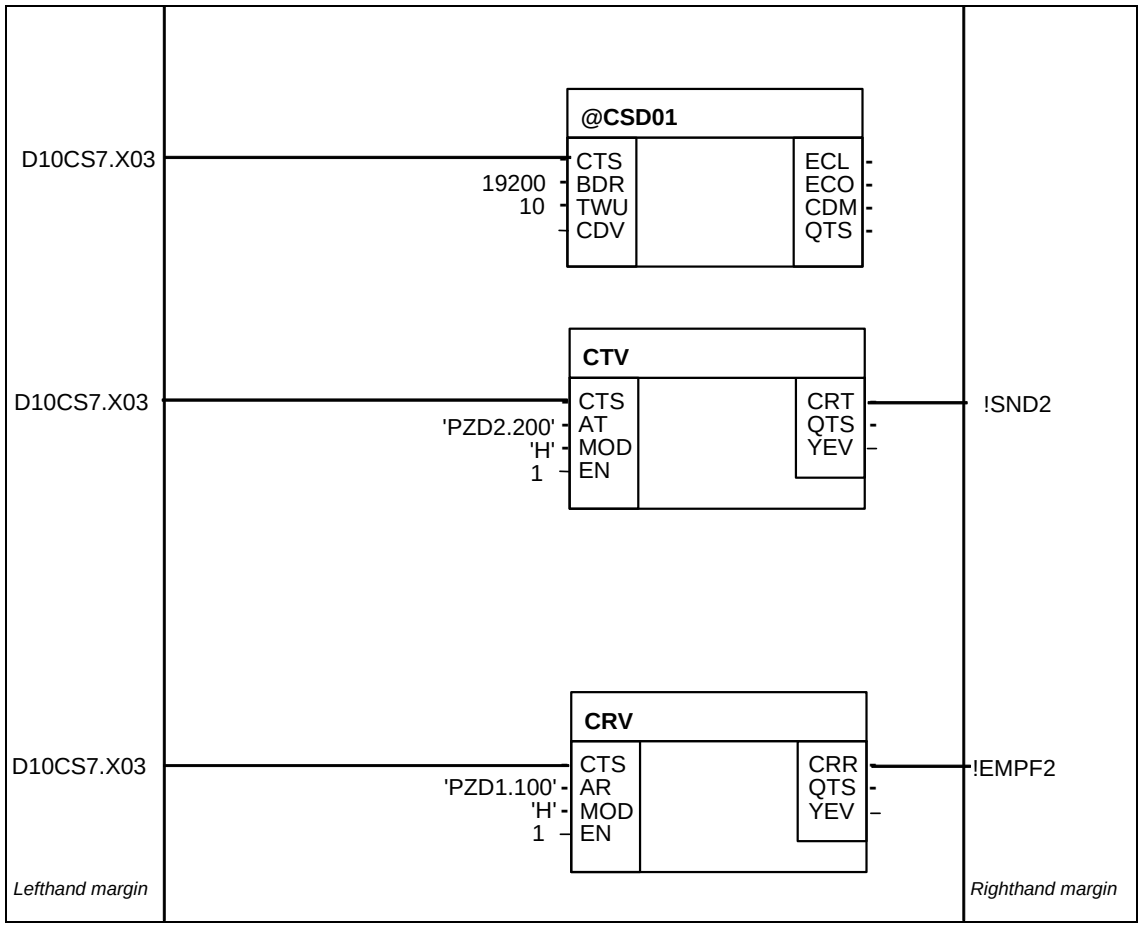


Fig. 3-43 Configuring example: Subrack 2

3.9 DUST2 coupling

Application

To output messages from a message system, printers can only be connected to SIMADYN D which can handle the serial communications protocol X-ON/X-OFF with additional telegram block check characters (ETX/ACK).

3.9.1 Hardware structure

Hardware required

The following hardware is required for the DUST2 coupling:

- CS7 communications module with SS4 communications module

Cables

The SC56 cable can be used to connect a printer to the communications module CS7 with communications module SS4 if an appropriate adapter is used. This adapter converts a 25-pin high-density connector into a 25-pin sub-D socket connector.

Printer

The printer must be equipped with the matching interface module, which is parameterized for the settings configured with SIMADYN D (e. g. baud rate, parity).

Further information
on the printer, refer to the printer Manual.

- Printer DR 215-N is used as message printer.
  (Refer to Catalog IC40 from AUT and SIMADYN D Info 94/14)

3.9.2 Configuring

DUST2 addresses

As the DUST2 protocol operates according to the "point-to-point" principle, and a message printer can only be handled as communications partner, to output messages, a transmit address is not required (when using CS7/SS4, only a channel name should be specified at the corresponding output block; address stages 1 and 2 are not used).

Central coupling block

A central coupling block is available to configure the DUST2 coupling and to set the format for printer output:

- @CSD02: For a coupling via CS7/SS4

The DUST2 central coupling block is used to initialize the communications interface (hardware driver and DUST2 software). In addition, it can configure the protocol (minimum) with the following I/O (connections):

- **PAR** (parity)
  This specifies the parity in the telegram characters
  (0 = even, or 1 = odd number of ones)

- **FRM** (format selection)
  To optically improve the text, it can either be output in a standard format (FRM = 0) (lefthand and righthand margin, narrow fonts, page break) or non-formatted (FRM = 1). The format instruction is only used by DUST 2 in conjunction with the 20mA interface after the interruption has been identified.

  – SIMADYN D is powered-up (20 mA current source from SIMADYN D as transmitter is active).

  – The printer is powered-down (20mA current source from the printer is inactive as transmitter).

  – The 20 mA connecting cable from SIMADYN D to the printer is not inserted.

Text output block

The MSIPRI message output block should be used (refer to Chapter Communications utility, message system).

3.10 DUST3 coupling

Application

The DUST3 data transfer protocol is mainly used to exchange data with SIMATIC S5 or TELEPERM M.

From the SIMATIC S5/TELEPERM M perspective, SIMADYN D behaves just like a SIMATIC S5/TELEPERM M device, with the restriction, that telegram fetch is not possible (however test telegrams from TELEPERM M are responded to).

Data transfer protocol

The data transfer protocol is a 3964(R) protocol with an RK512 computer coupling protocol overlay (a precise description, e. g. for: SIMATIC S5 COM525).

Data transfer time

The data transfer time is 1.15 ms/byte at 9600 baud. The telegram frame including response telegram is 25 bytes long
(net data length =< 128 bytes).

- Example: At 9600 baud, it takes: 1.15 ∗ (25 + 50) = 86 ms, to transfer 50 bytes of net data

Telegram length

The maximum telegram length is 750 bytes. However, there are coupling partners (e. g. TELEPERM), which permit a maximum telegram length of only 128 bytes.

3.10.1 Hardware structure

Hardware required

The following hardware is required for the DUST3 coupling:

- CS7 communications module with an SS4 communications module

3.10.2 Configuring

3.10.2.1 Data entries at inputs AT, AR

Rules

A channel name and address stage 1 must be specified at input AT/AR. Data entries for address stage 2 are optional. For address stage 1 and address stage 2 there is a defined syntax, which is now described:

Address stage 1 consists of:

- SIMATIC processor number: Precisely one character, value range "1".."4". This entry is optional and is only practical for transmitters. The data entry is used to address a SIMATIC processor, as long as the receiving SIMATIC can handle the multi-processor technology used.
- Output command with data block and data word:
  "ADxxx-yyy"
  - AD: "Output" "data block"
  - xxx: Data block, value range 1..255

- – - : Hyphen as separating character
- – yyy: Data word, value range 0..256

- Or an output command with absolute SIMATIC address: **"ASwwwww"**
  - – AS: "Output" "memory"
  - – wwwww: Absolute address, value range 0..65535

In the transmit direction, the output command addresses the data blocks and memory addresses in the SIMATIC. In the receive direction, the data entry is used to emulate an appropriate data block or memory address, so that an output command, received by a SIMATIC, is correctly processed.

NOTE SIMADYN D does not support a "Fetch" telegram or input command ("E" code).

The optional address stage 2 consists of:

- Coordination flag: This is only practical for transmitters: **"zzz-u"**
  - – zzz: Coordination flag byte, value range 1..255
  - – - : Hyphen as separator
  - – u: Coordination flag bit, value range 0..7

Example of data entries at inputs AT, AR

- AT- 'PZD1.3AD20-10.130-5"'
  - – The data are sent to SIMATIC processor No. 3 and saved in data block 20, from data word 10. A coordination flag must be specified
- AT- 'PZD2.AD10-30'
  - – The data are sent to the SIMATIC and are saved in data block 10 from data word 30.
- AR- 'PZD3.AD50-50'
  - – Data are received from a SIMATIC, which transmits output command "AD50-50" to SIMADYN D.

3.10.2.2 Central coupling block

General Central block @CSD03 is required to configure the DUST3 coupling via an SS4 communications module in a communications module CS7. This block has the task to initialize and parameterize the data interface on a communications module SS4 in a communications module CS7. All CPUs can access the CS7 communications module.

I/O (connections) The central coupling block has the following I/O (connections) to parameterize DUST3:

- **PRI** (transmit priority)
  If a transmit request occurs simultaneously, this defines which of the two communication partners can first transmit. PRI=0 means that the partner can first transmit; PRI=1 means that the SIMADYN D first transmits. This data entry must be different for SIMADYN D and the communications partner.

- **BCC** (block check character)
  This defines whether a block check character is also transferred. BCC=0 means that no block check character is sent (this corresponds to procedure 3964, Hamming distance=2); BCC=1 means that a block check character is sent (corresponds to procedure 3964R, Hamming distance=4). For SIMADYN D and the coupling partner, this data entry must be the same.

- **LS** (transport layer identification)
  This defines whether and how the RK512 protocol is to be used.

  – LS=0: The RK512 protocol is used, as specified for SIMATIC; especially for data transfers in the single-word format, the data words high byte before low byte are transferred ("Big-Endian" or "Motorola" format).

  – LS=1: Protocol RK512 is used, but for single-word format data transfer, the data words are transferred, low byte before high byte ("Little-Endian" or "Intel" format). For example, this is used for couplings to COROS.

  – LS=2: Protocol RK512 is not used. Data is directly transferred with the procedure 3964(R).

3.10.2.3 Transmit/receive blocks

General information and connections (I/O)

All transmit- and receive blocks of the process data utility can be used which have address inputs (AT/AR). To start off with, a unique channel name must be specified at these connections. This is then followed, separated by a point (period - separator), by the address data required for DUST3.

3.11 DUST7 coupling

3.11.1 General

Using the DUST7 coupling

The DUST7 coupling is a basic, serial point-to-point connection. The communication utilities, process data and message system, can use the DUST7 coupling.

The main use of the DUST7 coupling is:

- to transfer process data to devices with basic serial interfaces or PCs with the customers own applications, or
- to output messages on simple terminals.

In addition to the pure net data, an optional configurable end of telegram with maximum 2 characters is transferred. If an end of telegram has not been configured, then the end of telegram is identified by an interval time of 4 character times.

3.11.2 Hardware

Hardware required

The following hardware is required for the DUST7 coupling:

- Subrack
- CPU
- CS7 module with SS4 communications module (this must also be configured in HWConfig)

An RS232 interface is used which can also be changed over to 20 mA or RS485 by inserting an SS2 or SS3 interface module.

3.11.3 Configuring

Central DUST7 coupling block

The @CSD07 central coupling block must be configured. The character frame and the end of telegram can be configured at its initialization inputs.

Further information
on the @CSD07 central block, refer to the User Documentation "SIMADYN D, function block library".

Process data, transmitter and receiver

A maximum of one transmit block and one receive block (CTV and CRV) may be configured. Only a channel name must be specified as address parameter (AT-, AR input). The channel name must be different for the transmitter and receiver.

Message output block

One or several message output blocks (MSIPRI) can be configured. If several message output blocks are configured, then their channel names must be identical ("Select" data transfer mode).

3.12 MPI coupling

3.12.1 Characteristics and hardware

Characteristics

MPI (Multi Point Interface) is the standard communications protocol for SIMATIC S7/M7. Data transfer is realized via a multi-master bus with a maximum of 126 nodes.

For SIMADYN D, MPI is used to connect the CFC for start-up and testing configured software, and is also used to communicate with WinCC and SIMATIC OPs.

With the MPI coupling, the communication utilities service (FB-SER) and S7 communications (FB-S7OS) are used.

Hardware

The following hardware is required for the MPI coupling:

- Subrack
- CPU
- CS7 module with SS52 communications module (this must also be configured in HWConfig)

3.12.2 Configuring

HWConfig

The CS7 communications module and the SS52/MPI communications module must be configured in HWConfig. Its own MPI address must be specified for SS52/MPI.

Function block @CSMPI

Precisely one @CSMPI central coupling block must be configured for each SS52/MPI. The @CSMPI function block initializes and monitors the MPI coupling.

Additional information
to configure an MPI coupling, refer to:

- Section "Communications Utility Service"
- Section "Communications with SIMATIC Operator Panels"
- Section "Communications with WinCC (MPI)"

3.13 USS master coupling

General

The USS master coupling defines an access technique, according to the master-slave principle for data communications via a serial bus.

Features

- A multi-point-capable coupling is supported
- Master-slave access technique
- Single-master system
- 1 master and a maximum of 31 slaves
- Bus line: Line without any branching

Mode of operation

The master addresses the individual slaves using an address character in the telegram. A slave can never initiate data transmit. Individual slaves cannot transfer data directly between themselves.

SIMADYN D communication utilities

The following SIMADYN D communications utilities can be connected to the USS master coupling:

- Process data
- Message system
- Display control
- Parameter processing

3.13.1 Hardware structure

Hardware required

The following hardware is required for the USS master coupling:

- CS7 communications module with an SS4 communications module (USS master). The interface is an RS485 interface (SS31 interface sub-module).

Bus termination

The bus cable must be terminated at both ends. A 150 Ω resistor is connected between the RS485P and RS485N data signal lines at the first and last nodes.

Basic network

If a node is not transmitting, then the bus has an undefined potential, because all transmitters are switched into the high-ohmic state. To suppress signal faults in this status, a basis network is connected to the bus so that it has a defined positive signal level. The basis network should be connected at the nodes where the bus cable ends.

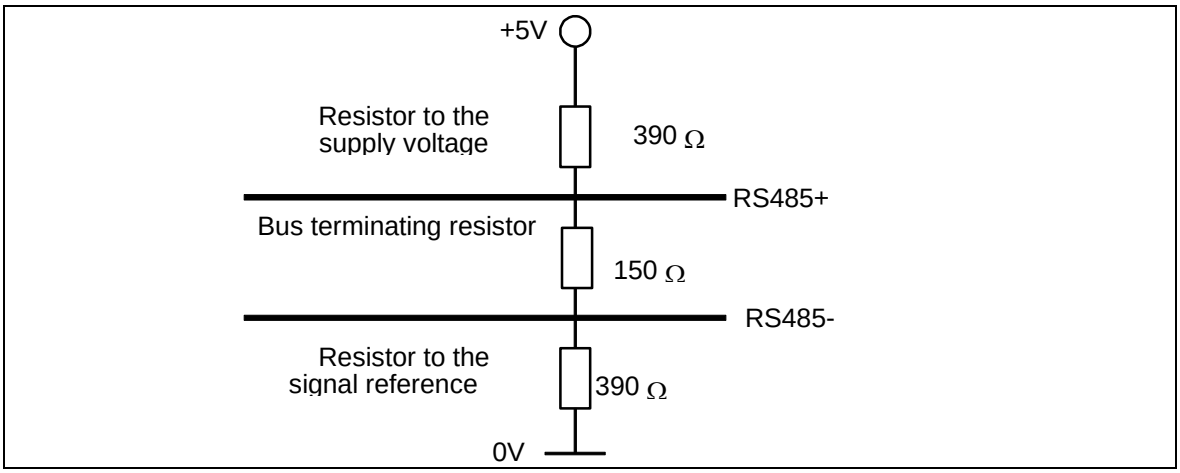


Fig. 3-44 Basis network and bus termination

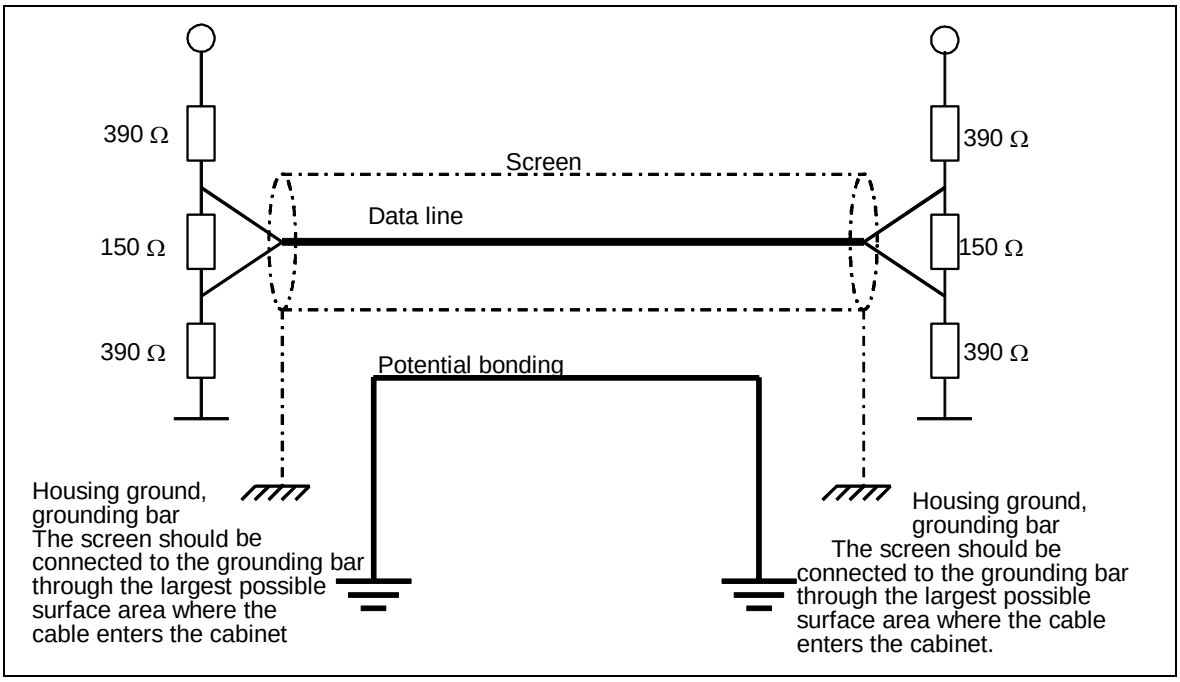


Fig. 3-45 Screening and potential bonding

Connector assignment with basis network

This circuit should be used if the SS4 communications module is used as end node on the USS bus, i. e. at the end of the bus cable.

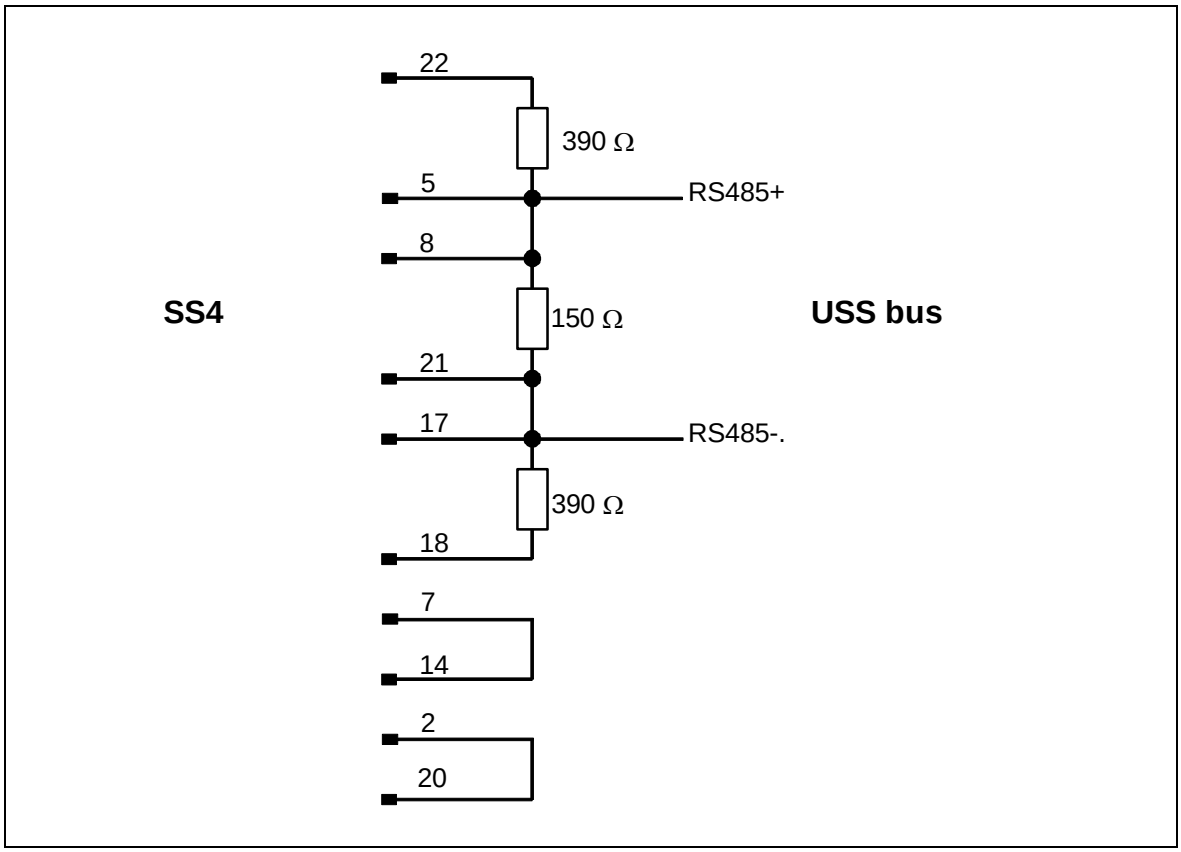


Fig. 3-46 Connector assignment with basis network

Connector assignment without basis network

This circuit should be used if the SS4 communications module is not used as end node on the USS bus, i. e. not at the end of the bus cable. In this case, the bus cable is looped-through the bus connector.

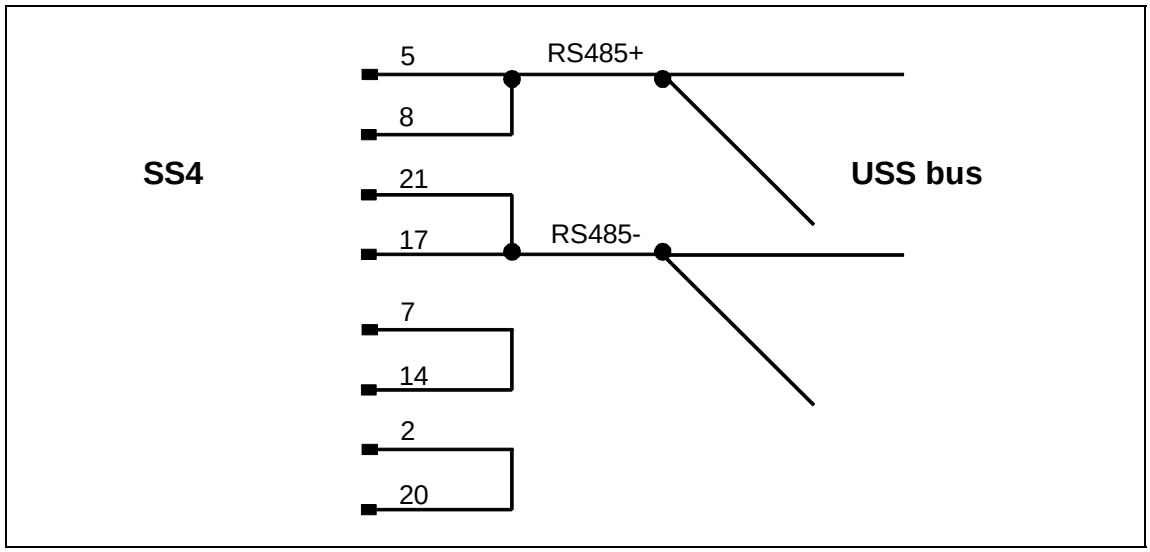


Fig. 3-47 Connector assignment without basis network

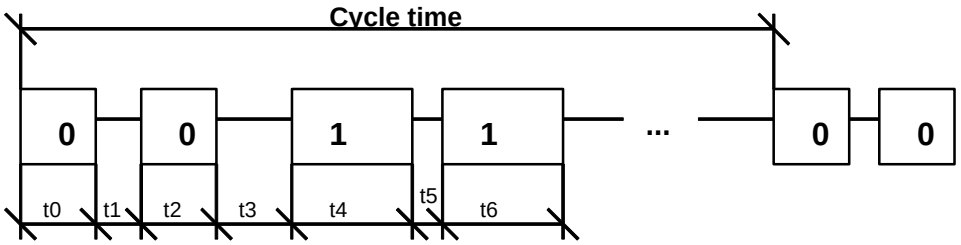
3.13.2 Data transfer technique

Mode of operation

Data transfer is realized in the half-duplex mode via an RS485 interface (2-conductor cable). The master addresses all of the slaves, one after another, with a telegram. The addressed slaves transmit a telegram back to the master. In accordance with the master-slave procedure, when the slave receives a telegram, it must first transmit a telegram back to the master before the master re-addresses this slave.

The sequence of the addressed slaves can be specified by entering the station address in a circulating list (refer to the central coupling block @CSU). If several slaves must be addressed in a faster cycle (scan) than the others, then their station address can be configured a multiple number of times in the circulating list.

The scan time isn't defined due to the inconsistent telegram delay- and processing times.



t0: Telegram delay time, master-slave0
t1: Response delay time, slave0
t2: Telegram delay time, slave0-master
t3: Processing time, master
t4: Telegram delay time master-slave1
t5: Response delay time, slave1
t6: Telegram delay time slave1-master

Fig. 3-48 Definition of the cycle time

3.13.3 Transferred net data

General

On the receive- as well as on the transmit side, up to 252 bytes of net data can be transferred. The net data length can be configured and is dependent on the particular application.

3.13.4 Configuring

3.13.4.1 Central coupling block @CSU

Initialization and monitoring

An @CSU central coupling block has to be configured to initialize and monitor the coupling. The central block only initializes the coupling during cyclic operation; the coupling remains inhibited before cyclic operation.

Thus, it can take several sampling periods until the first telegram is transmitted or received!

3.13.4.2 Function blocks which can be used

General

All of the function blocks for the communications utilities, process data, message system and display, can be used.

Data entries at inputs AT, AR

A unique channel name must be specified at inputs AT/AR. Address stage 1 and address stage 2 are used as follows:

AT/AR: **"Channel name.address stage 1.address stage 2"**

- **Channel name**
  - unique channel name
- Enter "." after the channel name
- **Address stage 1**
- telegram type
- value range and significance:
  0: drive telegram
  1: OP2 telegram
- Enter "." after address stage 1
- **Address stage 2**
- station address of the slaves where data is to be transferred.
- value range and significance:
  0 - 30: slave station address
  99: broadcast address

Examples of data entries at AT, AR

1. AT- 'SENDER.0.25'
   - the channel with the name BROADCAS sends a device telegram to the station with number 25.
2. AT- 'BROADCAS.1.99'
   - the channel with the name BROADCAS transmits an OP2 telegram as broadcast telegram.

NOTE

- Precisely one transmit- and precisely one receive channel are permitted for each slave. If more transmitters/receivers attempt to log-on, then these channels remain active.
- A maximum of 16 broadcast transmitters are permitted. If more than one broadcast transmitter attempts to log-on, these channels do not go into operation.

3.13.4.3 Telegram types

Drive telegram

The "Drive" telegram type should be used for communications to variable-speed drives. Drive telegrams are exclusively transmitted as standard telegrams in accordance with the drive profile (refer to /1/).

OP2 telegrams

The "OP2" telegram type should be used for establishing communications to operator control devices. OP2 telegrams are exclusively transmitted as special telegrams (refer to /1/).

Broadcast telegrams

Station address "99" should be configured for communications using broadcast telegram. Broadcast telegrams are only transmitted as special telegrams (refer to /1/). Broadcast telegrams cannot be transmitted to drives ("drive" telegram type)!

Mirror telegrams

The master can request a mirror telegram from a slave. To realize this, the master transmits a telegram to the slave. This telegram differs from the standard telegram only by the fact that one bit of the address byte is set. The slave transmits this telegram unchanged back to the master (mirrored). This mirror telegram can be used to check data transfer between master and slave. Mirror telegrams are transmitted, dependent on the configured telegram type, either as standard telegram in accordance with the device profile ("drive" telegram type) or as special telegram ("OP2" telegram type) (refer to /1/).

3.13.5 Mode of operation

Transmit

The USS master coupling cyclically transmits data, whereby all of the slave nodes are addressed one after the other. In this case, it is unimportant whether new transmit data were made available by the blocks or not. If no new data was made available, then the data which were last transmitted, are again transferred.

Receiving

The USS master coupling only identifies a valid receive telegram, if the number of received net data is the same as the configured number of receive data.

Circulating list

The sequence of the slaves which are addressed can be specified by appropriately entering the station address in a circulating list (also refer to the central coupling block @CSU). If several slaves are to be addressed in a faster cycle than others, then their station address can be configured a multiple number of times in the circulating list.

If a circulating list is not configured, all of the slaves are addressed according to their station address in an increasing sequence.

Broadcast

In the broadcast mode (station address=99), the master transmits a telegram to all of the slaves connected to the bus. The slaves do not respond to a broadcast telegram. The broadcast telegram is processed at the end of each bus circulation (all slaves are addressed once). In this case, a maximum of two broadcast telegrams are transmitted. If the maximum of 16 possible broadcast tasks are available, these are transmitted after 8 bus cycle. The USS master coupling ensures that a

"slower broadcast transmitter" is not blocked by a "faster" broadcast transmitter.

Monitoring mechanisms and error response

The USS master coupling monitors the delay time of the received telegram. The time interval between the last character of the transmitted telegram and the first character of the received telegram is considered to be the delay time. The maximum permissible delay time is 20 ms. If the addressed slave does not respond within the maximum permissible delay time, the USS master coupling flags the receive channel, assigned to this slave, as being faulted. If a receive channel is not configured, no error entry is made.

The USS master coupling then transmits a telegram destined for the next slave.

The error entry for the faulted slave is only reset after the slave receives the next error-free telegram.

3.13.6 USS master on the T400 technology module

This section describes the special issues which you have to observe when using the USS master coupling on the T400 technology module.

In this section, ***you will only find the differences*** over to ***Section 13.1 to 13.5***.

The USS master coupling allows you to connect, approx.

- 17 drive converters *or*
- 19 OP2 operator control devices, *or*
- 8 drive converters *and* 8 OP2

As prerequisite for the coupling, you will require a *T400 technology module (terminals 70..71, serial interface X01* ***or*** *terminals 74..75, serial interface X02)*.

Data transfer uses a half-duplex technique according to the RS485 Standard via a 2-conductor cable.

Please note:

- It is *not possible to simultaneously use* two USS couplings (USS master, USS slave) on the serial X01 and X02 interface.
- You must *set switch S1/8 to the on position* so that you can use the *serial X01 interface* for the USS master coupling.

3.13.6.1 Basis network for the T400 technology module

You must set the switch according to the table below dependent on whether you are using the T400 technology module as *end node* or *not as end node* on the USS bus, i.e. *at the end* or *not at the end* of the bus cable.

Serial interface	Switch
X01	S1/1 and S1/2
X02	S1/3 and S1/4

3.13.6.2 Initialization

You must configure the *@USS_M function block* so that you can initialize the USS master coupling.

3.13.6.3 Broadcast

You may configure *precisely 2 broadcast senders*. If you configure more than 2 broadcast senders, then these will not go into operation.

If the maximum of 2 possible broadcast tasks are present, then these are sent precisely after one bus circulating time.

3.13.7 Literature

/1/ Specification "Universal serial interface protocol (USS protocol)
Order No.: E20125-D0001-S302-A1 Version: 09.94
Bohrer/Möller-Nehring ASI 1 D SP3

/2/ EMC Guidelines
refer to the User Documentation SIMADYN D, hardware

3.14 USS slave coupling

The USS slave coupling allows you to

- transfer process data
- handle and visualize parameters

To exchange process data, you have a maximum of

- one transmit channel (actual values) and
- one receive channel (setpoint).

You can transfer up to 32 process data sets, each 16 bits via each of these channels.

For the coupling, you require a *T400 technology board (terminals 70..71, serial interface X01* ***or*** *terminals 74..75, serial interface X02)*.

Data transfer is realized using a half-duplex technique via a two-conductor cable in accordance with the RS485 Standard.

Please note the following:

- It is *not possible to simultaneously use* two USS couplings (USS master, USS slave) at serial interfaces X01 and X02.
- You must *switch-in switch S1/8* (close) so that you can use *serial interface X01* for the USS slave coupling.

3.14.1 Basis network for the T400 technology module

Depending on whether you use the T400 technology board as *end node* or *not as end node* on the USS bus *,* i.e. *at the end* or *not at the end* of the bus cable, then you must *open* or *close* the switches according to the table below.

Serial interface	Switches
X01	S1/1 and S1/2
X02	S1/3 and S1/4

3.14.2 Initialization

You must configure the *function block @USS_S* so that you can initialize the USS slave bus coupling .

3.14.3 Exchanging process data

3.14.3.1 Transmitting

You must configure the *CTV function block* so that you can transmit process data. Bus

Select the "Refresh" mode as the data transfer mode, i.e. always the most up to date data are available to you at the receive side.

At connection AT, configure a unique channel name for this data interface.

Please observe:

- If you have configured, using virtual connections, *more data* than specified at connection PZD of function block @USS_S, then this excess data is *cut-off.*
- If you have configured, using virtual connections, *less data* , than are specified at the PZD connection of function block @USS_S, then the telegram is *filled-up* with *"0s".*
- The transmit telegram is started *asynchronously to the sampling time* of the CTV function block after a telegram has been received.

Please refer to the "Manual, configuring the communications D7-SYS, Chapter communications utility, process data" for additional configuring rules when transferring process data.

3.14.3.2 Receiving

In order that you can receive process data, you must configure the *CRV function block*. Bus

Select the "Refresh" mode as the data transfer mode, i.e. always the most up to date are available to you at the receive side.

At connection AR, configure a unique channel name for this data interface.

Please note:

- If you have configured, using virtual connections, *more data* than specified at connection PZD of function block @USS_S, then this excess data is *cut-off.*
- If you have configured, using virtual connections, *less data* , than are specified at the PZD connection of function block @USS_S, then the telegram is *filled-up* with *"0s".*
- The transmit telegram is received *asynchronously to the sampling time* of the CRV function block, i.e. the sampling time of function block CRV is the max. deadtime between receiving and processing data.

Please refer to the "Manual, configuring the communications D7-SYS, Chapter communications utility, process data" for additional configuring rules when transferring process data.

3.14.4 Handling and visualizing parameters

You must configure the *@DRIVE function block* so that you can handle & visualize parameters.

Please refer to the "Manual, configuring communications D7-SYS, Chapter "Parameterizing SIMADYN D" for additional configuring rules for handling & visualizing parameters.

3.14.5 Special features for 4-conductor operation of the USS-slave coupling

Thee USS slave coupling via *serial interface X02* allows you to communicate with a standard COM interface (V24/RS232) of a PC using *4-conductor operation*.

In order that you can use this capability, you must

- set *connection WI4 to "1"* at function block @USS_S
- connect the COM interface of your PC using an interface converter (V24 <--> RS485) at *terminals 72..75* (serial interface X02)
- close or open switches S1/5 and S1/6 (refer to Chapter 14.1)

3.14.6 USS-slave coupling via V24/RS232

The USS-slave coupling allows you to communicate with a standard COM interface (V24/RS232) of a PC via *serial interface X01*.

In order that you use this capability, you must

- set *connection WI4 to "1"* at function block @USS_S
- connect the COM interface of your PC to *terminals 70..71* (serial interface X01)

3.15 Peer-to-peer coupling

The peer-to-peer coupling is a serial coupling from drive converter to drive converter. It allows you, for example

- to implement a fast digital setpoint cascade
- to power-up a multi-motor drive group together

To transfer process data, you can use, a maximum of

- one transmit channel (setpoints)
- one receive channel (actual values)

You can transfer up to five 16-bit pieces of process data via each of these channels.

You can configure the net data length on the transmit- and receive side differently.

To be able to use the coupling, you require a *T400 technology module (terminals 72..75, serial interface X02)*.

Data transfer is realized using a full-duplex technique with a four-wire cable according to the RS485 standard.

3.15.1 Initialization

You must configure the *@PEER function block* so that can initialize the peer-to-peer coupling.

3.15.2 Transferring process data

3.15.2.1 Transmitting

You must configure the *CTV function block* so that you can transmit process data.

Select the "Handshake" mode as the data transfer mode, i.e. the telegram in the previous sampling time must have been completely sent before a new telegram can be sent.

For this reason, adapt the *sampling time* of the CTV function block

- to the *baud rate*, and
- the *number of process data*

according to the telegram run time table, provided below.

At connection AT, configure unique channel names for this data interface.

Please observe:

- If you have configured, using virtual connections, *more data* than specified at connection LTT of function block @PEER, then this excess data is *cut-off.*
- If you have configured, using virtual connections, *less data* , than are specified at the LTT connection of function block @PEER, then the telegram is *filled-up* with *"0s".*
- The transmit telegram is started *synchronously to the sampling time* of the CTV function block, i.e. there is no dead time.

Please refer to the "Manual, configuring the communications D7-SYS, Chapter communications utility, process data" for additional configuring rules for exchanging process data.

Number of process data, each 16 bit	Baud rate [kbaud]				
	9.6	**19,2**	**38,4**	**93,75**	**187,5**
1	5.7	2.9	1.43	0.6	0.3
2	8.0	4.0	2.0	0.8	0.4
5	16	8.0	4.0	1.6	0.8

Table 3-58 Telegram run times [ms] as a function of the baud rate and the number of process data

3.15.2.2 Receiving

You must configure the *CRV function block* so that you can receive process data.

Select the "refresh" data transfer mode, i.e. you always have access to the most up to date data.

Configure a unique channel name for this interface at connection AR.

Please observe:

- If you have configured, using virtual connections, *more data* than specified at connection LTR of function block @PEER, then this excess data is *cut-off.*
- If you have configured, using virtual connections, *less data* , than are specified at the LTR connection of function block @PEER, then the telegram is *filled-up* with *"0s".*
- The transmit telegram is started a*synchronously to the sampling time* of the CRV function block after a telegram has been received, i.e. the sampling time of function block CRV is the max. deadtime between receiving and processing data.

Please refer to the "Manual, configuring the communications D7-SYS, Chapter communications utility, process data" for additional configuring rules when transferring process data.

3.16 SIMATIC P-bus coupling

P-bus memory

The **FM 458** has a RAM memory (128 Kbytes) which can be used to connect it to a P bus. Data can be exchanged with **one** SIMATIC S7-CPU via this P-bus memory.
The FM 458 is **passive on the P bus**, i.e. the FM 458 cannot directly access other modules of the SIMATIC station.
There are 3 ways to transfer data to the SIMATIC CPU:

- 4 bytes can be received from the SIMATIC-CPU using a **process interrupt**
- 128 bytes can be sent and received via SIMATIC **I/O accesses**
- extremely large data quantities can be sent and received using **data blocks/sets**

Accessing EXM 438, EXM 448

The **EXM 438**, **EXM 448** expansion modules can only be accessed from the FM 458 (via the FM-internal LE bus); they have no direct connection to the P bus.

Addresses

The start addresses of the I/O, under which a SIMATIC CPU can address the I/O range of the FM 458, are configured in HW Config. The addresses for inputs and outputs can differ.

HW Config menu: *"Edit/Properties/Addresses"*
Default: **512** (decimal; for inputs and outputs)

Diagnostic interrupts

The FM 458 also sends diagnostic interrupts to the SIMATIC-CPU, independent of what has been configured, in the following situations.

- Transition into the statuses
  - "initialization error "
  - "system error "
  - "user stop "
  - "RUN"
- If the memory module is inserted or withdrawn, or is not available

3.16.1 Overview of the 3 data transfer types, FM 458 ←→ SIMATIC-CPU

Designation	Number of data	Configuring	Speed	Computation time (on the FM 458)
1. **Process interrupt**	**4 bytes** to SIMATIC-CPU	*FM 458:* Block PAS7 *SIMATIC-CPU:* OB40, etc.	When PAS7 is called, an interrupt is initiated on the SIMATIC CPU, e.g. OB40 (if a higher priority interrupt isn't being processed at precisely that time).	Extremely low: only for PAS7
2. Data transfer with **I/O (peripheral) accesses**	**128 bytes** in the send and 128 bytes in the receive direction	*FM 458:* blocks S7RD, S7WR *SIMATIC-CPU:* transfer commands for the I/O (periphery)	When a block is called, data is immediately read-out of the memory or written into the memory.	Computation times of all configured S7RD/S7WR blocks: each approx. 5µs.
3. Transferring **data sets/blocks**	For extremely high quantities of data: max. approx. 125 data sets with each max. 240 bytes (refer below.)	*FM 458:* "virtual connections" with blocks @CPB, CRV/CTV *SIMATIC-CPU:* system functions SFC58/59 **Consistency:** All of the data associated with a telegram are consistent with one another, i.e. they are transferred in a "data package".	The data associated with a telegram are read or sent when the block is called.	Computation time is required for each data set via telegram processing (approx. 30µs each CRV/CTV) and to copy the net data into/out of the P-bus memory. If extremely large data quantities are involved and there is a P-bus utilization, then a somewhat higher degree of computation time can be assumed. The data are transferred into the memory in blocks up to max. 16 bytes. The P bus must be re-assigned between the blocks, which means that the required computation time may increase.

Table 3-59 Data transfer, SIMATIC-CPU ↔ FM 458

All of the 3 data transfer types can be used in parallel.

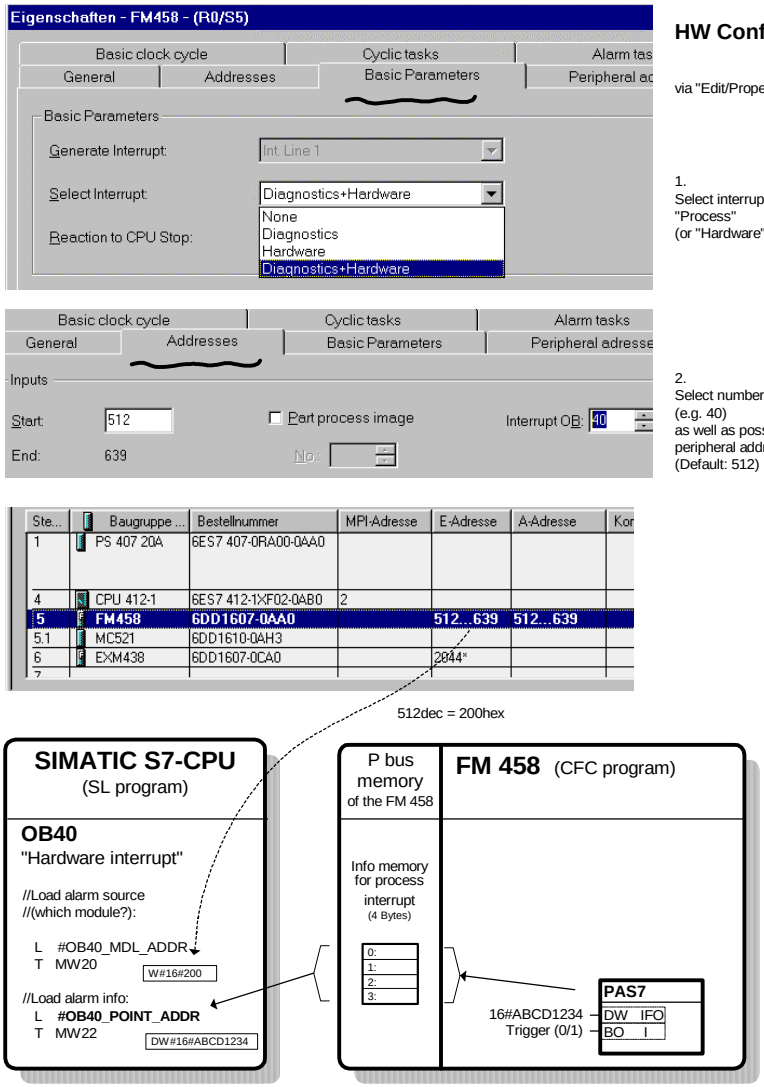
3.16.2 Initiating a process interrupt on SIMATIC-CPU

PAS7

Function block PAS7 initiates, when triggered, a process interrupt to the assigned S7-CPU. Supplementary interrupt info of 4 bytes is configured at the IFO input, which contains net data information.

When an interrupt is initiated, the interrupt OB, which should be configured in HW Config, is called in the SIMATIC S7-CPU. The supplementary interrupt info, taking up 4 bytes, is written into the local data of the interrupt OBs.

The start address of the input/outputs of the sending FM 458 (to be configured in HW Config; in the example 512dec = 200hex) is also saved in the local data of the OB 40.



HW Config

via "Edit/Properties" menu

1.
Select interrupt source:
"Process"
(or "Hardware")

2.
Select number of the OB
(e.g. 40)
as well as possibly the.
peripheral address(es)
(Default: 512)

Fig. 3-49 Data transfer to the S7-CPU with process interrupt

3.16.3 Data transfer via I/O accesses

Application

To transfer low data quantities: up to max. 128 bytes

Blocks and transfer commands

Appropriate function blocks are available for each data transfer direction and for each data type to be transferred.

SIMATIC-CPU			FM 458	
Data type	**Transfer command (SL program)**	**Write direction**	**CFC function block**	**Data type**
BYTE	T PAB abs.addr.	➔	**S7RD_B**	BOOL
INT	T PAW abs.addr.		**S7RD_I**	INT
DINT	T PAD abs.addr.		**S7RD_D**	DINT
REAL	T PAD abs.addr.		**S7RD**	REAL
BYTE	L PEB abs.addr.	➔	**S7WR_B**	BOOL
INT	L PEW abs.addr.		**S7WR_I**	INT
DINT	L PED abs.addr.		**S7WR_D**	DINT
REAL	L PED abs.addr.		**S7WR**	REAL

Table 3-60 Data types and the associated commands/blocks for peripheral accesses

CFC data type "BOOL"

The 8-bit CFC data type "BOOL" is represented in the SIMATIC S7-CPU as "**BYTE**" data type. This means that the SIMATIC S7 user must appropriately set or evaluate the decisive MSB (**M**ost **S**ignificant **B**it):

- S7-CPU: bit variable
- FM 458: 1XXX XXXX = TRUE
  0XXX XXXX = FALSE

Data save

In order to achieve high processing speeds with 32-bit accesses, the following must be ensured by appropriately configuring the FM 458/CFC (offset, refer below) as well as programming the SIMATIC-CPU, so that

- 16-bit values (INT/WORD data types)
  are saved at even addresses (word limits) and
- 32-bit values (REAL, DINT data types)
  at addresses which are divisible by 4 (double word limits)

are saved in the two P-bus memories which are 128 bytes large.

Entering the offset for FM 458

The FM 458 side is accessed using the S7RD/S7WR blocks, at which the offset of the data to be transferred is configured, i.e. the position within the 128 bytes.

When assigning the offset, the number of all of the values located before the block involved (blocks) and their data type (assigned memory range in bytes) are taken into account. It is especially important that possible overlaps are avoided. Gaps between individual values are not permitted (e.g. for reserve ranges).

However, the offset is not specified in the number of bytes, but as a multiple of the data type of the associated function block!

In this case, the offset, starting from an entry in bytes must be divided by 2 (for INT types) or by 4 (for REAL/DINT types) and this result must be configured at the offset input.

Using this technique, it is automatically guaranteed, that the data to be transferred is available at optimum addresses, i.e. addresses which can be quickly accessed. However, if the data is unfavorably structured, this can result in memory cells which cannot be used (refer to the example diagram below). In order to avoid this, for example, BYTE- and INT types should be individually distributed over the memory area, but should be arranged one after the other (consecutively).

Absolute address for SIMATIC-CPU

Absolute addresses are used in the SIMATIC S7 program which are obtained from the FM 458 address and the offset of the associated S7RD/S7WR block in bytes (!):

Absolute address = (offset x F) + FM 458 I/O address

FM 458 I/O address: The start address, configured in HW Config for the I/O range of the associated FM 458

Offset = Value at the associated S7RD/S7WR function block
F = Data type length in number of bytes:

F = 1 for S7WR_B, S7RD_B
F = 2 for S7WR_I, S7RD_I
F = 4 for S7WR, S7RD, S7WR_D, S7RD_D

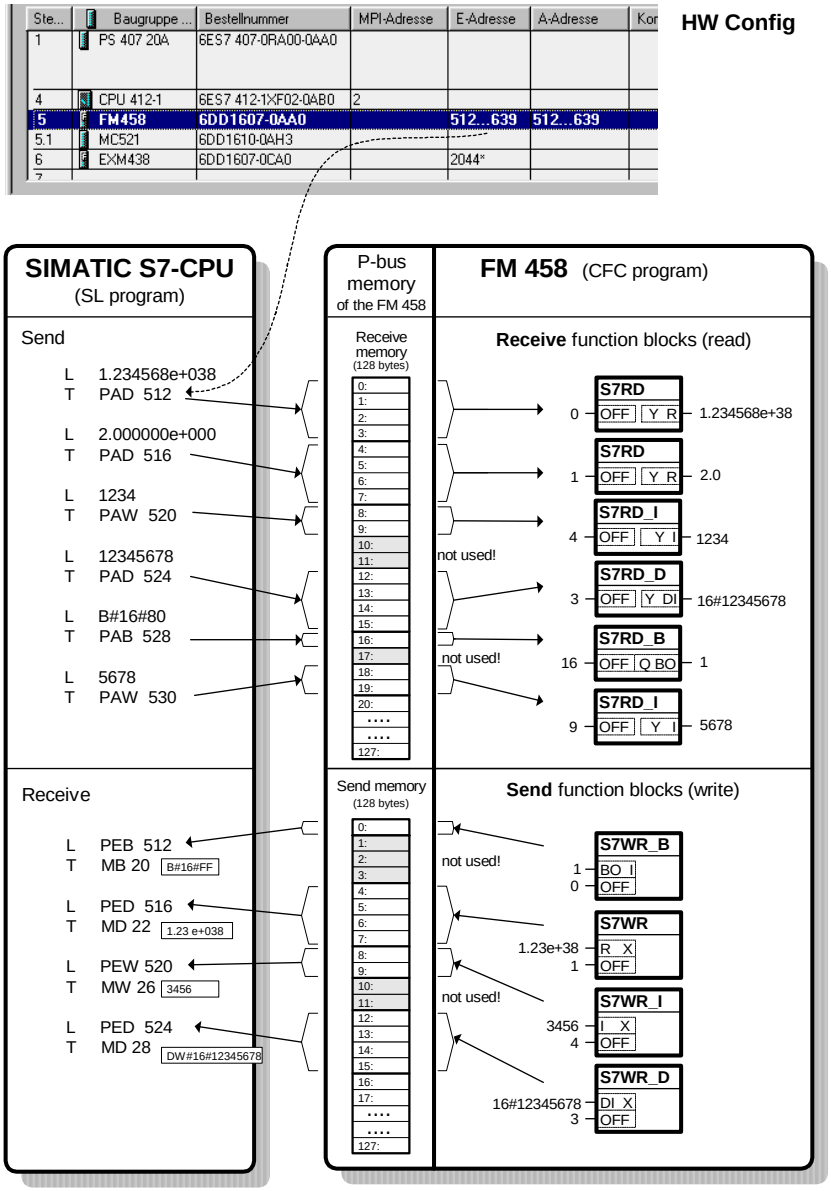


Fig. 3-50 Data transfer with peripheral accesses (I/O accesses)

3.16.4 Transferring data sets

Application

If extremely large quantities of data are to be transferred, e.g. for visualization applications (WinCC), or if data have to be transferred between SIMATIC and FM 458 for an extremely high number of drives.

Features, limit values

- Memory available on the P bus: 114688 bytes (0x1C000 hex), for various "data sets" (or "telegrams").
- max. 125 read and 125 write data sets
- max. length per data set (telegram): 240 bytes

- max. data quantity which can be transferred:
  For internal data management and buffer mechanisms, the following are required
  - for received data sets, 2x data set length
  - for sent data sets 3x data set length

  The sum of the required bytes for all of the write and read data sets may not exceed the above mentioned memory size of 114688 bytes!

Example:
Max. number of write and read data sets, each 240 bytes:

114688 bytes / (5 * 240 bytes) = 95.5733

A maximum of 95 write- and 95 read data sets, each with 240 bytes can be configured.

SIMATIC S7 access with SFC

"**S**ystem **F**unction **C**alls" SFC are used in the SIMATIC-CPU for data set transfer:

- write **SFC 58** data set (to the FM 458)
- read **SFC 59** to the data set (from FM 458)

FM 458 with "virtual connections"

This coupling type is configured on the FM 458 in 3 steps:

1. Establish the coupling:
   Configure a central communications block @**CPB** (from the "SpezKomm" block family) to initialize and monitor the data set coupling.
2. Define the send and receive data sets:
   A function block must be configured for each data set (telegram):

   CRV to receive,
   CTV to send

   Data/entries at the CRV/CTV connections:
   - ***CTS = FM458.*P_B**
     Connection is connected to the P bus coupling:

   CFC entry:
   Mark the CTS/righthand mouse key/connection to the operand. The configured module name (default "FM458") appears in the selection list for the module to be connected.

   - ***AR / AT = 'channelname.datasetnumber"***
     Any name (max. 6 characters) and separated by a point, the data set number, which corresponds to the RECNUM info/data in the SCF58/59 calls.
     Value range: 2 to 127
     for the send and receive data set
     If several data sets are used, the channel names must be unique, i.e. they must be different.

- ***CRR / CRT = 'Text'***
  Enter the name for the virtual connections are which are combined to form a data set (telegram).
  CFC entry:
  Mark the connection / righthand mouse key / connection to operand **"!"**
  and comprises max. 6 characters.

- ***MOD = R***
  P-bus communications always operates in the refresh mode.

3. Assigning process quantities to the data set:
   Marked block outputs are sent and the inputs are supplied from a receive data set if they are connected to the data set/telegram via the dialog box "Insert Connection to Address". All virtual connections with this name are combined to form a data set.

A **sequence number** still has to be specified for each value (connection). This only specifies the sequence of the associated value in the data set, but not the absolute position!
For the CFC code compilation, the data, associated with a data set, are arranged in the memory in an increasing sequence. The sequence numbers can be assigned with gaps, e.g. so that data can be easily and subsequently inserted..
Contrary to "data transfer with peripheral accesses", for virtual communications, data is always packed consecutively **without any gaps**. The configuring engineer must ensure, by sensibly assigning the sequence number, that the data are saved to word or double word limits in order to achieve a high processing speed.
The sequence number does not provide information on the address and does not specify the offset!

If an **offset of a value** in the data set (e.g. in bytes) is required for S7 program, it can be calculated from the sum of all of the previously located values, taking into account their data type (length=2 for INT, length=4 for REAL/DINT).

Different data types

SIMATIC S7 data type	FM 458 (CFC) data type	Comments
BYTE	BOOL	The MSB in the byte to be sent is decisive MSB = 1, BOOL is TRUE MSB = 0, BOOL is FALSE
REAL	SDTIME	

Table 3-61 Assignment of SIMATIC S7 and SIMADYN D data types

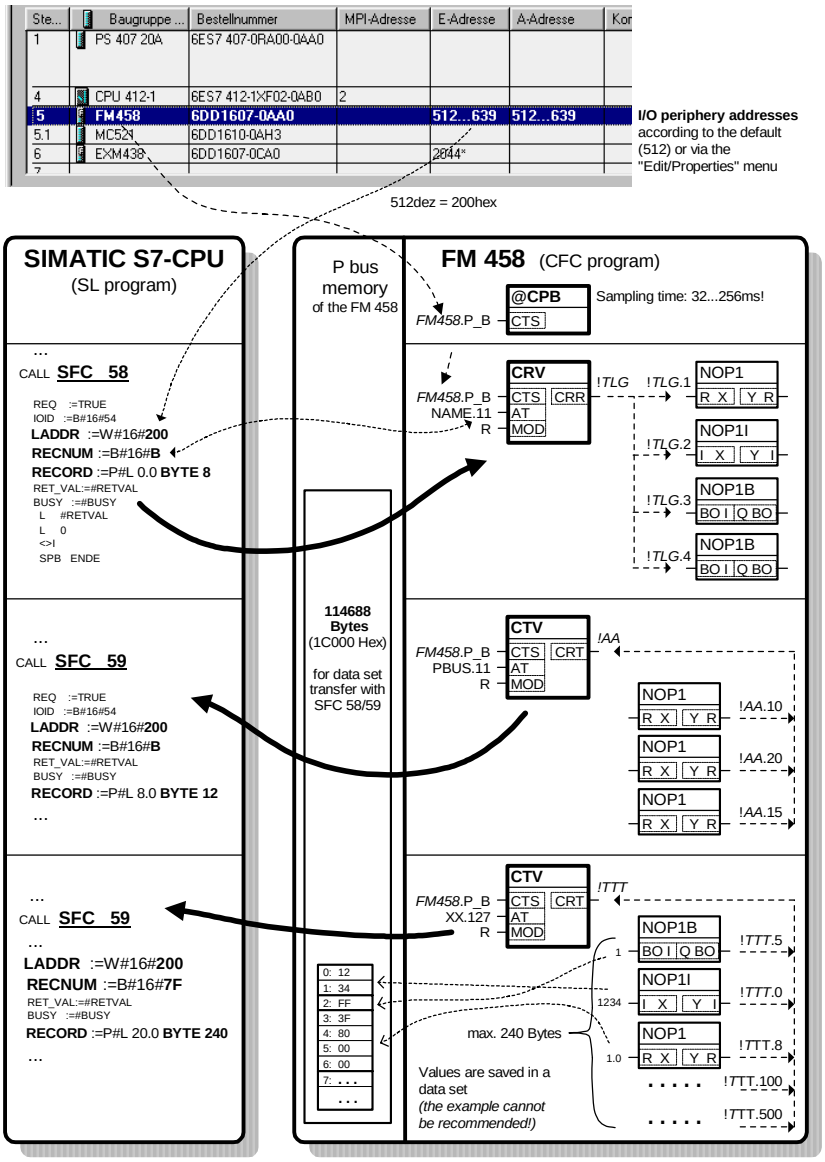


Fig. 3-51 Transferring 3 data sets

3.17 SIMOLINK drive coupling

3.17.1 Basic information

Introduction

SIMOLINK (**Si**emens **Mo**tion **Link**, SL) is a digital, serial data transfer protocol using fiber-optic cables as data transfer medium.

The SIMOLINK drive coupling has been developed for extremely fast and/or rigid cycle transfer of process data (setpoints, actual values, control and status information)

- between drives (dispatcher, transceiver)
  - SIMOVERT MASTERDRIVES MC/VC, or
  - SIMOREG DC-MASTER or
- between drives and a higher-level automation system (SL master)
  - SIMATIC S7-400 station with FM 458 and EXM448-1 or
  - SIMADYN D subrack with PM5/6 and ITSL
- between automation systems (SL master, slave/s)

Where all of the connected nodes are synchronized (SYNC telegram) to a common system clock.

Application

By transferring a time-equidistant and jitter-free SYNC telegram, SIMOLINK allows high-dynamic response and all of the connected individual drives move in absolute position synchronism (e.g. virtual shaft).

Features

- Max. 201 active nodes (SL master, dispatcher and transceiver, passive nodes include switches and cable concentrators)
- Bus cycle:
  Time between two SYNC telegrams, i.e. the circulating time in the ringbus
- SYNC telegram:
  All of the connected nodes are synchronized after the telegrams were sent
- Telegram:
  32-bit word (double word), occupies one channel for each piece of process data.
- Nodes read **and** write their data once every bus cycle.

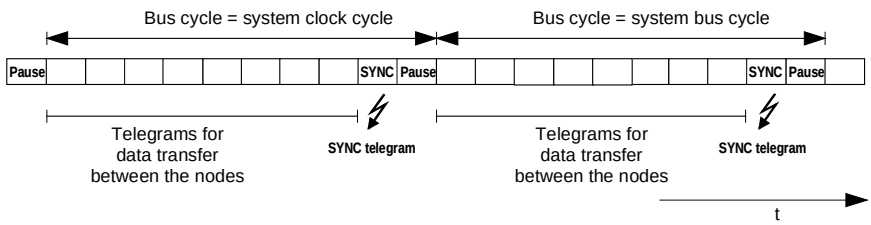


Fig. 3-52 SIMOLINK telegram data transfer

- Telegram runtime: $6.\overline{36}\ \mu s$
- All of the telegrams are sent immediately one after the other.
- For instance, for a selected bus cycle time of 0.8 ms, the SL master can transfer

  – one double word each to a max. of 124 slaves/transceiver, or
  – 4 double words each to a max. of 31 slaves/transceiver

  The remaining times are intervals where a telegram is not sent (NOP).
- Master-slave process data transfer:

  – up to 200 slaves/transceiver can be addressed with address gaps
  – up to 8 double words individually for each slave/transceiver
  – own process data for each slave/transceiver
- Dispatcher transceiver process data transfer:

  – up to 200 consecutively addressed transceivers
  – up to 8 double words
  – the same number of used channels for dispatcher and transceiver (nodes with a max. number of double words defines the number of channels for all)
- Data transfer rate: 11 Mbit/s
- Bus topology: Fiber-optic cable ring, each node as signal amplifier
- Max. distance between two nodes:

  – 40 m for plastic fiber-optic cables, or
  – 300 m for glass fiber-optic cables.

3.17.2 Application with master-slave process data transfer

The automation system with SIMOLINK interface is generally configured as the SL master. Whereby, all of the other coupling nodes are set as slaves/transceiver (refer to MASTERDRIVES option module SLB SIMOLINK).

The number of channels used for each slave/transceiver is defined by the SIMOLINK function blocks (connections CTV, CSV).

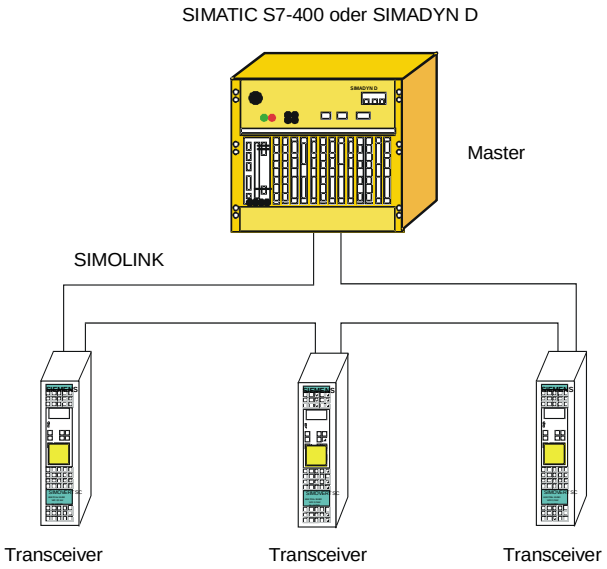


Fig. 3-53 Application example for master-slave process data transfer

Master

- The SL master can read and write into all of the channels of all of the slaves/transceiver.
  Configuring data:
  Function block @SL: MOD connection = 1...5
  For each slave: e.g. one SLSVAV

Slave

- Each slave can read all of the channels and write into a max. of 8 (**own!**) channels.
  Configuring data:
  Function block @SL: MOD connection= 0
  For each read channel: e.g. one SLAV
  For each write channel: e.g. one SLSV,
  Connection, FSL: Slave's **own** address
  Connection, NSL: 1

Slave-to-slave data transfer

- In order to transfer data from slaves/transceivers to slaves/transceivers which are physically located in front in the ring, in the same bus cycle, the slave-to-slave communications setting must be used.
  Configuring data:
  Function blocks SLAV and SLDIS: Connection QV = 1

3.17.3 Applications and modes which should be set

Various SL master, dispatcher and slave modes can be set by appropriately configuring SIMOLINK.

For **position-synchronous** actual value sensing and setpoint input (e.g. “virtual shaft” for printing or packaging machines), the **jitter-free** (equidistant in time) modes should be set

- External mode (Mode 4),
- Interrupt automatic mode (Mode 3) and
- External cyclic mode (Mode 5)
- Cyclic automatic mode (mode 10) and

(refer to the SIMOLINK function block description @SL).

Synchronized data send, 1 cycle deadtime

For the mode 3, 5 and 10, the telegram data of the previous bus cycle are processed in parallel to the bus cycle and equidistant SIMOLINK telegrams are sent and received. This allows the shortest SIMOLINK cycles to be configured. Ideally, this technique is suitable for applications with “**virtual shaft with values which uniformly change**”, which are required, for example, for printing machines.

The operating modes **automatic mode** (Mode 3) with processing in an interrupt task Ix should be used for jitter-free synchronization of the drives

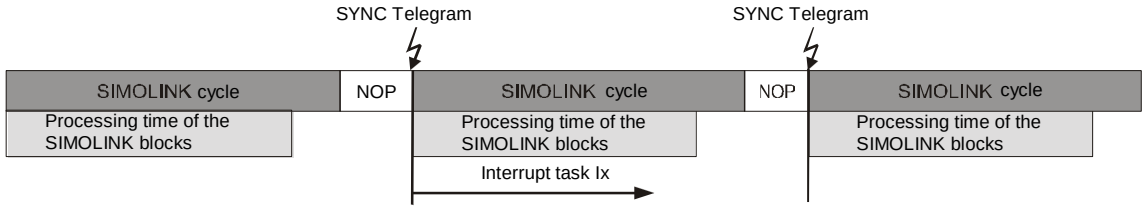


Fig. 3-54 Automatic mode (Mode 3)

and **external-cyclic mode** (Mode 5) with synchronization to the basic sampling time T0.

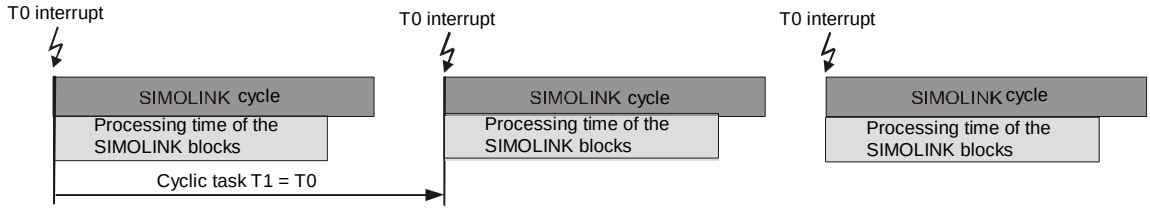


Fig. 3-55 External-cyclic mode (Mode 5)

The sampling time should be selected somewhat higher than the bus cycle time.

The external-cyclic mode offers the advantage that the processor hardware of two SIMOLINK rings can be synchronized to the (common) base sampling time T0.

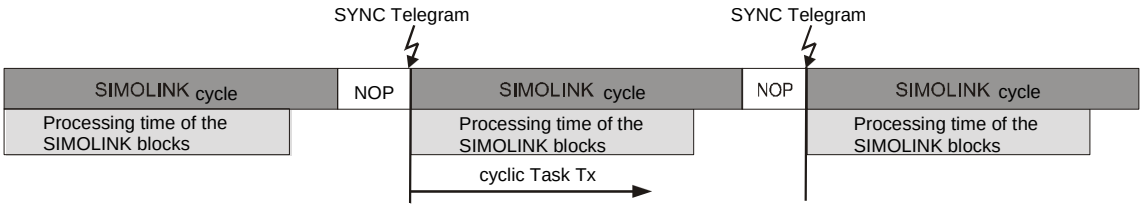


Bild 3-56 Cyclic automatik-mode (Mode 10)

The cyclic-automatic-mode 10 offers the advantage to place the function block configuration in cyklic tasks, in opposed to mode 3.

Fastest sensing, synchronous

The jitter-free SL-master mode, external-mode is best suited for synchronous actual value sensing with the fastest processing (minimum deadtime). This means, that it can be used as "**virtual shaft with dynamically changing values**", for example, for packaging machines.

In the **external mode** (Mode 4) the SIMOLINK cycle is synchronized to the base sampling time T0. The SIMOLINK blocks are immediately executed in the configured interrupt task Ix when the SYNC telegram is subsequently received.

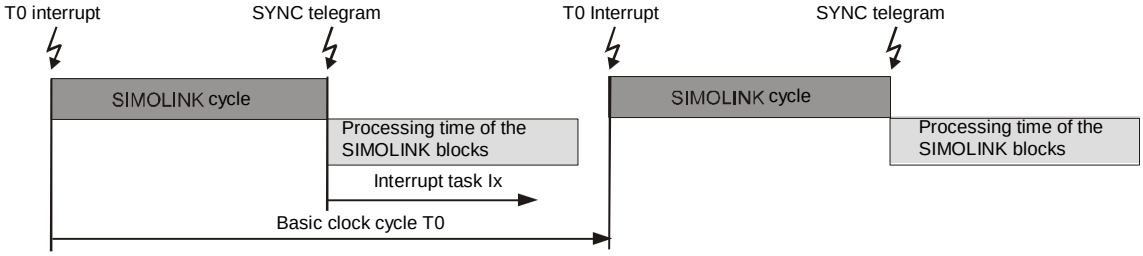


Fig. 3-57 External-mode (Mode 4)

The base sampling time T0 setting must correspond as a minimum to the bus cycle time plus the interrupt task processing time.

Fastest data send, non-synchronous

If data are to be transferred to other nodes after the calculation with minimum deadtime, then either the non-synchronous mode or the timer mode is used.

For the **non-synchronous mode** (Mode 1), data is directly output after the SIMOLINK blocks have been processed in a cyclic task Tx.

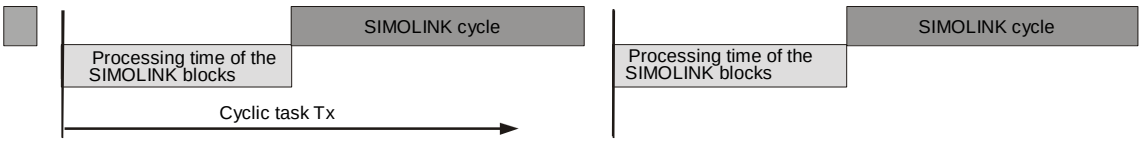


Fig. 3-58 Non-synchronous-mode (Mode 1)

In the **timer mode** (Mode 2), data is directly output after calculation in an interrupt task Ix which assigns the processing of the SIMOLINK blocks a higher priority.

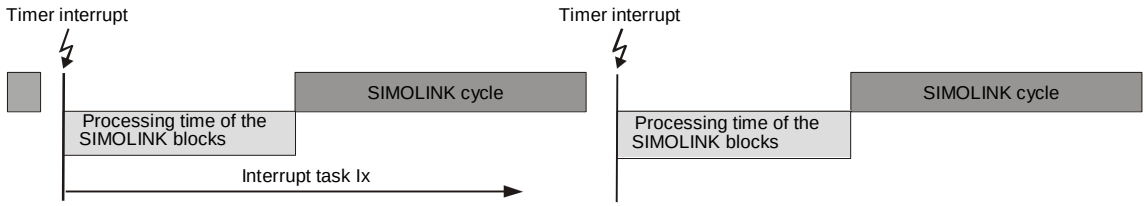


Fig. 3-59 Timer-mode (Mode 2)

In these non-synchronous SL-master modes, which exhibit jitter, the coupled drives cannot be operated with position synchronism if the SYNC telegram is sent in the time intervals which depend on the actual configuring. This allows the fastest possible data transfer between SL master (Mode 1 or 2) and the slave (Mode 0).

Reading telegrams, synchronous

The **slave mode** (Mode 0) is used to read and evaluate the bus data transfer in a drive ring, for e.g. monitoring and diagnostic purposes.

With each received SYNC telegram, the SIMOLINK module initiates that the configured interrupt task Ix is processed. If it is used as the receive section for fast data transfer between SL master and slave, all of the telegrams can be read and processed. Furthermore, it is possible to write a max. 8 telegrams, in order to, for example, transfer signals to the SL master.

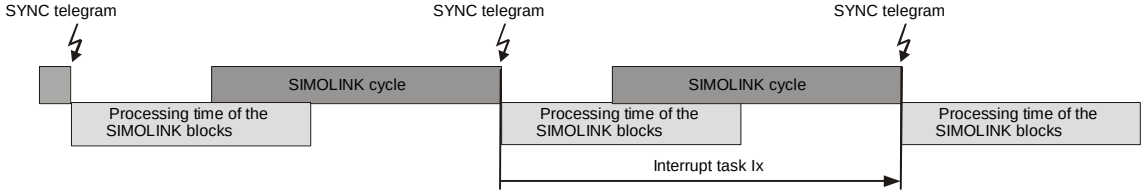


Fig. 3-60 Slave mode (Mode 0)

Coupling two automation systems

In order to send data between two automation systems via SIMOLINK, which exceeds the amount of data using 8 telegrams, two independent SIMOLINK rings are required. This means that every node can be configured once as SL master to send in one ring and as slave to receive in the other ring. This technique is used, for example, to achieve

- synchronized processing and
- extremely fast data transfer

between two SIMATIC FM 458 modules each with two EXM 448-1 expansion modules.

Cyclic or interrupt task ?

When selecting the operating mode, it should be noted, that interrupt task processing can interrupt cyclic tasks at any time. This can influence the timing. For the non-synchronous mode, the SIMOLINK cycle is delayed and for the external cyclic mode, T0 must be adapted to prevent computation time overflow or multiple sending of the same values which have not been re-calculated.

Synchronization to the base sampling time T0 can be set in 100 µs intervals while interrupt tasks are initiated by the SYNC telegram, dependent on the telegram duration.

3.17.4 Configuring - first steps

Using as an example a master-slave coupling, the necessary settings are subsequently described which must be or should be observed when configuring.

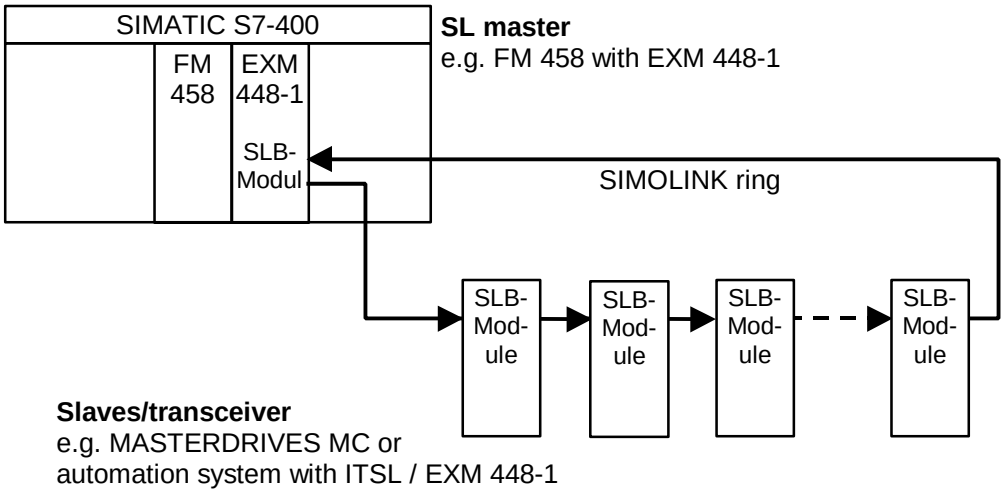


Fig. 3-61 Example for a master-slave coupling

Hardware

The SIMOLINK ring comprises the minimum of two and a maximum of 201 SLB modules, which are coupled to one another through fiber-optic cables. There is only one SL master on a ring. All of the other nodes are slaves.

An SLB module is a hardware component of an ITSL, an EXM 448-1 module or an option module SLB (**S**IMO**L**INK **B**oard, Order No. 6SX7010-0FJ00).

NOTE Additional information on these modules and their installation is provided in the User Manual D7-SYS “Hardware“, or SIMOVERT MASTERDRIVES Instruction Manual SLB SIMOLINK board.

3.17.4.1 Configuring the SIMOLINK coupling under STEP 7

For SIMATIC FM 458 with EXM 448-1, the basic clock cycle T0, possibly the interrupt task Ix and the symbolic hardware assignment for the SIMOLINK are set in the HW Config of STEP7 in the properties dialog box.

NOTE The EXM 448-1 expansion module should be configured as EXM 448 in HWConfig.

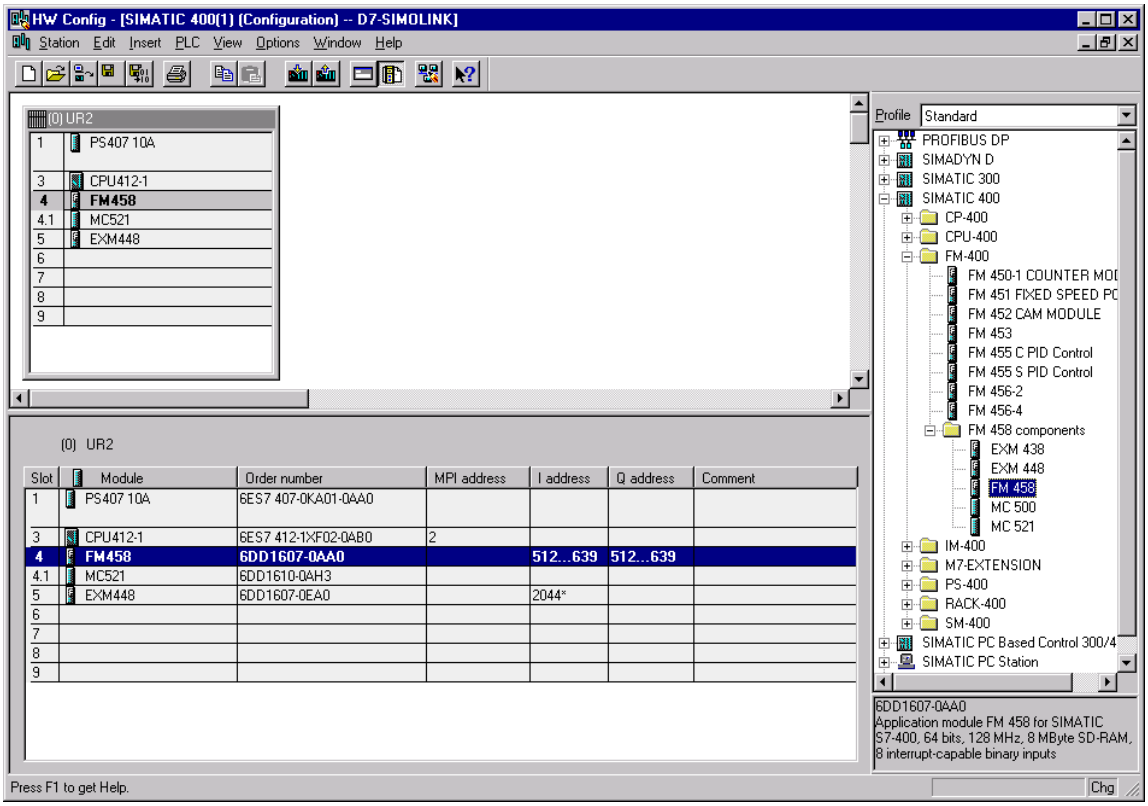


Fig. 3-62 Configuring for FM458 with EXM448-1

Basic clock cycle

The basic clock cycle time must be set in HWConfig in the properties window under the "Basic clock cycle" tab.

The basic sampling time must match the PWM frequency set in the MASTERDRIVE MC (the factory setting is: 5 kHz, parameter P340). The time sectors are derived from this frequency.

The usual values are 3.2 ms, 1.6 ms and 0.8 ms, to which the system can be synchronized. 1.6 or 3.2 ms are set depending on the control type.

The value, set as the base sampling time, must also be entered in parameter P746 of the MASTERDRIVES MC.

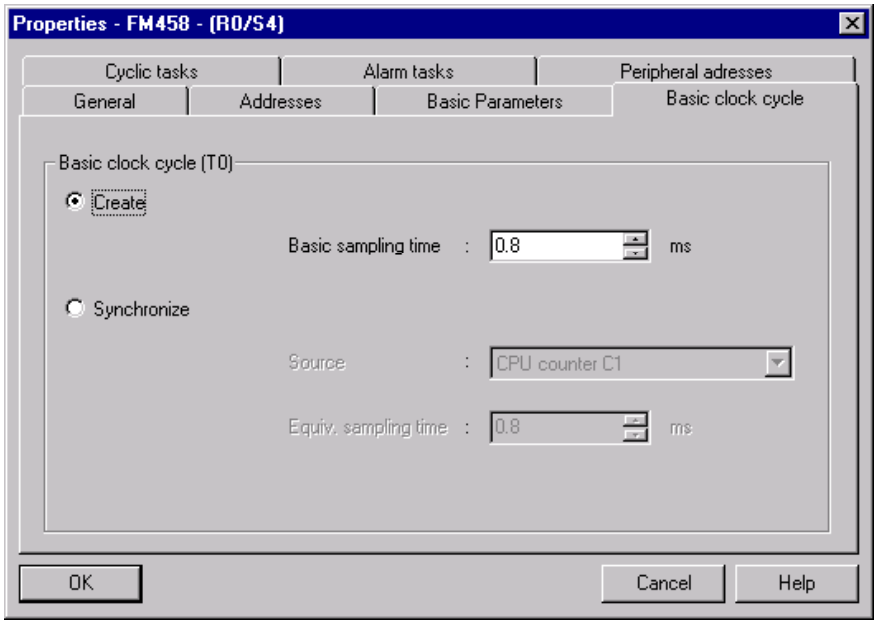


Fig. 3-63 Basic clock cycle in the HW Config

Interrupt task

For modes 0, 2, 3 and 4, sources must be assigned to initiate the configured interrupt tasks.

The settings are made in HW Config in the Properties window under the "Interrupt task" tab, dependent on the configured hardware components.

Mode	Interrupt source to be set for interrupt task Ix of the SIMOLINK blocks, if:			
	EXM 448-1/ITSL, 1st expansion	**EXM 448-1/ITSL, 2nd expansion**	**optional SLB module ITSL, 1st expansion**	**optional SLB module ITSL, 2nd expansion**
0	LE bus interrupt 1	LE bus interrupt 3	LE bus interrupt 2	LE bus interrupt 4
2	LE bus interrupt 5	LE bus interrupt 6	LE bus interrupt 7	LE bus interrupt 8
3	LE bus interrupt 1	LE bus interrupt 3	LE bus interrupt 2	LE bus interrupt 4
4	LE bus interrupt 1	LE bus interrupt 3	LE bus interrupt 2	LE bus interrupt 4

Table 3-62 Interrupt task source assignment for expansion modules with SIMOLINK

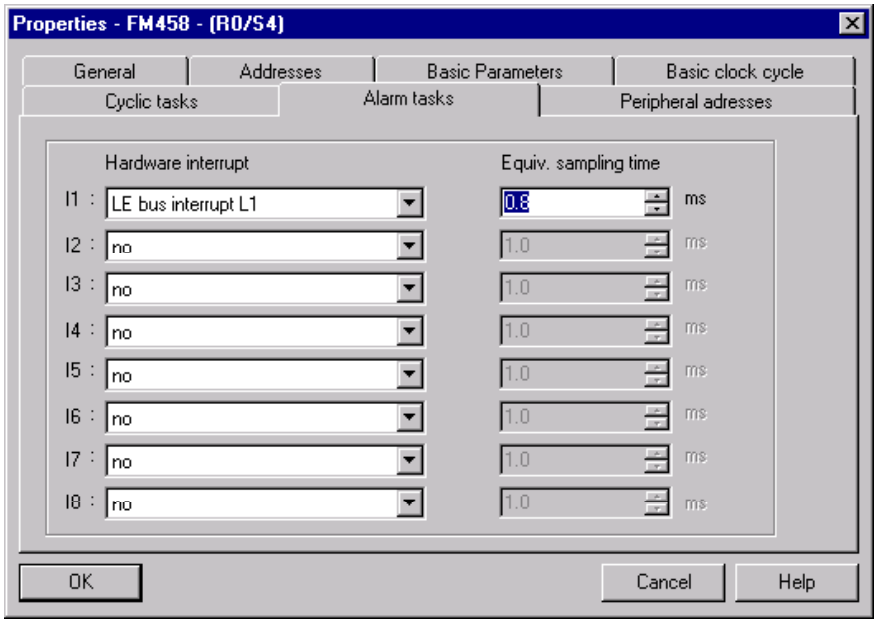


Fig. 3-64 Alarm task setting in the HW Config

Hardware addresses, SIMOLINK blocks

The SIMOLINK blocks @SL, SLAV, SLD, SLDIS, SLSV, SLSV2 and SLSVAV must be assigned to a HW address in the HW Config properties window of the EXM 448 under the "Plug-in module / I/O addresses tab.

The "process I/O" should be activated as plug-in module type. After this, symbolic names can be assigned for the I/O addresses (pre-set symbolic names are entered via the "Default" button.

The SIMOLINK blocks only use the symbolic name under “I/O address 2” (SIMOLINK does not require “I/O address 1”).

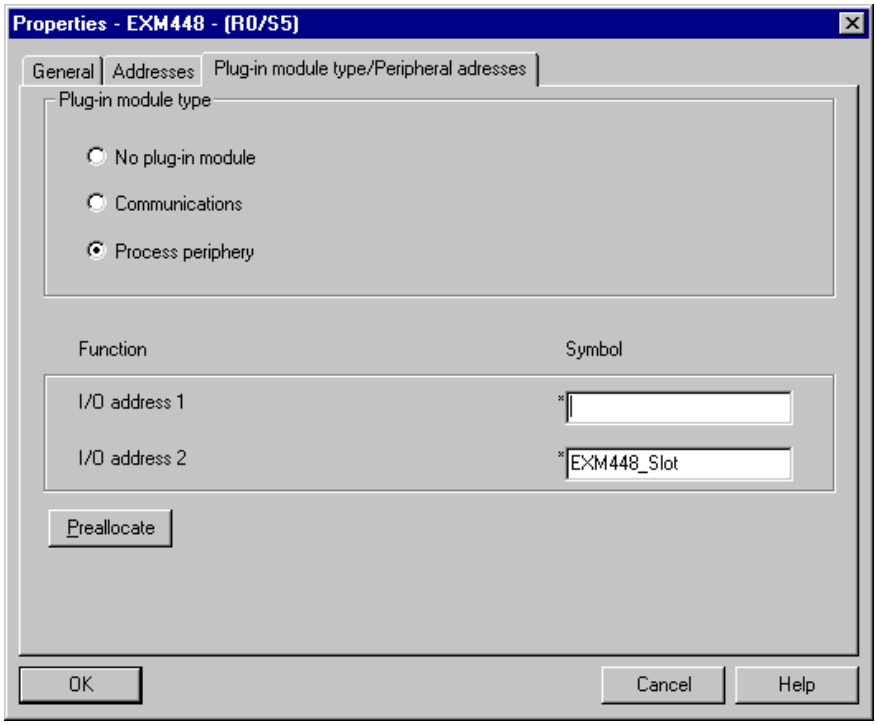


Fig. 3-65 Symbolic hardware assignment of an EXM 448-1

Different symbolic names are assigned for each SIMOLINK interface.

For example, when configuring an ITSL module, symbolic names are entered for the integrated (TAD) and the optional SIMOLINK interface (OAD) under the "Addresses" tab:

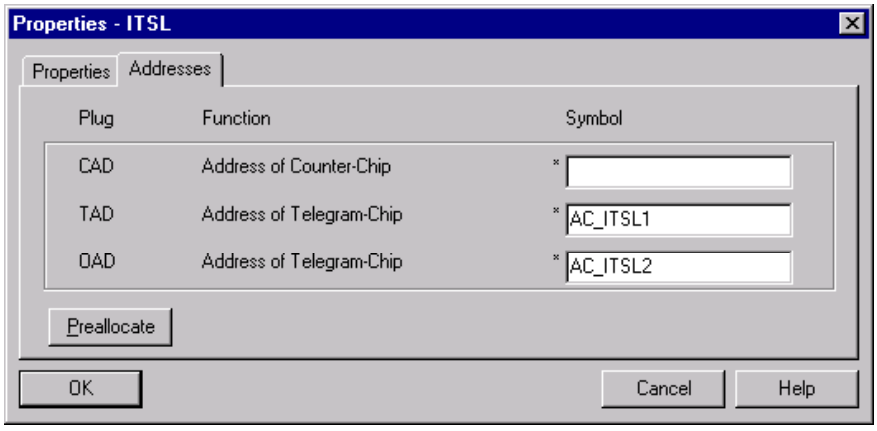


Fig. 3-66 Setting hardware addresses for an ITSL module with optional SLB module

3.17.4.2 SIMOLINK function blocks

The configuring engineer can use the following function blocks:

- @SL SIMOLINK central block
- SLAV SIMOLINK receive block, one for each actual value
- SLSV SIMOLINK send block, one for each setpoint
- SLSV2 SIMOLINK send block, for two setpoints
- SLSVAV SIMOLINK send and receive block for up to 8 setpoints and actual values of the slave
- SLD SIMOLINK delta evaluation
- SLDIS SIMOLINK dispatcher

The central block @SL permits the initialization and monitoring of communications in a SIMOLINK ring.

It may only be configured once for each SIMOLINK ring in a sampled cyclic task (T4 or T5) which is, as a minimum, 4x longer than the send and receive block.

If a transceiver no longer receives a telegram as a result of an interruption, then it automatically sends a special telegram, which evaluates the @SL function block. The address of the node is output at NDM, which first signals the fault.

NOTE

Additional information regarding the mode of operation and the connections (I/O) of the specified blocks are provided in the online help of the CFC Editor and in the "Function block library" reference Manual".

3.17.4.3 Parameterizing the MASTERDRIVES MC

The following parameters must be set in the SIMOVERT MASTERDRIVES MC (refer to the User Documentation „MASTERDRIVES MC“):

Parameter	Significance/setting
P740	Own node address, transceiver/slaves: 1...200 (dispatcher=0)
P741	Telegram failure time, if the telegram fails, fault F056 is output. The usual values: > 3 x bus cycle time (refer to P746)
P742	Send power, dependent on the length of the fiber-optic cable
P743	Number of nodes in the SIMOLINK ring
P745	Number of channels (this is only relevant for the dispatcher)
P746	Bus cycle time (only relevant for the dispatcher)
P749	Read address, which is generated from the node address and the channel number, whereby the node address does not have to match its own node address (P740) Example: 2.0 = node address 2, channel number 0
P751	Send data, Index 1 = channel 1 (low word), Index 2 = channel 1 (high word), Index 3 = channel 2 (low word), etc.
P755	SIMOLINK configuration 0x100 should be entered for modes 4 and 5 so that synchronization is realized (this is valid from firmware release 1.4 for MASTERDRIVES MC)

Table 3-63 Parameters for MASTERDRIVES MC

SIMOLINK

P.-Nr.	Name		Ind	Indextext	Parameterwert	Dim
P740	SLB Teiln.Adr.	+	001	1.SLB	1	
P741	SLB Tlg.Ausz.				10	ms
P742	SLB Sendeleist.				3	
P743	SLB AnzahlTeiln.	+	001	1.SLB	5	
P744	Q.SYNC Auswahl	+	001		B0 Festbinektor 0	
P745	SLB Kanalanzahl	+	001	1.SLB	4	
P746	SLB Zykluszeit	+	001	1.SLB	3.20	ms
P747	Q.SLB Appl.Flags	+	001		B0 Festbinektor 0	
r748	SLB Diagnose	+	001	Anz. SYNC-Tlg	0	
P749	SLB Leseadresse	-	001		1.0	
			002		1.1	
			003		1.2	
			004		1.3	
			005		1.4	
			006		1.5	
			007		1.6	
			008		1.7	
r750	SLB Empf.daten	+	001		0x0	
P751	Q.SLB Sendedaten	+	001		K32 Zustandswort 1	
r752	SLB Sendedaten	+	001		0x0	
P753	Q.SyncZeitzähler				K0 Festkon. 0%	
P754	Max.sync.Zeitsch				0 Buszykluszeit	
P755	SIMOLINK Konfig.				0x100	

Fig. 3-67 Parameters for MASTERDRIVES MC (DriveMonitor, and SIMOVIS)

Number of nodes

When configuring the system, it should be noted that the number of nodes is restricted by the following factors:

- Pulse frequency set in MASTERDRIVES MC
  The sampling time for the time sector to be synchronized is obtained from this pulse frequency (parameter number P340).

- Data quantity to be transferred
  The number of telegrams which are to be sent along the SIMOLINK ring between the SL master and the slaves.

The following formula applies:

$$N = \left(\frac{P746 + 3.18181\,\mu s}{6.36\,\mu s} - 2 \right) * \frac{1}{P745}$$

- with P746=bus cycle time (this depends on the pulse frequency and the time sector to be synchronized)
- with P745=number of channels
- with 6.36 μs=telegram run time

Node tables

When the MASTERDRIVES MC pulse frequency is set to 5 kHz, for example, the following values are determined:

No. of channels	No. of nodes		
	0.8 ms (T2)	1.6 ms (T3)	3.2 ms (T4)
1	124	201	201
2	62	124	201
3	41	83	167
4	31	62	125
5	24	49	100
6	20	41	83
7	17	35	71
8	15	31	62

Table 3-64 Node table for various bus cycle times (drive converter/inverter time sectors in brackets)

3.17.5 Coupling diagnostics

LEDs

The user can use the 3 LEDs on the front of the SLB module to analyze the operating status.

Operating display

LED	Status	Diagnostics information
green	flashing	Error-free net data transfer via SIMOLINK
red	flashing	SLB module in operation
yellow	flashing	Data transfer with the information processor FM458 or PMx is OK

Table 3-65 Operating display, SLB module

Fault display

LED	Status	Diagnostics information
green	dark/ bright	No net data transfer via SIMOLINK: Bus cable not connected or defective, poor fiber-optic cable transition, send power (launch power) too low
red	dark/ bright	SLB module power supply failed Replace the SLB module or power supply through FM458 and check PMx
yellow	dark/ bright	No data transfer with the automation processor FM458 or PMx, bus cable not connected or defective, poor fiber-optic cable transition, send power (launch power) too low, replace SLB module or automation processor FM458 and PMx

Table 3-66 Fault display, SLB module

Fault output

The fault statuses are output coded at the outputs YF of the appropriate SIMOLINK blocks.

NOTE Only the last fault event is displayed.

Value	Diagnostics information **F:** Fault cause **R:** System response **A:** Remedy
2	F: TAD input is incorrectly connected (e.g. HW address of CS8+SLB module) R: No telegram data transfer A: Use symbolic hardware assignment of the EXM 448-1 or ITSL module
3	F: Incorrect module or SLB module not inserted or defective hardware R: No telegram data transfer A: Use or replace SLB module
4	F: SLB module is already being used by another central block @SL, configured twice R: No telegram data transfer A: Only use one FB @SL for each SIMOLINK ring

Value	**Diagnostics information** **F:** Fault cause **R:** System response **A:** Remedy
5	F: Memory access problem (internal error message) R: No telegram data transfer A: Reduce the size of the application software or move to another process module
6	F: Send/receive block(s) signal: Central block @SL not configured R: No telegram data transfer A: Insert @SL in the software (min. 4 x sampling time of send/receive blocks)
9	F: This software does not support this hardware combination, e.g. CS8+SLB module R: No telegram data transfer A: Use an EXM 448-1 or ITSL module for the drive coupling
10	F: Modes 0, 2 and 4: Block was not configured in an interrupt task R: No telegram data transfer A: Configure the appropriate block in the interrupt task
11	F: Modes 1 and 3: Block was not configured in a cyclic task R: No telegram data transfer A: Configure the appropriate block in a cycle task
12	F: Mode 5: Block was not configured in a cyclic task with T1=T0 R: No telegram data transfer A: In HW Config: Select T1=T0, configure the appropriate block in cyclic task T1
13	F: Mode 4: Equivalent sampling time is not equal to T0 R: No telegram data transfer A: In HW Config: Select an equivalent sampling time = T0
14	F: Modes 0, 2 and 4: Interrupt source for the interrupt task is incorrect R: No telegram data transfer A: In HW Config: Set the interrupt task source as in the assignment table
15	F: Mode 1: Not all send/receive blocks in one sampling time R: No telegram data transfer A: Configure all of the send/receive blocks in the same sampling time
16	F: Incorrect mode setting R: No telegram data transfer A: Set a valid mode (mode 0...5) at FB @SL
17	F: Mode 0, FB @SL: incorrect node address (slave) at input ASL R: No telegram data transfer A: Select a valid setting at input ASL: 1...200
18	F: FB @SL signals: No send and receive blocks available R: No telegram data transfer A: Configure send and/or receive block(s)
19	F: No. of SIMOLINK telegrams too high or SIMOLINK cycle time exceeded R: Telegram data transfer up to max. possible number A: Configure max. 1021 net telegrams or increase SIMOLINK cycle time or configure fewer SIMOLINK blocks (refer to the formula)
20	F: Send/receive block signals: Incorrect slave address R: Restricted telegram data transfer functions A: Select valid slave address: 0...200
21	F: Send/receive block signals: Channel number incorrect R: Restricted telegram data transfer functions A: Select a valid channel number: 0...7

Value	Diagnostics information **F:** Fault cause **R:** System response **A:** Remedy
22	F: Mode 0: Slave attempts to write into an incorrect address R: Restricted telegram data transfer functions A: Select own slave address
23	F: Logical configuring error: Slave-to-slave communications was configured as duplex operation, however, only one direction is possible for each slave (send or receive) R: Send and receive the same data A: Either configure send or receive for slave-to-slave communications
30	F: Physical data transfer faulted on the SIMOLINK ring R: No telegram data transfer A: Increase send power (launch power) at one of the subsections, replace medium or connector
31	F: CRC error (check sum error), data transfer along the ring faulted R: Telegram failure A: Increase send power (launch power) at one of the subsections, replace medium or connector
32	F: Timeout error in the SIMOLINK ring, bus node signals a fault R: No telegram data transfer A: FB @SL, evaluates output NDM, beforehand, check node and medium
33	F: Mode 0: Signaled SIMOLINK cycle time (in the special telegram from SL master) does not correspond to the configured equivalent sampling time R: Restricted telegram data transfer functions A: In the HW Config: Adapt the equivalent sampling time of the slave to that of the SL master

Table 3-67 Error output, SIMOLINK-FBs

3.17.6 Options and accessories

The following are available to configure a SIMOLINK coupling and as spare part:

Order No.	Components
6SE7090-0XX84-0FJ0	SLB module, spare part (without documentation, without connector)
6SX7010-0FJ00	SLB module, retrofit package (documentation, 2 fiber-optic cable connectors, 5m plastic opto-cable, 1 connector for terminal X470)
6SY7000-0AD15	Attachment for SLB (2 LWL cables, 5m plastic opto-cable)
6SX7010-0FJ50	System package for SLB (40 fiber-optic cable connectors, 100m plastic opto-cable, 20 connectors for terminal X470)

Table 3-68 SIMOLINK option modules and accessories

3.18 Table function

3.18.1 Introduction

The table function in SIMATIC TDC / SIMADYN D provides the user with the possibility of linking-in and using tabular values (values in a table) in a configured software application. In this case, the function blocks TAB and TAB_D must be configured on the SIMATIC TDC and SIMADYN D sides. Tabular values, data type REAL are managed using the TAB and data type DINT, using TAB_D. The user provides the tabular values.

The table function can be configured in three modes:

- **Manual mode**, i.e. the tabular values are directly entered at the block via an online interface (e.g. CFC in the test mode), or transferred to the block using teach-in from the program.
- **Automatic mode: Communications**, i.e. the tabular values are transferred via a communications interface (TCP/IP, DUST1, S7 via P bus). In order to transfer tabular values from an S7 control to a SIMATIC FM 458 application module via the P bus, in addition, the WR_TAB should be configured on the S7 control side.
- **Automatic mode: Memory card**, i.e. the table values are downloaded into the memory card, from where they are read.

NOTE The "Automatic mode, memory card" mode is presently still not available.

It should be noted, that it is only possible to toggle the modes between "**Manual mode"** and **"Automatic mode: Communications"** as well as "**Manual mode"** and **"Automatic mode: Memory card"**.

A validity check is made if the tabular values have been entered or transferred. The address of the table is displayed at "TAB" output.

The tabular values are managed twice, i.e. in two tables. The table, defined as "valid" (=active) is used for all arithmetic/computation operations of the configured application software. The "invalid" (=inactive) table is used to manage value changes. All of the tabular values, changed by the user, are initially transferred into the invalid table. If the inactive table is activated, the new tabular values are mirrored in the second table. The table which had been active up until then automatically becomes invalid. This means that the new tabular values are available in both tables.

Both tables can be saved in the SAVE area which is backed-up (buffered) by a battery in order to prevent data loss (connection SAV=1 when initializing).

NOTE A precise description of function blocks TAB and TAB_D is provided in their respective online help.
A detailed description of the WR_TAB function blocks is provided, further below in the Section "Function block WR_TAB".

3.18.1.1 Overview, "Manual mode"

The principle procedure in the "Manual mode" is shown in the following diagram:

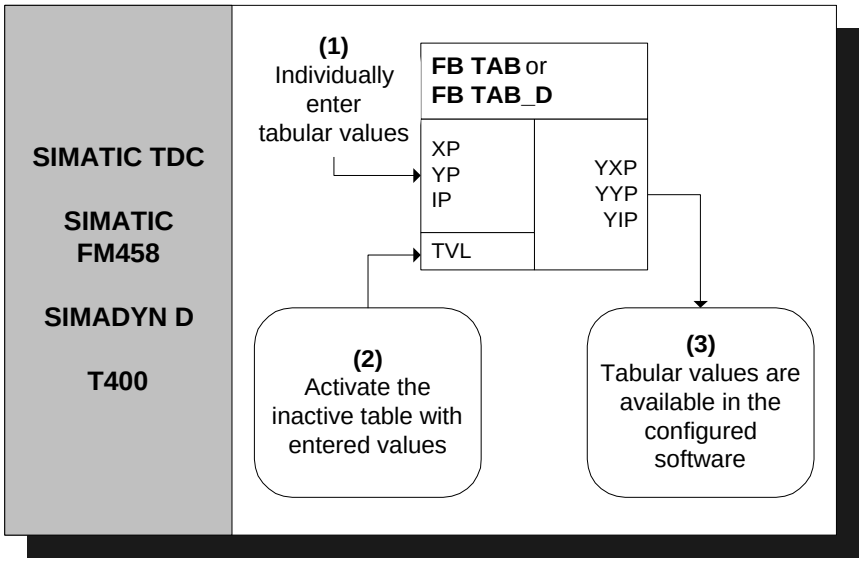


Fig. 3-68: Principle procedure in the "Manual mode"

A detailed description of the "Manual mode" is provided in Section "Manual mode" (Page 3-182)

3.18.1.2 Overview, "Automatic mode: Communications"

In the "Automatic mode: Communications", tabular values can be transferred using the following communication versions:

- S7 via the P bus for SIMATIC FM 458 (it is necessary to additionally configure the WR_TAB on the control side)
- TCP/IP (tabular values can be transferred from a SIMATIC TDC module to another one using the CTV and CRV FBs)
- DUST1 (tabular values can only be transferred via a DUST1 interface)

The tabular values are transferred using data telegrams.

The following diagram illustrates the principle procedure in the "Automatic mode: Communications" for transferring tables from an S7 control to a SIMATIC FM 458 application module via the P bus:

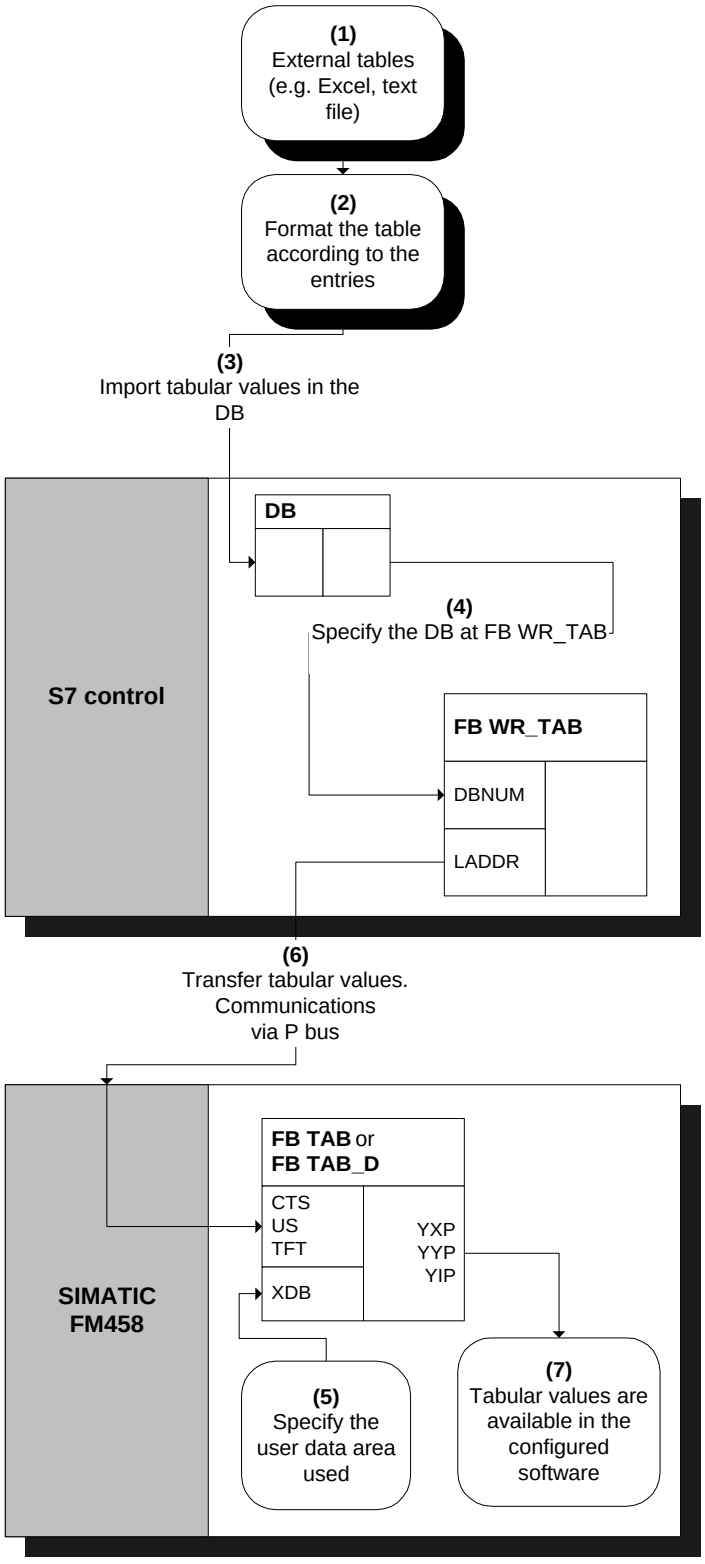


Fig. 3-69 Principle procedure for "Automatic mode: Communications"(via P bus)

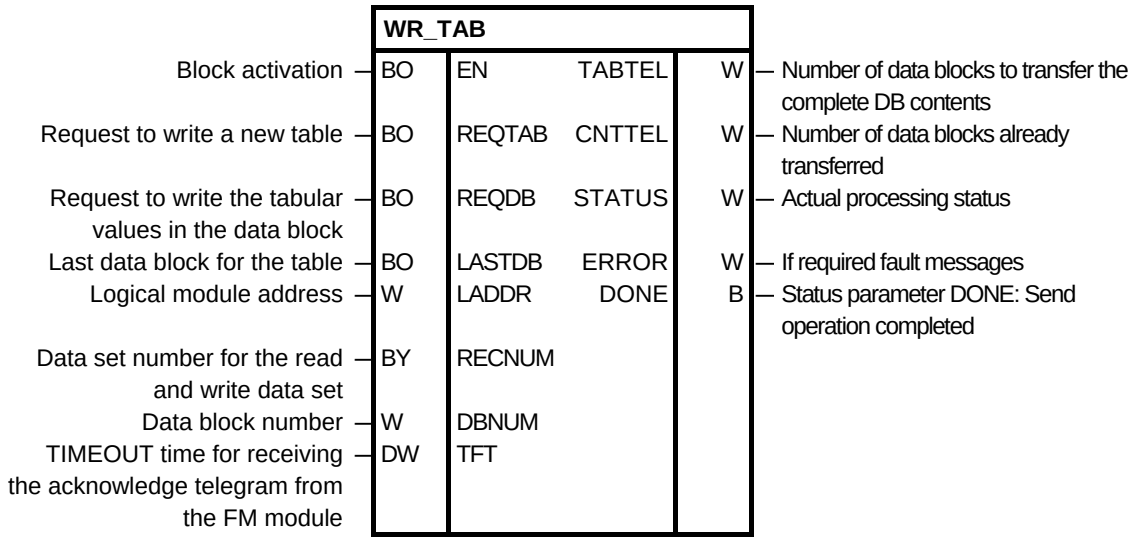
A detailed description of the "Automatic mode: Communications" mode to transfer tables from an S7 control to a SIMATIC FM 458 application module is provided in the Section "Automatic mode: Communications" (Page 3-184).

3.18.1.3 Function block WR_TAB

The function block WR_TAB is used to transfer tables from one S7 control to a SIMATIC FM 458 application module. The tabular values (permissible data types are REAL and double integer) are saved in a data block. They are transferred from WR_TAB to the function blocks TAB and TAB_D on the SIMATIC FM 458 application module, which then internally manages the tabular values.

The WR_TAB should be configured on the control side. The tabular values are transferred from one S7-400 control to a SIMATIC FM 458 application module via the P bus. All of the values are always transferred, which are in the DB specified at the DBNUM input.

Symbol



I/O

The individual connections (I/O), their data types and a connection description are listed in the following table:

Parameter	Declaration	Data type	Description
REQTAB	INPUT	BOOL	REQTAB = 1: Request to write a new table
REQDB	INPUT	BOOL	REQDB = 1: Request to write the tabular values which are saved in the data block
LASTDB	INPUT	BOOL	Last DB for the table
LADDR	INPUT	WORD	Logical address of the SIMATIC FM 458 application module
RECNUM	INPUT	BYTE	Data set number for the read and write data set
DBNUM	INPUT	WORD	Data block number of the DB in which the tabular values are located.
TFT	INPUT	DWORD	TIMEOUT time in ms for receiving acknowledge telegrams from the SIMATIC FM 458 application module.
TABTEL	OUTPUT	WORD	Number of data blocks required to transfer the complete DB contents
CNTTEL	OUTPUT	WORD	Number of data blocks already transferred to the FM module
STATUS	OUTPUT	WORD	Indicates the current status of the processing / data transfer: 0: Table transfer is inactive 1: Table transfer is active. Table values have been partially transferred from a DB (wait for the next partial transfer) 2: Table values have still not been completely transferred from a data block.
ERROR	OUTPUT	WORD	If a fault/error occurs while processing the function, then the return value is an error code
DONE	OUTPUT	BOOL	Status parameter DONE=1: Send operation has been completed

The following errors can occur and are displayed at the ERROR output:

Error code	Explanation	Remedy
0xB210	OK	-
0xB211	Logical module address invalid	Specify a valid module address at input LADDR.
0xB212	Data set number not valid	Enter the tabular values in an increasing sequence in the DB.
0xB213	Invalid table data format	Tabular values must have data type REAL for the TAB and data type DINT for the TAB_D.
0xB214	The data format of the new data set does not match that of the previously transferred data set	Ensure that all of the tabular values have the same data format.
0xB215	FM 458 does not respond	Check the communications connection and configuring.
0xB216	Table is too large	Transfer the table in sub-sets, i.e. either distribute tabular values over several DBs or after each partial transfer write new (additional) tabular values into DB and transfer.
0xB217	Table is not complete (X / Y values)	Complete the table, there must be a Y value for each X value.
0xB218	REQTAB is reset during processing	Transfer the tabular values again.
0xB219	REQDB reset during processing	Transfer the tabular values again.
0xB21A	DB number is not valid	Specify a valid DB number.
0xB21B	TIMEOUT when receiving the acknowledge telegram	Check the communications coupling and configuring. Transfer the tabular values again
0xB21C	Invalid processing status	Check the configuring of the WR_TAB.

Errors associated with the SFC58 or SFC59 are displayed at the ERROR output.

3.18.2 Manual mode

3.18.2.1 Application

The "Manual mode" mode represents the simplest way of inserting tabular values into a configured software package. However, it is comparatively time consuming as data has to be manually entered or taught-in from the program.

Entering tabular values

After the TAB or TAB_D has been correctly configured, the tabular values can be entered one after another. To start off with, the table size, i.e. the number of value pairs (=points) should be specified at input NP. If the table is to be saved in the SAVE area, then input SAV of the must be 1.

The tabular values can then be subsequently entered. In this case, to start, the index point i should be specified at input IP of the value pair to be entered. The X and Y value of the point should then be entered at inputs XP and YP. In order to accept the entered value, after entering each value pair, input WR should be set from 0 to 1. Before entering the next point, the index at input IP should be incremented. The values for this point should then be entered. This procedure is repeated until all of the values have been entered.

A specific sequence does not have to be observed when entering the individual points.

The number of entered points must match the data at input NP.

All of the entries during this procedure are transferred into the inactive table of the and are only available after being activated in the configured software. In order to activate the inactive table with the entered values, input TVL should be set to 1.

Additional changes can then be again made in the inactive table and are only available after this has been re-activated again.

Interrogating the tabular values

In order to output the entered tabular values, after entering the data at input IP, the index of the point i, to be displayed is specified, and input RD is set from 0 to 1. The tabular values of point i are then displayed at the outputs YXP (X value) and YYP (Y value). The index of point i is output at output YIP.

3.18.2.2 Configuring

For the "Manual mode", only the TAB and/or TAB_D have to be configured depending on whether tabular values, data type REAL and/or DINT have to be managed. Each table may only contain values associated with one data type. If several tables having different data types are to be managed, then an TAB or TAB_D must be configured for each table.

The function blocks TAB and TAB_D should be configured in the same sampling time of 32ms. The following connection (I/O) settings are required:

AUT =	0 (automatic mode de-activated)
NP =	[specifies the table size]
XP =	[enters the X values]
YP =	[enters the Y values]
IP =	[enters the value pair to be changed]
TVL =	1 (to activate the table after all of the values have been entered)
WR =	1 (to transfer the value pair which was entered in the table)
RD =	1 (to display the value pair, specified under IP, at outputs YXP and YYP)

NOTE

If, in the "Manual mode" the CTS connection is set to "0" when initializing (CTS=0; AUT=0), then it is no longer possible to changeover into the "Automatic mode: Memory card" (CTS=0; AUT=1).
If the CTS connection is set to "0" while initializing, and the "Automatic mode: Memory card" is activated (AUT=1), then it is possible to subsequently changeover to "Manual mode" (CTS=0; AUT=0). The table, saved on the memory card, can then be processed in the "Manual mode".
If, after this, a change is made back to "Automatic mode: Memory card" (CTS=0; AUT=1), this no longer has any effect, because it is only activated during the initialization operation.
If a communications interface is configured at the CTS connection, it is possible to toggle, as required between "Manual mode" and "Automatic mode: Communications".

3.18.3 Automatic mode: Communications

3.18.3.1 Application with an S7 control and SIMATIC FM 458 application module

Transferring tabular values

The following prerequisites must be fulfilled in order to successfully transfer tables:

- The function blocks TAB and/or TAB_D must be configured in the FM 458 application module corresponding to the configuring specifications for "Automatic mode: Communications" (A detailed explanation is provided in Section "Configuring for S7 control and SIMATIC FM 458 application module").
- The X and Y values of a table in a DB must always be present alternating. There must be a Y value for each X value, so that the number of values in a data set is always an integer number.

In order to start data transfer, inputs REQTAB and REQDB at WR_TAB must be set to 1. The tabular values of the DB, specified at input DBNUM at WR_TAB can then be transferred.

The actual number of transferred data blocks is always displayed at the CNTTEL output of the WR_TAB.

The number of data blocks is displayed at the TABTEL output of the WR_TAB, which is required until the complete contents of the DB are transferred to the SIMATIC FM 458 application module.

If the tabular values have been completely entered in the specified DB, or if it involves the last partial transfer of a table (sub-set of a table), which does not “fit” completely into a DB, then before starting the transfer, input LASTDB of the WR_TAB should be set to 1. This means that the SIMATIC FM 458 application module is signaled at the end of the data transfer. The STATUS output of the WR_TAB then changes from 2 to 0.

NOTE All of the tabular values, which are located in the DB, specified at the DBNUM input of the WR_TAB, are always transferred.

Table too large for a DB

If the table is too large for a data block, then the tabular values are split-up into individual sub-sets for transfer. The procedure is as follows:

To start, the first table section is written into the DB and is then transferred as described above. The LASTDB input of the WR_TAB remains at 0. The STATUS output of WR_TAB stays at 2 during data transfer and then changes, at the end of the table sub-set transfer (partial transfer) from 2 to 1.

The old tabular values in the DB should then be overwritten with the following tabular values. Once this has been completed, at WR_TAB the REQDB input should be again set from 0 to 1 to activate the next table sub-set transfer.

This procedure should be repeated until all of the tabular values have been transferred.

At the last sub-set transfer, input LASTDB of the WR_TAB should be set from 0 to 1. This signals the SIMATIC FM application module that data transfer has been completed. The STATUS output of the WR_TAB then changes from 2 to 0.

NOTE If there is adequate user memory available, the table can also be saved in several different DBs. In this particular case, for each table sub-set transfer, only the matching DB number at the input DBNUM of the WR_TAB has to be specified. However, it should be ensured that the DBs are transferred in the correct sequence, so that all of the tabular values are transferred in an increasing sequence.

Data transfer duration

The time taken to transfer the tabular values depends on the following factors:

- Number of tabular values
- Size of the data blocks
- Sampling time of the TAB and TAB_D
- WR_TAB processing time

In each cycle, a telegram with 56 tabular values is transferred, from the control to the SIMATIC FM 458 application module.

The time taken for a table to be transferred can be calculated as follows:

Duration of the data transfer = [No. of tabular values / 56] * cycle time of the slowest FB
(i.e. TAB, TAB_D or WR_TAB)

The time taken for the data to be transferred via the P bus is not relevant for this estimation, as this data transfer time is generally less than 1ms and generally, the function blocks TAB and TAB_D are configured in sampling times which are greater than 32ms.

If a table is distributed over several data blocks, the time required increases. The reason for this is that in addition to the time taken to transfer the tabular values, which can be determined using the formula above, the user has to manually make the changes described above.

3.18.3.2 Configuring for S7 control and SIMATIC FM 458 application module

The following function blocks must be configured for the coupling between an S7 control and an SIMATIC FM 458 application module via P bus:

- SIMATIC FM 458 application module:
  - TAB (for REAL data type) and/or
  - TAB_D (data type DINT)
  - @CPB (P-bus coupling, central block)
- S7 control:
  - WR_TAB

Each table may only contain values associated with one particular data type. If several tables with different data types are to be managed, then an TAB or TAB_D must be configured for each table.

WR_TAB is used to transfer the tabular values from SIMATIC DB to function blocks TAB and TAB_D. The tabular values are transferred using a data telegram. When the last data telegram has been transferred, the TAB or TAB_D is automatically signaled that all of the tabular values have been transferred and that the table should be activated. WR_TAB receives a checkback signal as to whether activation was successful or not. After the table was successfully activated, its address is output at the TAB output of the TAB or TAB_D.

TAB and TAB_D

TAB and TAB_D should be configured as follows:

They should be configured in a sampling time greater than or equal to 32ms. The following connection settings are required:

CTS =	[name of the configured communications interface]
AUT =	1 (automatic mode activated)
US =	[channel name.address stage1] (address data for receive)
MOD =	[data transfer mode] (H=Handshake; R=Refresh; S=Select; M=Multiple)
TFT =	[monitoring time in milliseconds] (maximum telegram failure time

while receiving tabular values)

NP = [specifies the maximum table size]

NOTE If a communications interface is configured at the CTS connection, it is possible to toggle, as required between "Automatic mode: Communications" and "Manual mode".

WR_TAB

The following connection settings should be configured at WR_TAB:

LADDR =	[specifies the logical address of the SIMATIC FM 458 application module]
RECNUM =	[specifies the data set number for the read and write channels. This must be identical with "Address stage1" at the US connection of the TAB or TAB_D.]
DBNUM =	[specifies the data block number]

3.18.3.3 Inserting tabular values in the data block

In order to be able to transfer tabular values to a SIMATIC FM 458 application module, they must be available in a data block (DB). The DB should be programmed on the control side.

There are two ways of generating a DB with the required tabular values:

- Generating a new DB in STEP7 and manually entering the tabular values in the application "LAD/STL/CSF"
- Importing tabular values from an existing table (e.g. MS Excel) as external source in STEP7

3.18.3.3.1 Manually entering tabular values

In this case, it involves the simplest method of providing tabular values in a DB. It is realized by entering the initial (starting) and actual values of the individual table values manually in a newly generated DB in the application "LAD/STL/CSF". The steps required will now be explained.

NOTE

The initial value is any value which can be defined for every tabular value. It is only used if there is no actual value specified for the associated tabular value.
The actual value is that value which is made available as tabular value in the configured software. The required tabular values should be specified here.

(1) Generating a new DB under STEP7

To start, a new DB should be generated under STEP7. In this case, the "Blocks" folder is selected in the appropriate S7 program and in the context-sensitive menu, the entry "Insert new object → data block" is selected.

The procedure is shown in the following diagram:

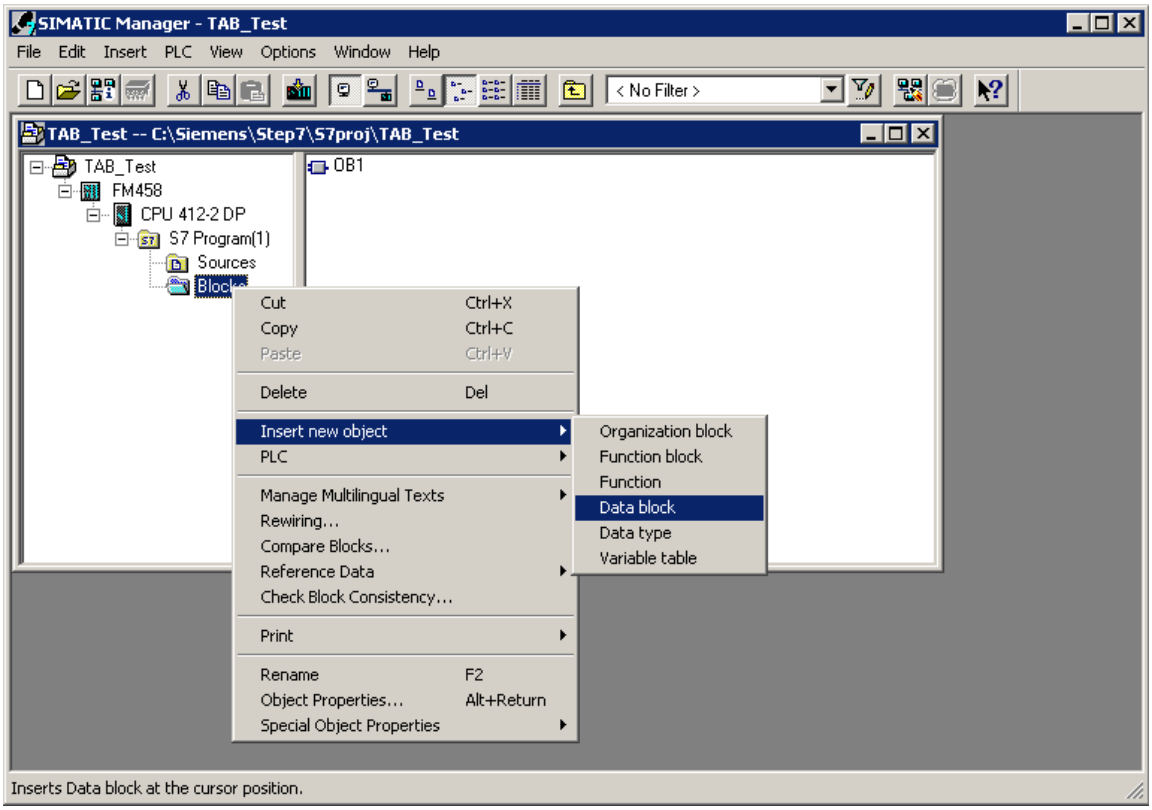


Fig. 3-70 Generating a new data block under STEP7

(2) Opening the new DB

The next step is to open the newly generated DB by double-clicking with the application "LAD/STL/CSF". "DB Editor" is the tool which is used to generate it and only one "Data block" is generated.

The following diagram illustrates the selection when opening a new DB:

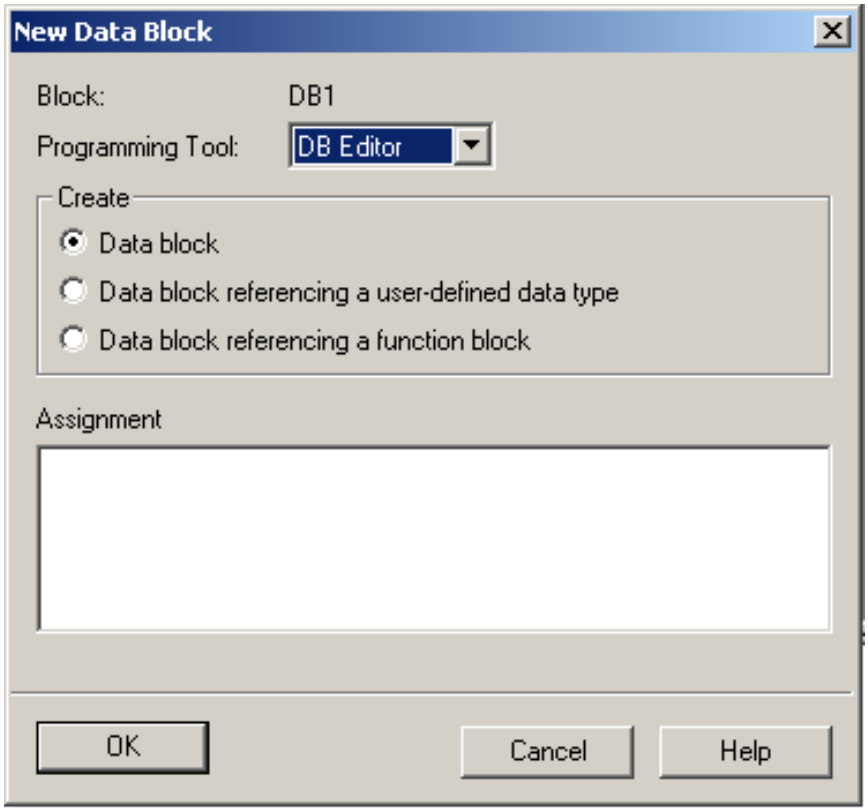


Fig. 3-71 Making a selection when generating a new DB

The opened, new DB is illustrated in the following diagram:

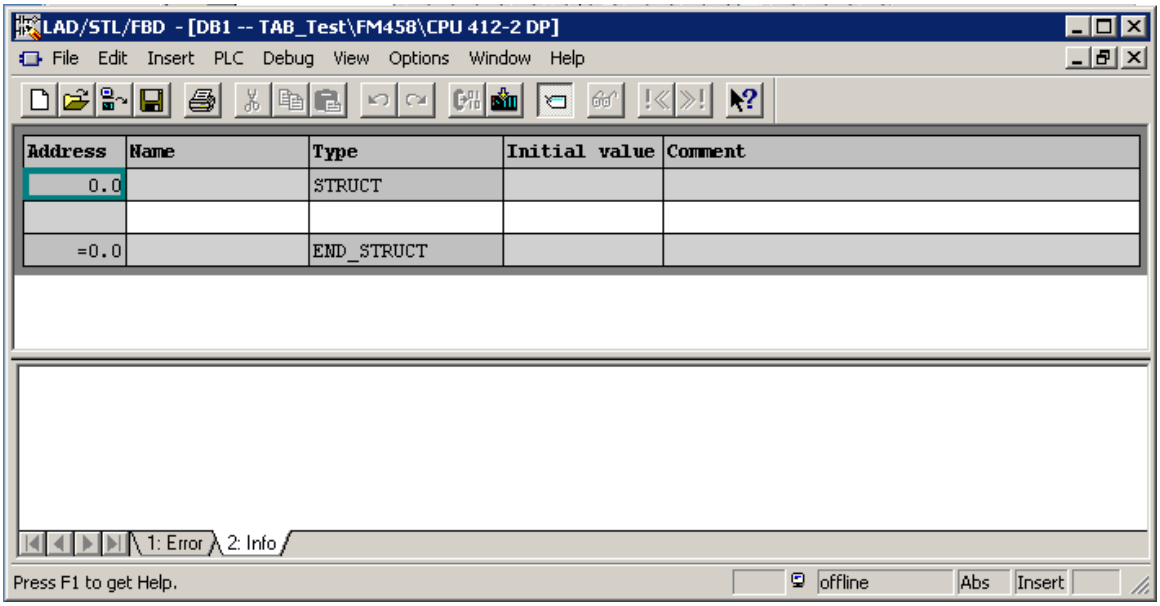


Fig. 3-72 Newly generated DB in the application "LAD/STL/CSF"

(3) Entering the tabular values

The required tabular values can now be entered. It should be ensured that the X and Y values are entered, alternating.

To start, the data type, used in the table, should be entered (REAL or DINT). In this case, the name is always "Data type", "WORD" type and initial value for data type REAL "W#16#1", for data type DINT "W#16#2".

Then, for each individual tabular value, the name, data type ("Type" column) and value ("Initial value" column) should be entered.

The procedure when entering tabular values, data type REAL, is shown in the following diagram:

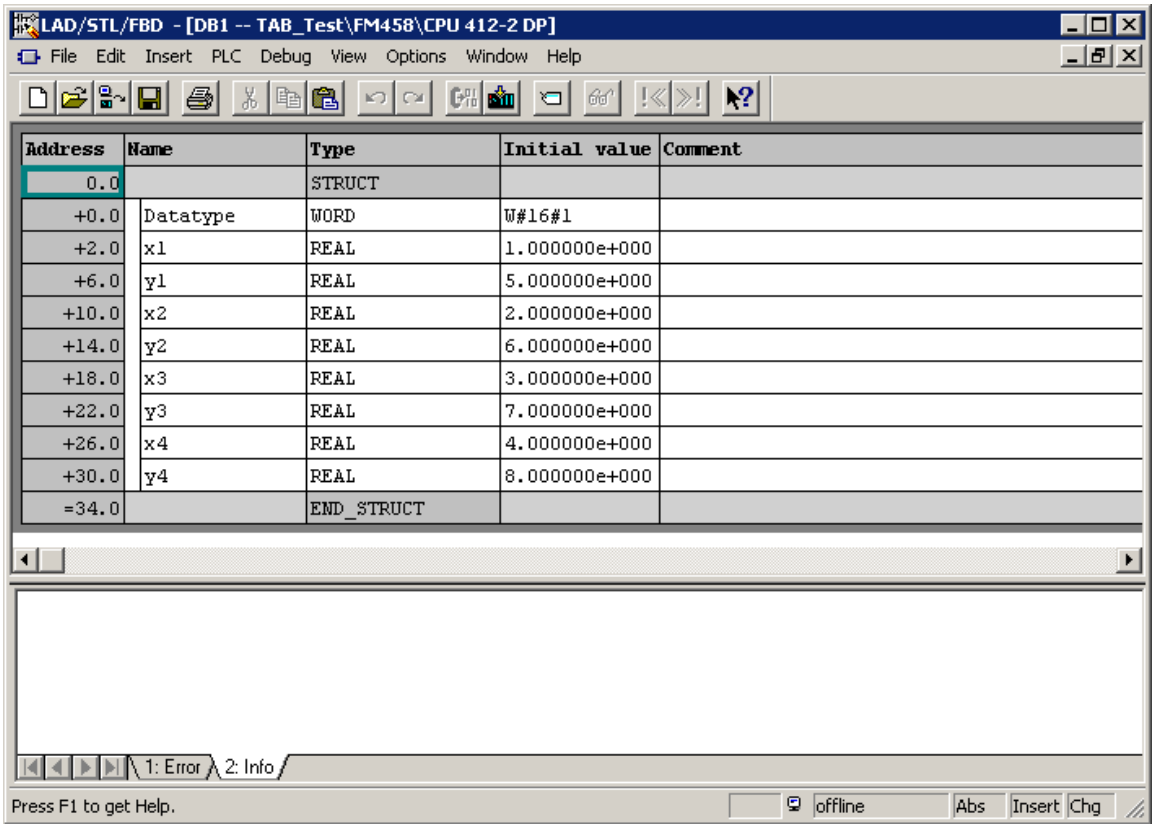


Fig. 3-73 Manually entered tabular values in the "LAD/STL/CSF" application

HINWEIS

Only values associated with the same data type may be included in a table. For this reason, specifying an ARRAY is an effective way of entering data. This means that the data type doesn't have to be specified each time.
Refer to the online help of the application "LAD/STL/CSF" - especially "Help for STL" for the procedure to make entries for an ARRAY type.

(4) Saving the DBs

After the tabular values have been completely entered, the DB can be saved under "File → Save".
The tabular values are then located in the DB for transfer.

3.18.3.3.2 Importing tabular values

The tabular values, provided in the DB, can also be imported from an external source, e.g. an MS Excel table. However, the following points should be observed for error-free import:

- The source file of the table must have a specific format
- The source file must be linked-in as external source file under STEP7
- A new DB is generated from the external source file
- The necessary points and steps, required for the import operation, will now be explained.

Table format

In order to import an existing table (e.g. generated using Excel) into the DB, it must be compliant with a specific format syntax:

- The table must contain a header, which contains information about the name of the DB and the version.
- Information about the structure and the data type of the tabular values should then be specified.
- The tabular values are then specified (as initial values).
- It should be observed that X and Y values must always be specified, alternating.
- The table should be saved with the *.AWL extension.
- The table can then be used as external source file.

HINWEIS The *initial value* is any value which can be defined for each tabular value. It is only used if an actual value is not specified for the associated tabular value.
The tabular values are exclusively defined as *initial values*. *Actual values* are not used.
This significantly reduces the file size and in turn, the required memory.

An example of a table with four X and four Y values, data type REAL is shown in the following diagram:

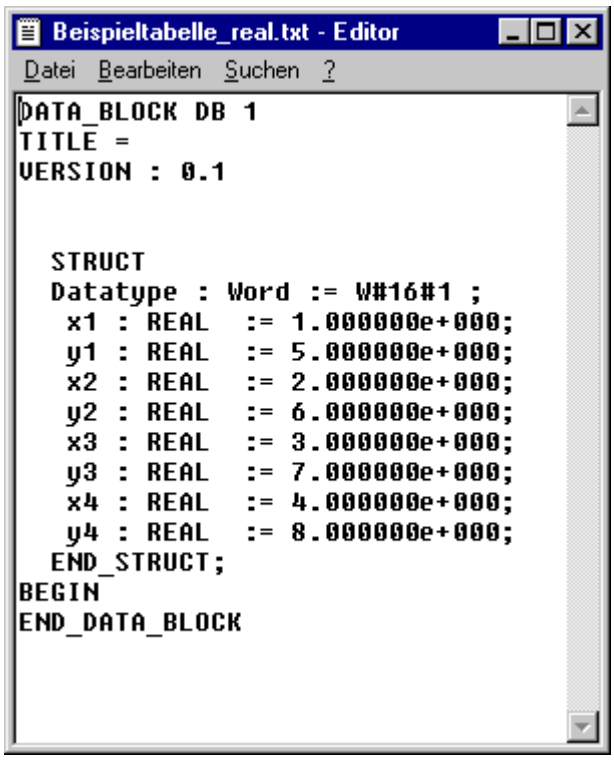


Fig. 3-74 An example of a table with values, data type REAL

An example of a table with two X and two Y values, data type DINT is shown in the following diagram:

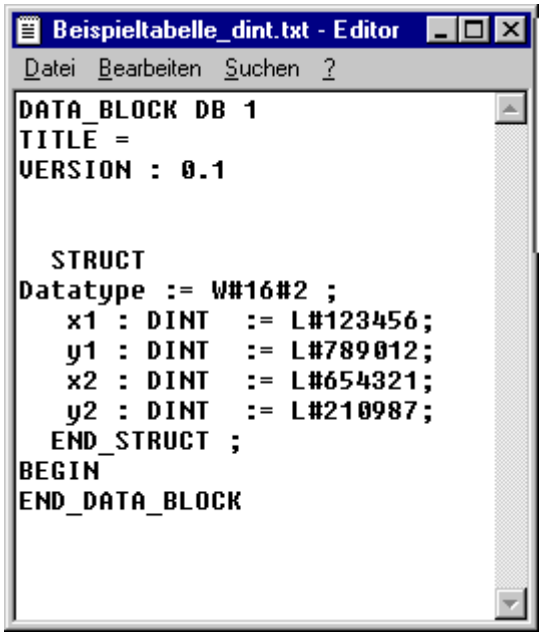


Fig. 3-75 An example of a table with values, data type DINT

From Excel to STL

The following sections explain, using examples, how to re-format an Excel table to obtain the required table format.

The file example, shown in the following diagram, is formatted step-by-step corresponding to the specifications of the required table format.

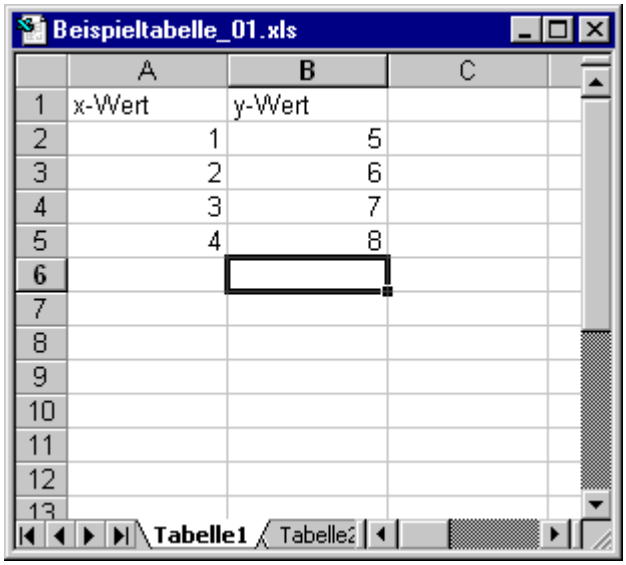


Fig. 3-76 An example of a table in MS Excel

(1) Header

Initially, the required header is inserted. To do this, 5 lines are inserted at the beginning and the following data is entered:

- DATA_BLOCK DB 1 [number of the DB]
- TITLE = [enter as required]
- VERSION : 0.1 [version data]

The Excel table with inserted header is shown in the following diagram:

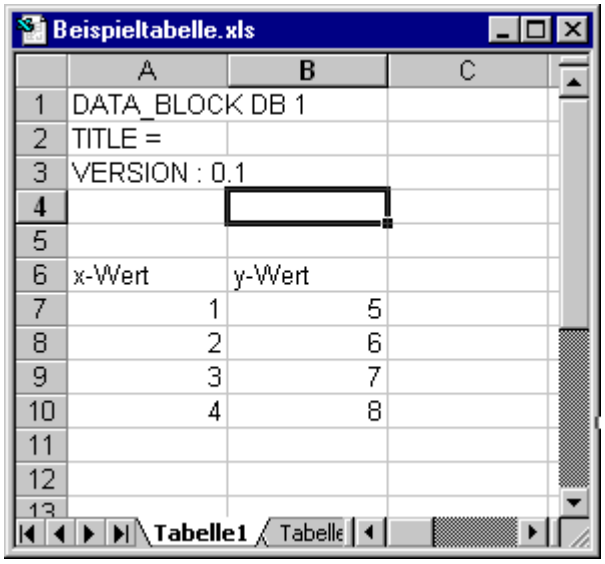


Fig. 3-77 An example of a table in MS Excel with inserted header

(2) Insert structure and tabular values

In a next step, the structure of the tabular values and the values, specifying the data type, are inserted. In this case, two lines plus an initial and end line are inserted for each value pair. Furthermore, a line is inserted at the start to specify the data type used.

The start of the structural data is displayed in the starting line with the "STRUCT" entry. The data type, used in the table, is specified in the following line ("W#16#1" for data type REAL, "W#16#2" for data type DINT).

This is followed by the structural data and tabular values for the individual value pairs, where X and Y values are always entered alternating. The tabular values are specified corresponding to the data type used (in this case REAL). The end of the structural data is displayed in the final line with the "END_STRUCT;" entry.

Finally, only the data for the data section of the actual values has still to be specified ("BEGIN" and "END_DATA_BLOCK"). As the tabular values already have the structural data in the starting (initial) values, it is not necessary to specify the individual actual values.

The Excel table with inserted structural data and tabular values is shown in the following diagram:

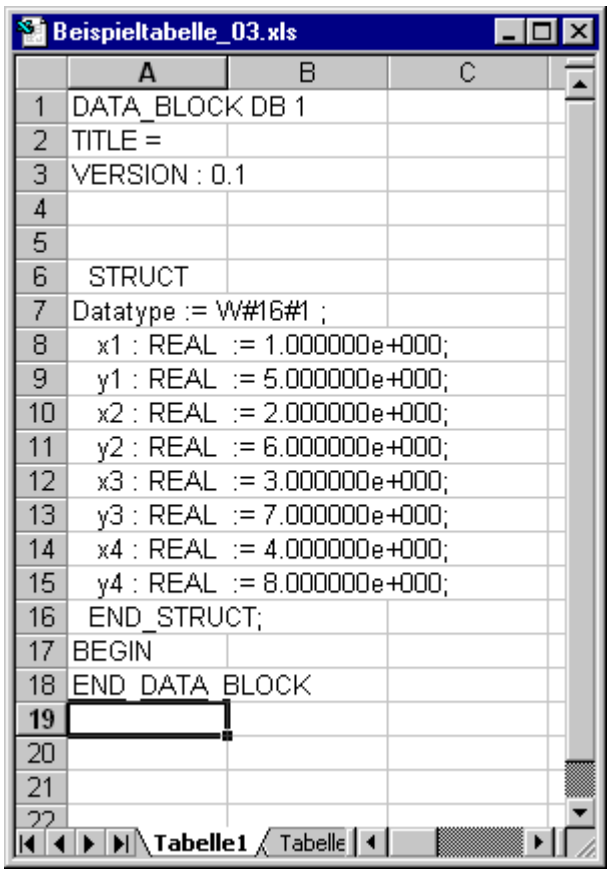


Fig. 3-78 Example of a table in MS Excel with inserted structural data and tabular values

(3) Saving as STL [AWL] file

Finally, the correctly formatted file only has to be saved as text file with the extension *.AWL. In this case, the following should be selected in MS Excel "File → Save as...". "Formatted text (separated by blanks) (*.prn)" file type should be selected and the table example should be saved under a freely selectable name and location.

"Save as" window in MS Excel with the appropriate selection is shown in the following diagram:

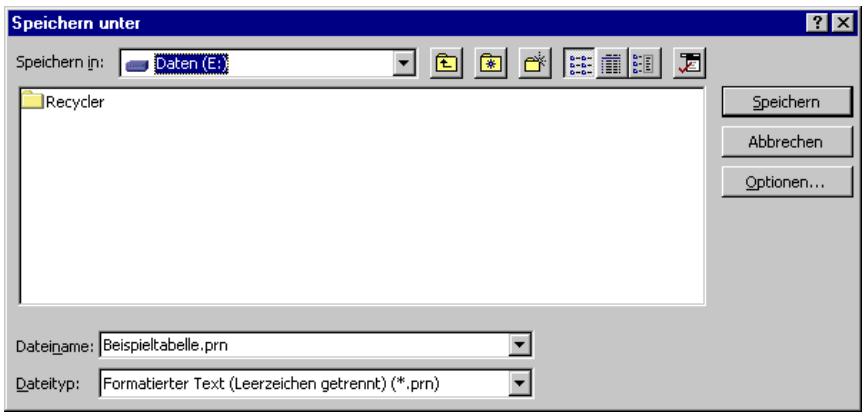


Fig. 3-79 An example of a table in MS Excel saved as text file (.prn)*

After the file has been saved, the file type should be changed from *.prn to *.awl. This file can then be opened with any text editor.

The following diagram shows the table example as STL [AWL] file, opened in the standard Windows text editor:

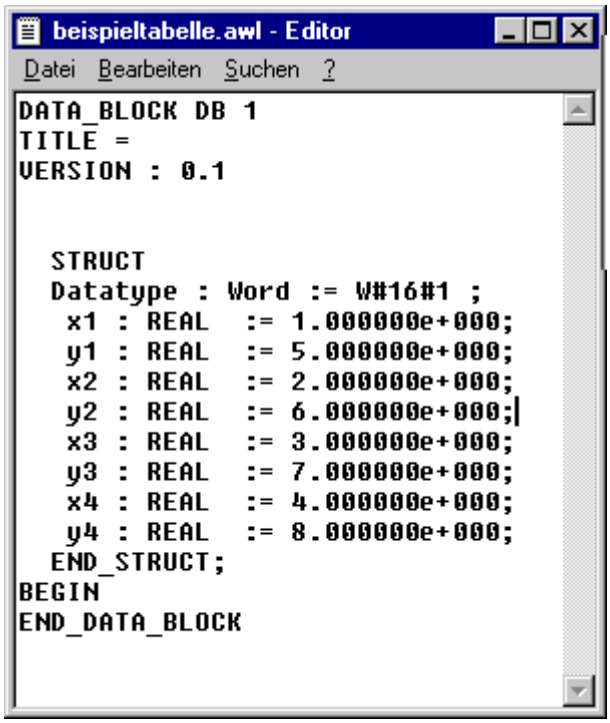


*Fig. 3-80 Table example, saved as *.awl file, opened in the text editor*

This file can only be used as external source file in STEP7 for a DB.

Incorporating the table as source file

Using the file example "BEISPIELTABELLE.AWL", generated above, the individual steps to incorporate an externally generated table in a DB will now be explained.

HINWEIS

In addition to specifying the tabular values, it is especially important to specify the name of the DB. A DB is subsequently generated using the name specified in the file.
In the above file example, "DB1" is specified as DB name in the first line. (refer to Fig. 10)

Now, an external source is inserted in the STEP7 configured software in the S7 program under "Sources". After selecting "Sources", the context-sensitive menu can be called-up by clicking in the righthand partial window with the righthand mouse key. An external source should be inserted here as new object.

The procedure is shown in the following diagram:

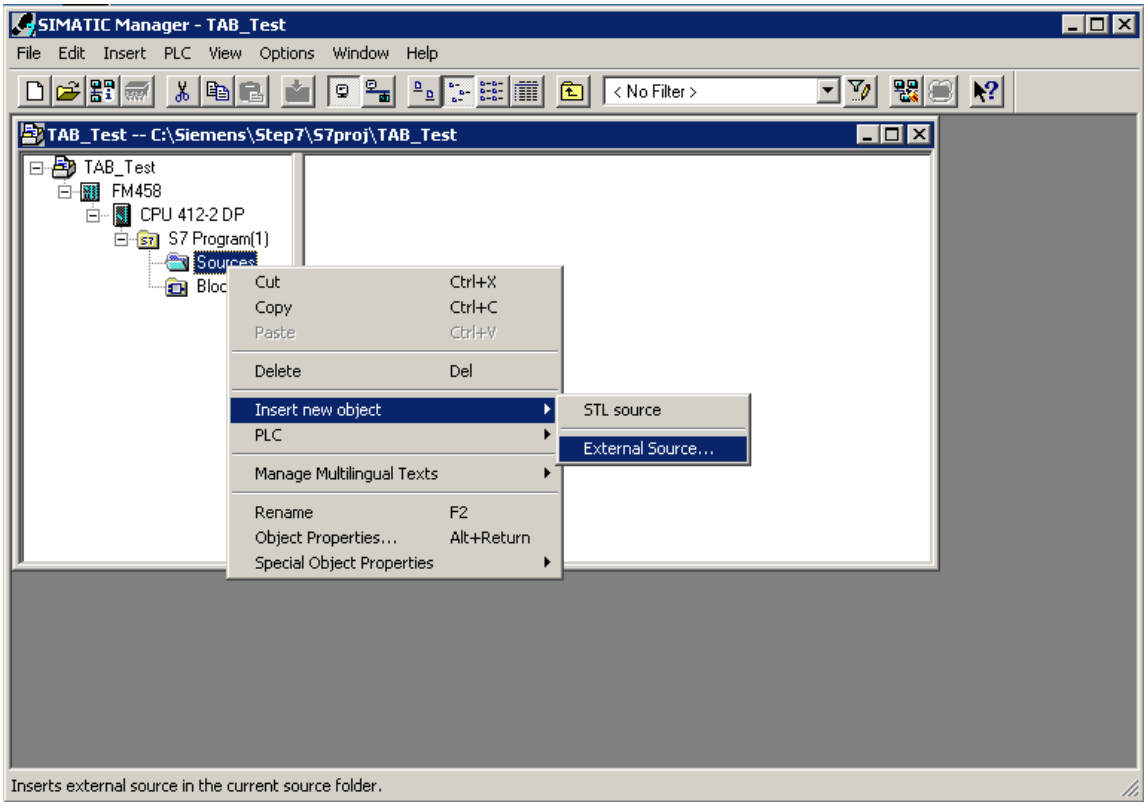


Fig. 3-81 Inserting an external source in STEP7

The STL [AWL] file, generated above, is selected as source file. The following diagram shows the file selection window:

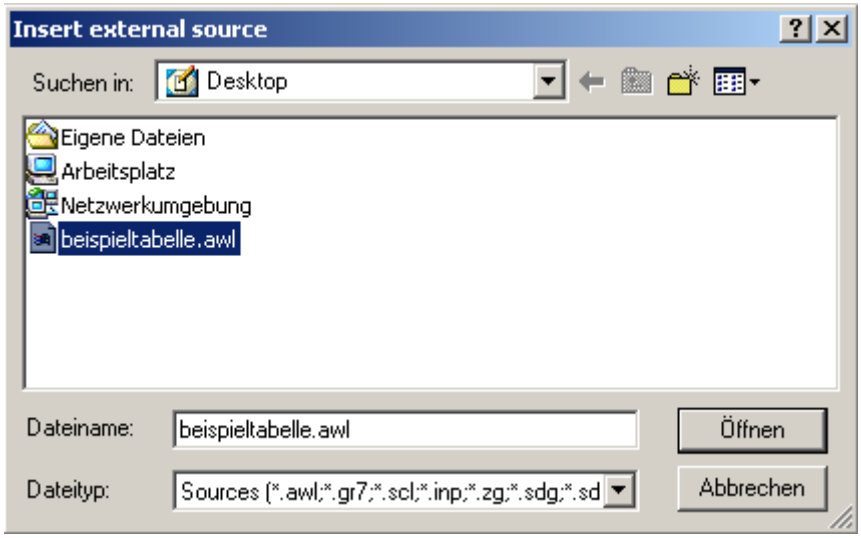


Fig. 3-82 Selecting the file to be inserted in STEP7 as external source

The selected file is opened (in this case: BEISPIELTABELLE.AWL). It now exists as source file in the configured software under "Sources". It is selected there and is opened.

The file example, available under "Sources" and its context-sensitive menu is shown in the following diagram:

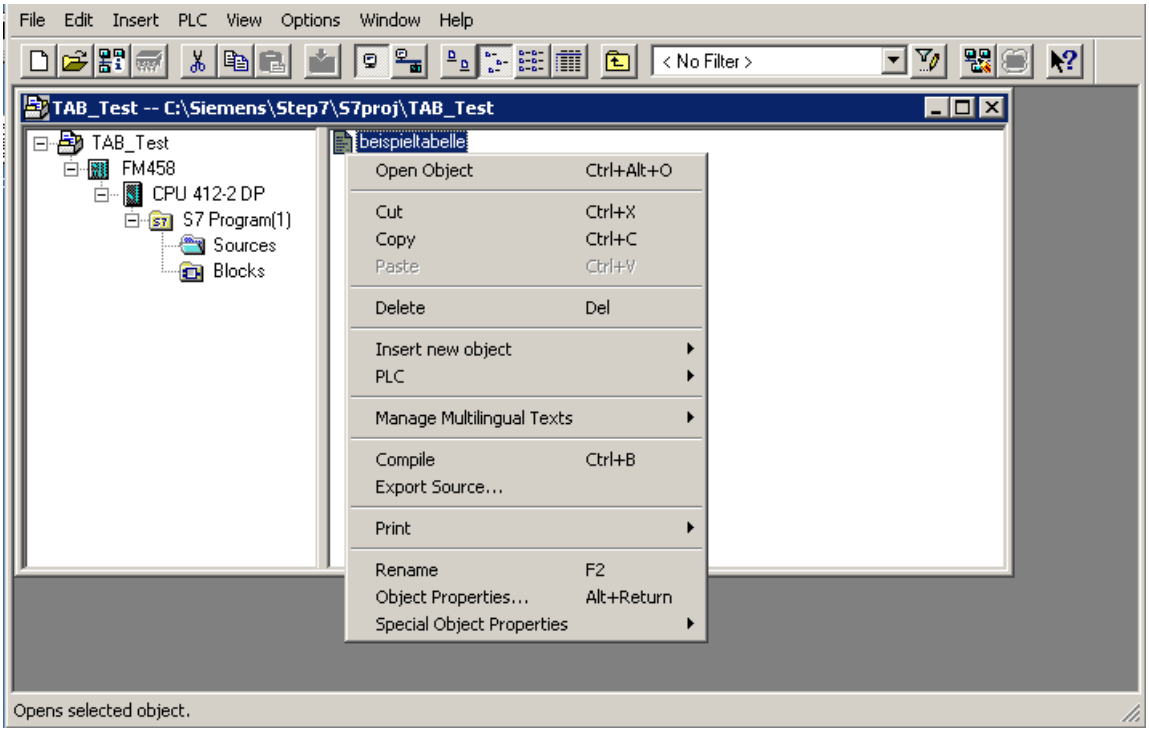


Fig. 3-83 Generated source file in STEP7

After the file has been opened, it can be edited in the "LAD/STL/CSF" program. There it can be compiled via "File / Compile".

The procedure is shown in the following diagram:

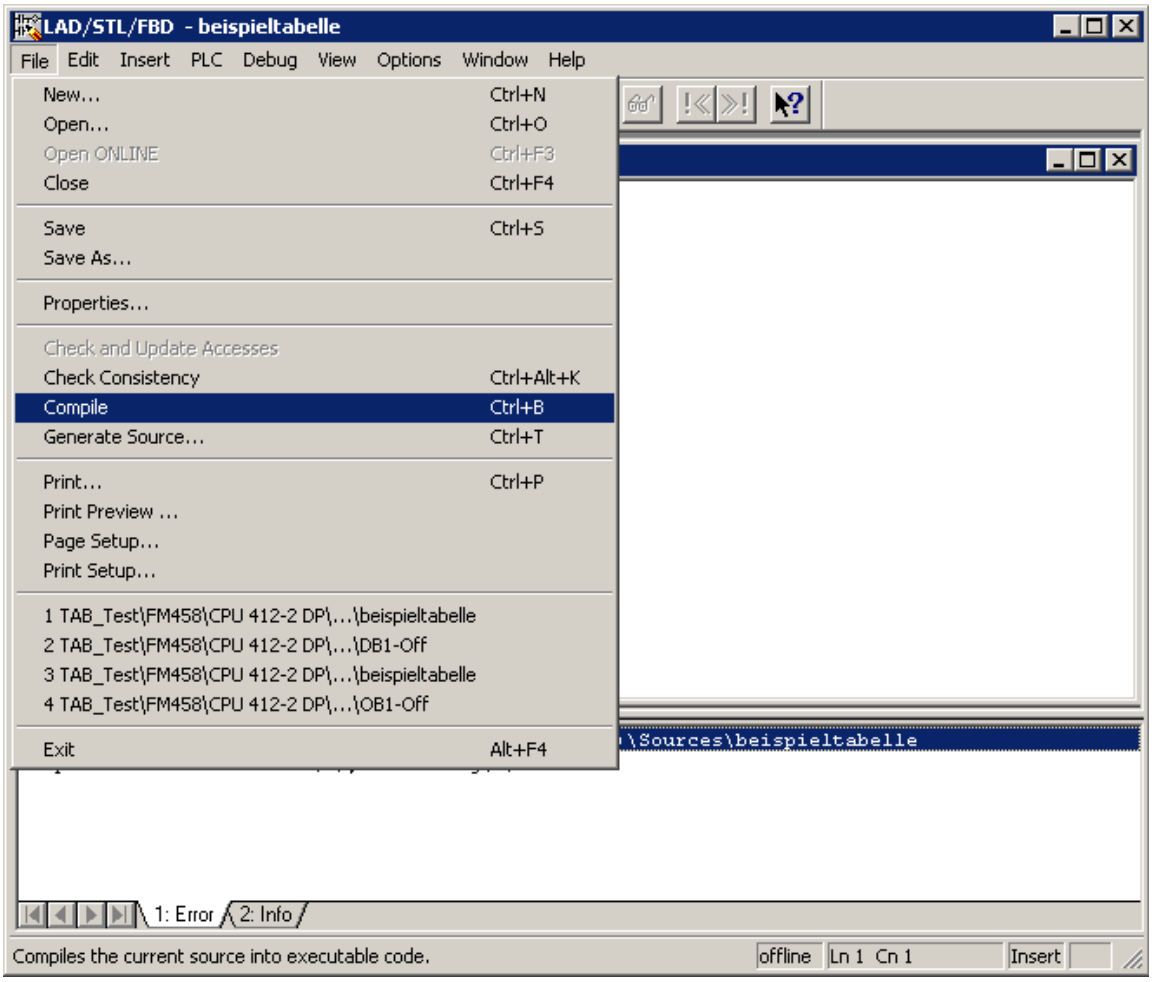


Fig. 3-84 Compiling the source file in the "LAD/STL/CSF" application

After the file has been successfully compiled, a new DB is available in the configured software. The name of the DB corresponds to the name specified in the header line of the file.

The following diagram illustrates the newly generated DB in STEP7 configured software under "Blocks":

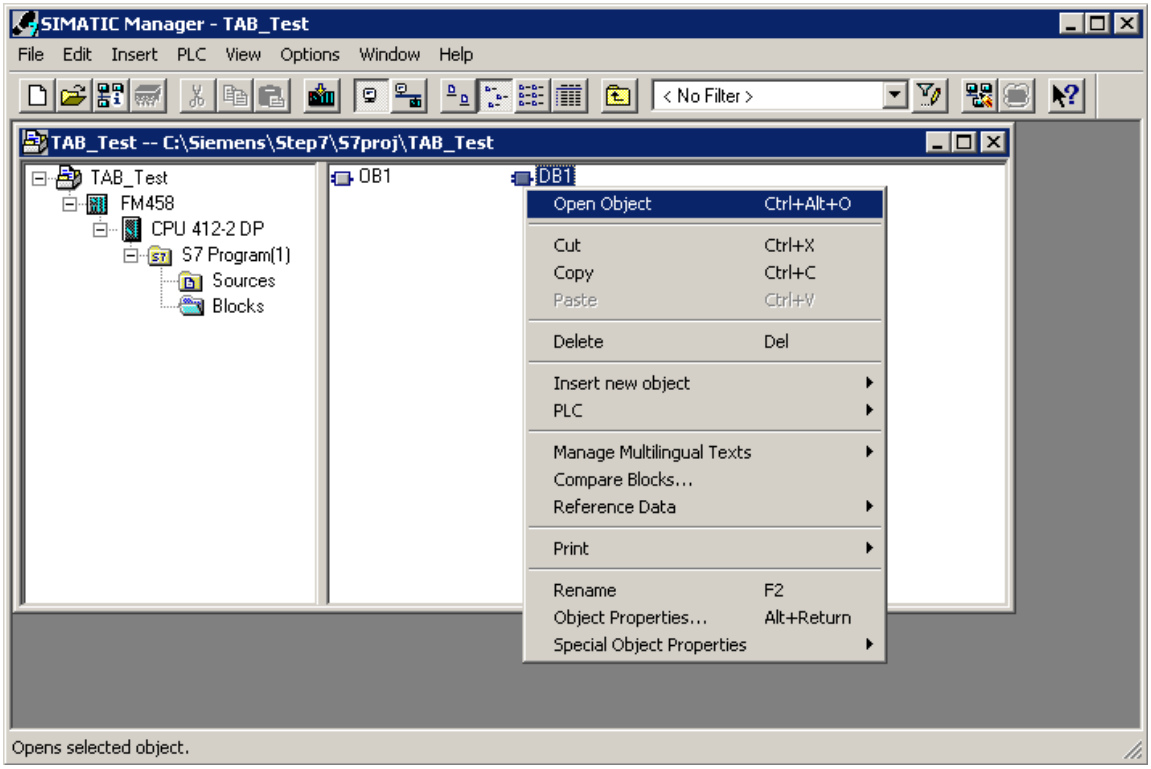


Fig. 3-85 Newly generated DB after compiling the source file

In order to check the contents of the DBs, it can be opened in the "LAD/STL/CSF" program. "Data view" should be selected in the "View" menu to display the initial (starting) values as well as the actual values.

The contents of the opened DB is illustrated in the following diagram:

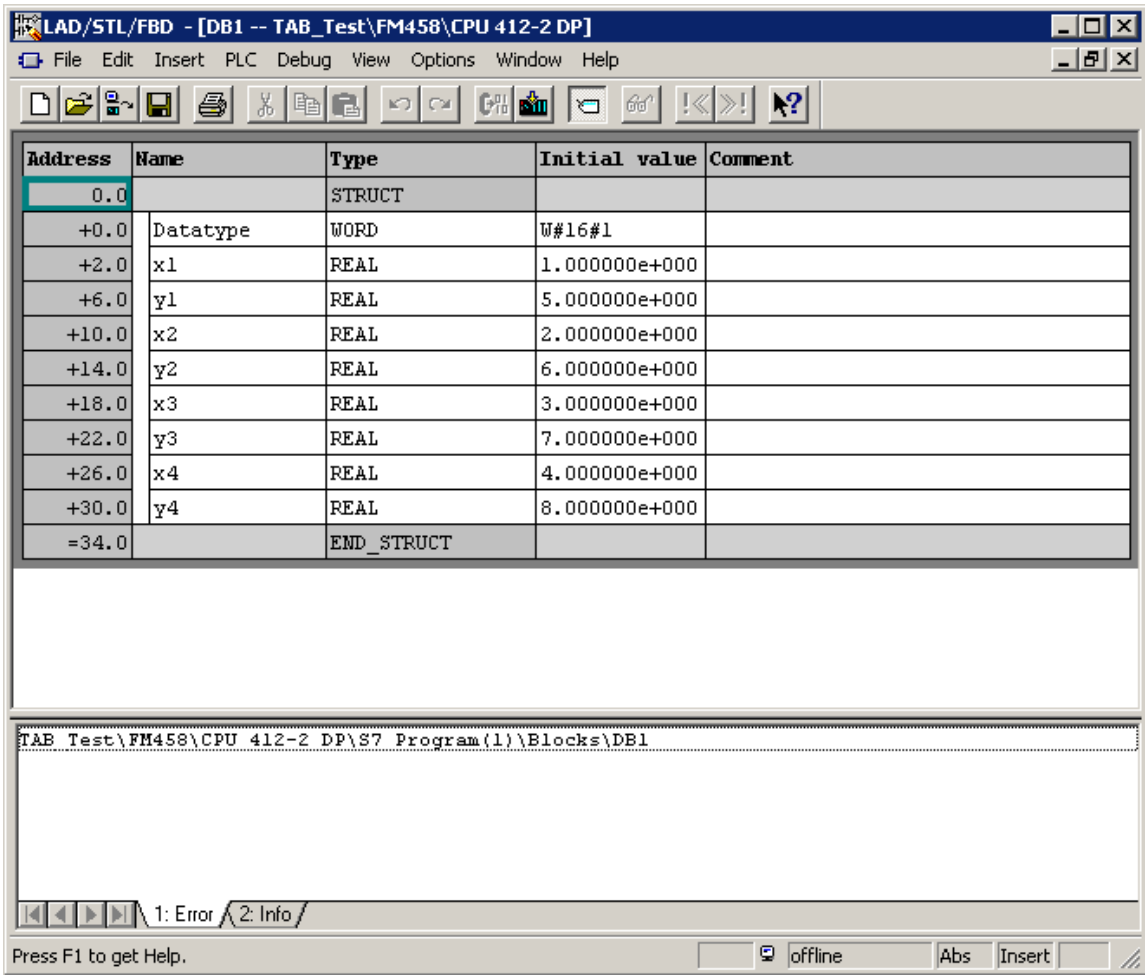


Bild 3-86 Contents of the newly generated DB in the "LAD/STL/CSF" application

3.18.3.3.3 Subsequently downloading tabular values into a DB

If tabular values are to be subsequently downloaded into the DB, because the table is too large and there is not sufficient user memory for several DBs, then the table should be transferred to the SIMATIC FM 458 application module in several sub-sets of the table. To do this, the table must be split-up into sub-sets of the table. The size of the individual sub-set tables should be selected so that the user memory of the S7-CPU is not exceeded. The individual table sub-sets are then transferred one after another.

HINWEIS It is especially important that the individual table sub-sets are transferred in the sequence of the value pairs. If they are transferred in the incorrect sequence, then the tabular values will not be correctly available in the configured software.

There are two possibilities:

- Manually enter the individual tabular parts at the DB in the "LAD/STL/CSF" application and then transfer this part of the table
- Generate individual source files with different names for each table sub-set and after being successfully linked-into the DB one after the other, then transfer

Manual entry

In order to subsequently download tabular values into a DB manually, the following steps should be carried-out:

- The appropriate DB should be opened by double-clicking in the "LAD/STL/CSF" application.
- The existing tabular values should be replaced by entering the value of the subsequent tabular section.
- The DB should be saved.
- The values of the table sub-sets can now be transferred.

Generating several source files

The following steps have to be carried-out when subsequently downloading tabular values into a DB by generating several source files:

- The same DB name should be specified in the header of the individual source files (*.AWL).
- The individual files may not exceed the memory size of the DB.
- The file names are best numbered in an increasing sequence.
- The individual files are now linked-in as source files as described above. However, they are still not compiled.
- The first source file is compiled and the tabular values, now available in the DB, transferred.
- The second source file is compiled so that its tabular values are now available in the DB. These are now transferred to the S7 control system.
- Analog to this, the other source files are compiled and transferred one after the other.
- After the last table sub-set has been transferred, the LASTDB connection should be set from 0 to 1. This signals that the table has been transferred.

3.18.3.4 Structure of the data telegram for TCP/IP or DUST1 connection

If the communications link involves a TCP/IP or DUST1 coupling, then the data telegram structure must be carefully observed. This is described in the following. The data telegrams are "generated" using the function blocks CTV and CRV.

The data telegram is defined so that all of the tabular values can be transferred in a data block as well as in several data blocks.

The structure of a data block is shown in the following table:

Data type	Description
char [4]	Telegram ID Each table telegram is identified with the "TAB0" ID
u_int16	Telegram commands (bit-coded) 1: New table (rising edge, from 0 -> 1) 2: End of table
u_int16	Data format (REAL=1, DINT=2)
u_int32	No. of the actual data block
u_int32	No. of tabular values (X and Y values) The number of values must always be an even number. This means that always the same number of X and Y values are transferred.
u_int32 [56] / float [56]	Array with tabular values. (X and Y values, always alternating)

The TAB or the TAB_D sends an acknowledgement to the sender for each data block received.

The structure of the acknowledge telegram is shown in the following table:

Data type	Description
char [4]	Telegram ID Identifies each table telegram with the "TAB0" ID
u_int32	No. of the actual data block
u_int32	Status / error numbers 0xB210 OK (data block is o.k.) .....

HINWEIS New table data is now transferred into the inactive table if the "New table" command is set.
After the "End of table" command has been received, all additional table data are rejected until the "New table" command is received.

3.18.4 Automatic mode: Memory card

Table values can be combined to form components using the D7-SYS additionalComponentBuilder (this is included in D7-SYS V5.2 plus SP1). These components can be downloaded as additional objects on the memory card. From there, they are read-out using the TAB or TAB_D function blocks.

One or several table files are imported in the D7-SYS additionalComponentBuilder, which then combines these files to form a component file (download file), which can then be downloaded onto the memory card.

The D7-SYS additionalComponentBuilder (aCB) does not check the contents of the files. The tables are an exception to this rule. The contents of these table files are checked. If the table file has an erroneous structure, then aCB immediately flags this.

The procedure from generating a table file up to configuring the function blocks is explained in the following sections using an example.

3.18.4.1 Generating a table file in the csv format

The table values are generated as required using a table calculation program (e.g. Excel).

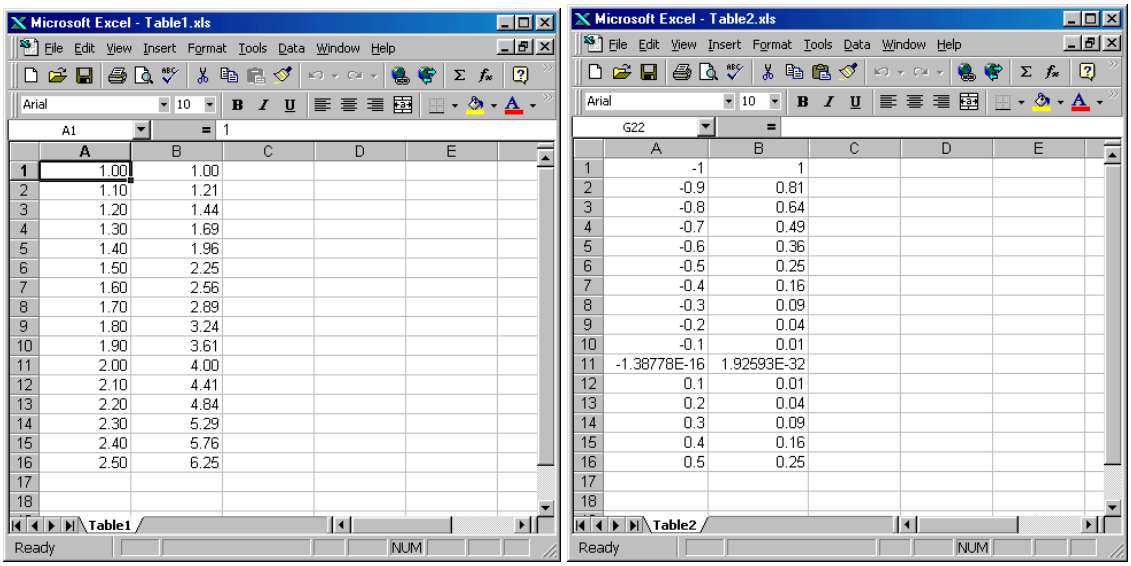


Fig. 3-87 Tables values in Excel

Conditions

The table files must fulfill the following conditions:

- A table file may only comprise two columns – if additional columns are included in the table, an error message is displayed in a dialog window.
- Both of the columns must contain the same number of values. If this is not the case, then the D7-SYS additionalComponentBuilder displays an error message in a dialog window and the table values are rejected.

The D7-SYS additionalComponentBuilder expects the following data format:

- [+/-] xxx.yyy – real value, decimal places are specified using a „.“ (e.g. 145.123)
- [+/-] xxx,yyy – real value, decimal places are specified using a „,“ (e.g. 145,122)
- [+/-] xxx.yyyE+/-mm – real values shown as an exponent, decimal places are specified using a „.“ (e.g. 145.122E+12)
- [+/-] xxx,yyyE+/-mm – real values shown as an exponent, decimal places are specified using a „,“ (e.g. 187,122E+12)

For the „Table DINT“ type description:

- [+/-]xxx – Integer or double integer (e.g. 145)

The following conditions still apply for the table files:

- ASCII files
- The table columns are separated using a semicolon or tab character
- Lines are separated using a line break or semicolon

Saving tables

Tables, which are generated using MS Excel and are saved in the *.csv format or as "Text (Tabs separate)“ fulfill these conditions.

The following diagram shows two example files with table values which were saved in the csv format:

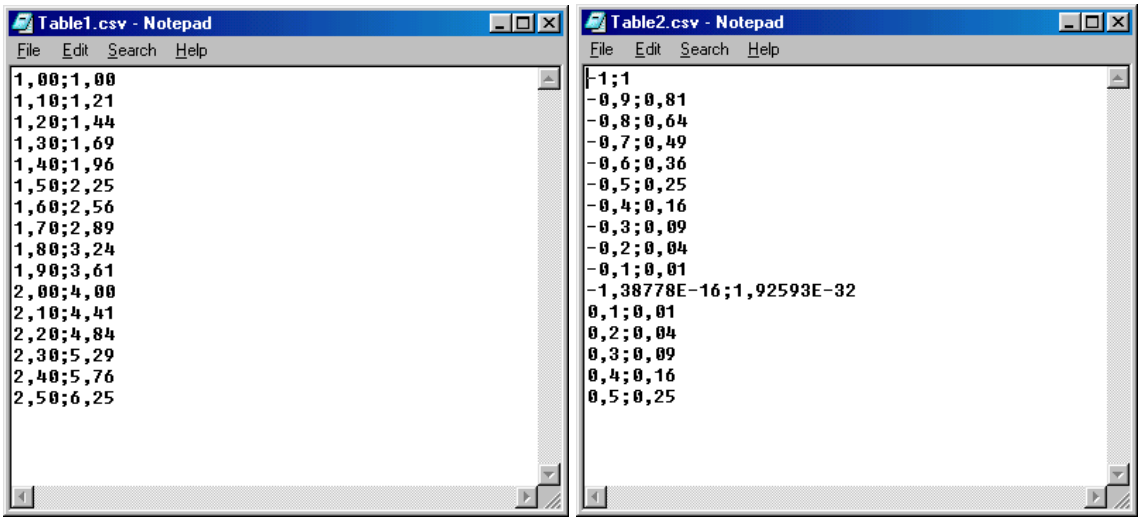


Fig. 3-88 Table values which were separated using semicolons (.csv format)*

3.18.4.2 Working with the D7-SYS additionalComponentBuilder

After the table files were saved in the csv format, they can be imported in the D7-SYS additionalComponentBuilder.

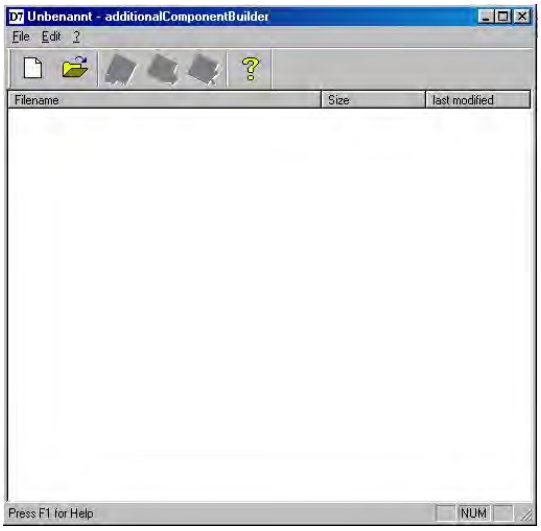


Fig. 3-89 D7-SYS additionalComponentBuilder

In the next step, a new component file is set-up with  . To start, the properties are specified in the following dialog field.

New component

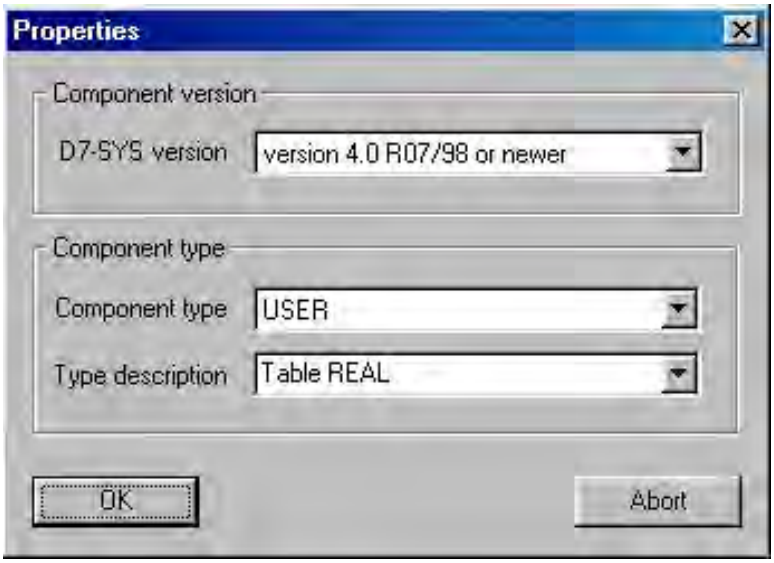


Fig. 3-90 Setting the properties

The following settings should be made:

These properties cannot be changed at a later time and have a gray background.

- **D7-SYS version**
  List box, in which the version is specified for which the components should be generated

- **Component type**
  List box with the fixed entries "USER“, "IT1“ and "IT2“. “USER” is the default value

  The entries have the following significance:

  – USER = Component file generated by the user,
    e.g. table files

  – IT1/IT2 = System component file for ITSP modules

- **Type description**
  List box with the “Table REAL” and “Table DINT” entries. "Table REAL“ is the default value for the “USER” component type. "Table DINT“ is used for tables in the DINT format.

  The entries have the following significance:

  – REAL table: Table file with REAL data type

  – DINT table: Table file with double integer data type

  A new type description can be entered in the list box and acknowledged using RETURN. This new type description is then transferred into the list box and can be selected from the list box the next time.

Saving

The new component file can be set-up after the settings have been completed.
The new component file is, as standard, set-up in C:\temp. If another memory path is specified, then when the program re-starts, this is used as standard memory path.

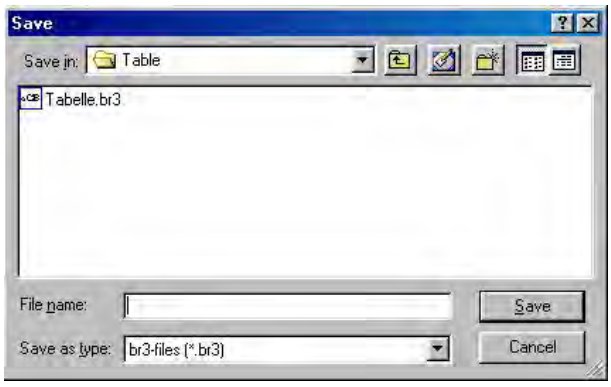


Fig. 3-91 Saving the new component file

Table files can now be added. A file selection window is opened using  with which the required table files can be selected.

NOTE

Only tables with a uniform value format can be included in a component with the "table" type description! This means that a REAL table only contains tables with REAL values.

The following diagram shows the contents of the D7-SYS additionalComponentBuilder after importing the two generated table files:

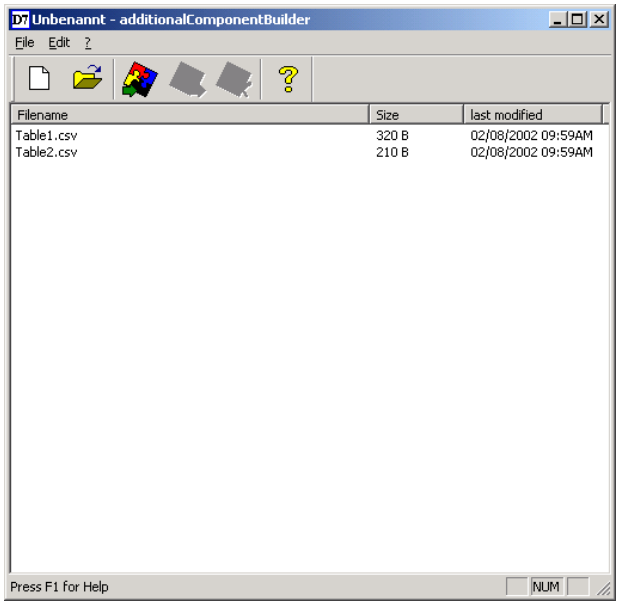


Fig. 3-92 D7-SYS additionalComponentBuilder with imported table files

Additional table files can be added or imported or deleted at any time. The D7-SYS additionalComponentBuilder automatically takes-over the management of the table files and saves the modified component files.

Opening

When opening existing components, "C:\temp“ is the standard search path of the D7-SYS additionalComponentBuilder. If another path is selected, when the program re-starts, this is used a standard search path.

3.18.4.3 Downloading

After the component file was set-up with the D7-SYS additionalComponentBuilder, it can be downloaded into the general download dialog box.

(1) Opening the download dialog box in D7-SYS with “target system→ Download”
Using this dialog box, the current configuring can download the optional components into a memory card (offline/online).

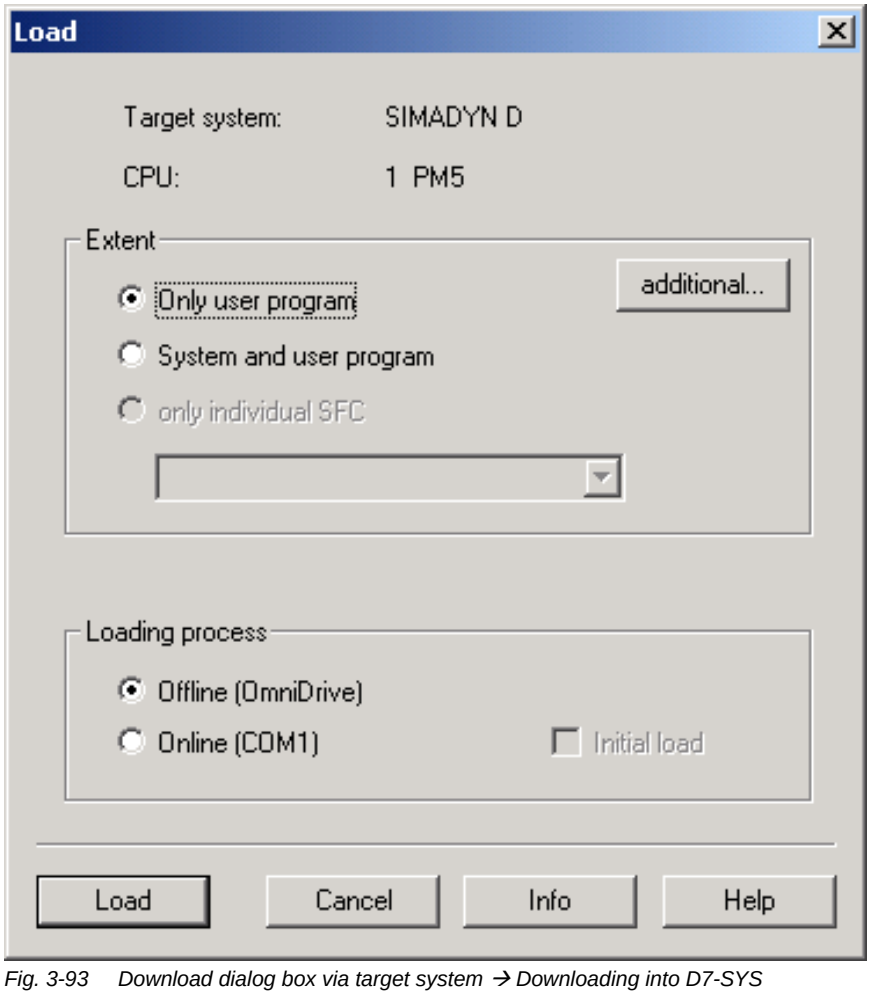


Fig. 3-93 Download dialog box via target system → Downloading into D7-SYS

(2) Opening the dialog box for optional components
A maximum of 2 components can be selected. A file can be selected for the selected components by clicking on the “NEW” button.

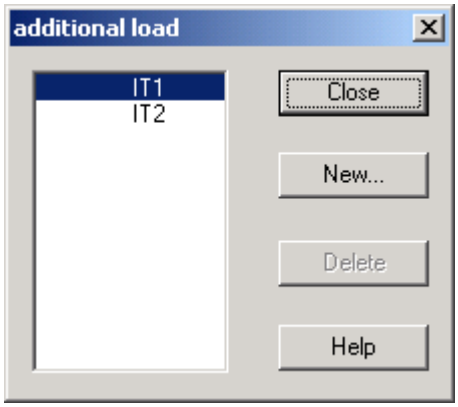


Fig. 3-94 Selection dialog box for optional components, e.g. table data

(3) A file selection dialog box opens to select additional components

The component file, previously created using the D7-SYS additionalComponentBuilder, is now assigned the component IT1 and during the next download operation, is written into the memory card.

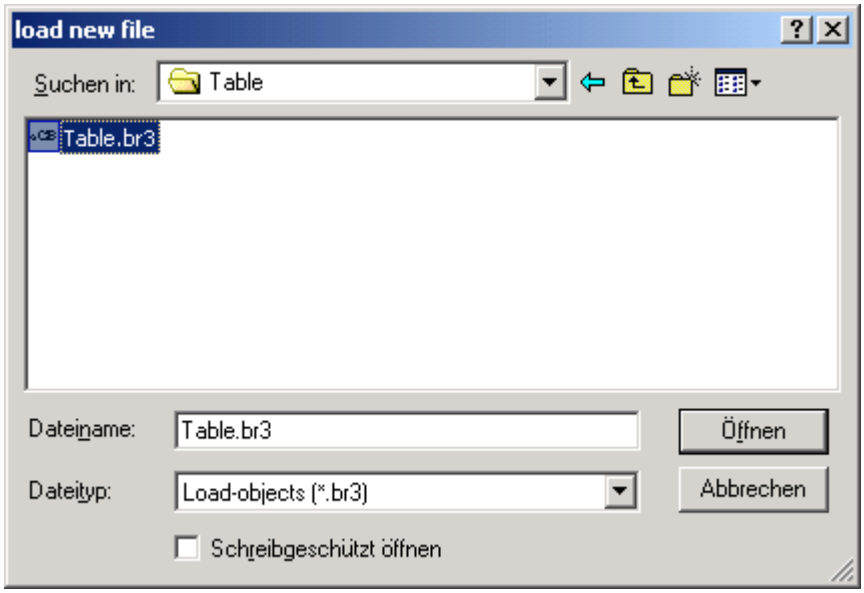


Fig. 3-95 Downloading a component file

3.18.4.4 Configuring the function blocks

For the "automatic mode, memory card" mode, only the TAB and/or TAB_D function blocks must be configured, depending as to whether table values, REAL data type and/or DINT data type have to be managed. Each table may only contain values of one data type. If several tables are to manage various data types, then a TAB or TAB_D should be configured for each table.

The TAB and TAB_D function blocks should be configured in a sampling time greater than or equal to 32ms. The following connection settings are required:

CTS= 0

US = Not assigned

NAM = Name of the table file (with file name extension which was defined when "saving", e.g. MS Excel)

AUT = 1 (automatic mode activated)

The configuring is shown in the following diagram:

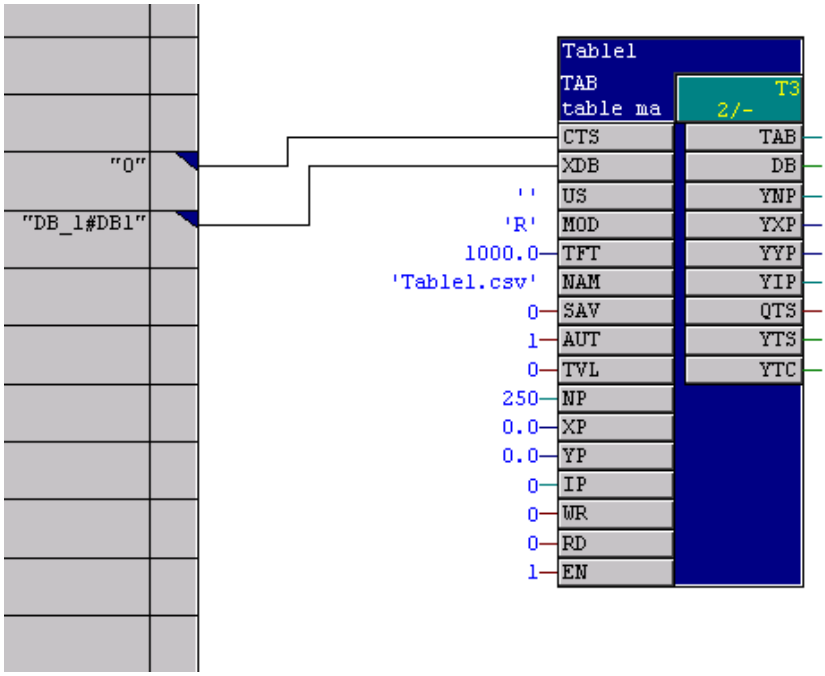


Fig. 3-96 Configuring the TAB function block

The table function blocks for 2 tables are shown in the following diagram. The table values, which are now managed by the function blocks, can now also be used by additional function blocks, e.g. FB TABCAM.

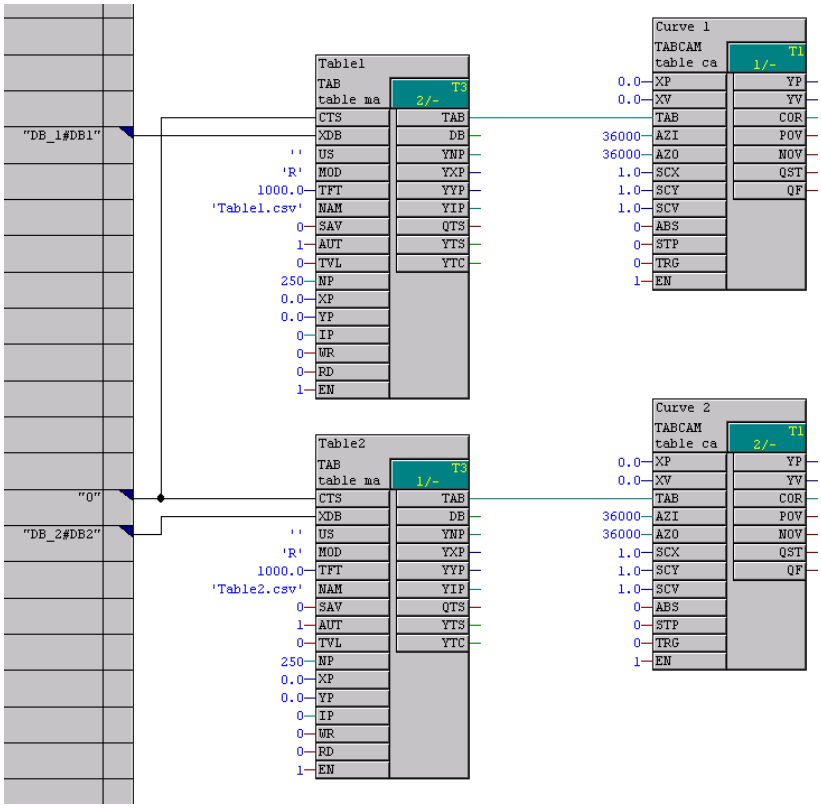


Fig. 3-97 Configuring example

3.19 Parameter access technique for D7-SYS

3.19.1 General description of the parameter functionalityinformation

By appropriately parameterizing using operator control devices for parameters at the block I/O:

- Reading values
- Changing values
- Changing values and saving in the CPU change (cache) memory
- Changing interconnections using BICO technology
- Changing interconnections and saving in the CPU change (cache) memory
- Reading parameter descriptive elements

Hardware platforms

You can be used for the Parameter access technique following hardware platforms:

- T400 technology module
- Application module FM 458
- SIMADYN D standard CPUs

NOTE Masterdrives operator control devices, for example, OP1S or “DRIVE ES”/“DRIVE Monitor“ can be used for parameterization.

3.19.1.1 Parameters

When the parameter access technique for D7-SYS you designate block inputs or outputs as parameter.

There are two types of parameters:

- **Monitoring parameters**
  - These can be configured at the inputs and outputs of blocks
  - Values can only be read.

- **Setting parameters**
  - are configured at block inputs
  - values can be read, changed and saved in the change memory.
  - interconnections to other blocks can be changed using BICO technology

NOTE You cannot change parameter values if $ signals or virtual connections are configured at the block inputs.

Connection data types for parameters

You can configure the following D7-SYS connection data types of the blocks as parameter:

D7-SYS connection data type in CFC	Bool	Integer	Double Integer	Word	Real	SDTime
Parameter data type in the parameter description	O2	I2	I4	V2	I4	I4

Configuring parameters

A maximum of 2000 different parameters are available. Each parameter may only be assigned once. Parameters are configured in CFC as follows:

Designate the block connection using a pseudo comment @TP_bnnn, with

- b: range identification "H", "L", "c" or "d"
  - designates the number range
  - "H" or "L": I/O can only be read and changed
  - "c" or "d": Connections can only be read
- nnn: three-digit parameter number
  - 000 to 999

NOTEs

- A parameter number may only be assigned once (checked using the CFC).
- A pseudo comment may not be configured at a chart interface connection.
- A pseudo comment may not be configured at a block connection in a chart, which is to be compiled as block type.
- No more than one parameter may be configured as pseudo comment per block connection.
- A comment can include several pseudo comments, separated by blanks, followed by a "standard" comments text, e.g. "@TP_H089 @DATX ...".)

Accessing parameters

You can externally access parameters (e.g. from a higher-level control system such as SIMADYN D) as follows:

Pseudo comment	T400 Techboard	T400 baseboard / CPU modules in SIMADYN D subracks	Can be configured at connection	Connection	Significance
	Display operator control units	Display operator control units	O: Output I: Input		
@TP_dxyz	dxyz	rxyz	A / E	Any	Monitoring parameter
@TP_cxyz	cxyz	nxyz	A / E	Any	Monitoring parameter
@TP_Hxyz	Hxyz	Pxyz	E	None or OP connections	Setting parameter
@TP_Lxyz	Lxyz	Uxyz	E	None or OP connections	Setting parameter
@TP_Hxyz	Hxyz	Pxyz	A	Any	Monitoring parameter
@TP_Lxyz	Lxyz	Uxyz	A	Any	Monitoring parameter

Legend

xyz:	Parameter number
any:	Interconnected or not interconnected .
OP connection:	Interconnected using global operands.

3.19.1.2 BICO technology for SIMADYN D

With MASTERDRIVES operator control devices, with BICO technology you can change interconnections between blocks. You can change configured software without using the CFC. You can change interconnections on a T400 technology board, Application module FM 458 or CPU module in a SIMADYN D subrack.

DANGER

- **BICO technology and the CFC test mode should not be used simultaneously.**
- **If you make online changes in the CFC test mode, then you must first re-compile before you use BICO technology. Changes made in the CFC only become effective on the display of the operator control device after compilation.**
- **If changes were made using BICO technology without saving them in the CPU change memory, then data consistency between the changes on the CPU and your configured software on the PC/PG are no longer guaranteed, and can no longer be established by updating the project. If you wish to avoid this inconsistent condition, you must first RESET the module before you use CFC in the test mode**

NOTE If you have made interconnection changes using BICO technology, and then you activate the CFC test mode, a warning is displayed in the form of the "different software release" dialog box.

Data types for technological connectors

You can configure the following D7-SYS connection data types of the blocks as technological connectors:

D7-SYS connection data type in CFC	Bool	Integer	Double Integer	Word	Real	SDTime
Data type of the technological connector in the parameter description	O2	I2	I4	V2	I4	I4

Configuring technological connectors

In order that you can change interconnections between blocks using BICO technology, you must, in addition to the parameters, still configure technological connectors at block outputs in the CFC. You can use block outputs with technological connectors to change the interconnection using BICO technology.

Technological connectors are configured as follows:

Designate the block output with a pseudo comment @TC_nnnn, with nnnn: four-digit technological connector number 0000 to 9999

NOTES

- No more than one technological connector may be configured as pseudo comment per block output.
- A technological connector number may only be assigned once (checked using CFC).
- It is not permissible to configure a technological connector at a plan interface connection.
- It is not permissible to configure a technological connector at the connection (I/O) of a block in a chart, which is to be compiled as block type.
- A comment can include several pseudo comments, separated by blanks, followed by "standard" comments text, e.g. "@TC_1389 @TP_H345 ...

Reading parameters

You can read a parameter and output the value using an operator control device.

The output value corresponds to:

- for block I/O, interconnected with technological connectors, the number of the technological connector @TC_nnnn
- for block I/O which are not interconnected, the value of the block input or output

From the parameter documentation of a standard software package, you can identify whether the output value represents the number of a technological connector or the value of the block input. It is not possible to make this differentiation at the operator control device display.

Changing interconnections using BICO technology

Using BICO technology, you can only change existing interconnections between blocks, if these interconnections are configured as follows in the CFC:

- technological connectors @TC_nnnn are configured as pseudo comments at the block output,
- parameter @TP_Hnnn or @TP_Lnnn is configured as pseudo comment at the input of a block,
- the blocks are interconnected by connecting an input with pseudo comment @TP_Hnnn or @TP_Lnnn and an output with pseudo comment TC_nnnn.

The interconnection is changed using BICO technology, by entering, at the operator control device, the number of another technological connector @TC_nnnn as parameter value.

NOTE

- The maximum number of interconnections of different inputs which are changed with BICO technology, which are saved in the change memory, are, for
  - technology module T400: approx. 1600
  - Application module FM 458: approx. 400
  - CPU module in the SIMADYN D subrack: approx. 400
- Using BICO- technology, you can only change existing interconnections between block I/O, but you cannot delete them.
- Using BICO technology, you cannot establish a new interconnection at inputs which are not connected.
- Changes made to the interconnections of block I/O using BICO technology, are only effective when updating the project in the CFC, if they were saved.
- For changes made to the interconnections of block I/O using BICO technology, when type checking the connections, the same rules apply as for CFC.

CAUTION

The pseudo comment @DATX is not supported by the CFC test mode. When changing an interconnection, where @DATX is available as pseudo comment at the block input, the value for this connection is updated again, but still maintaining the data consistency mechanisms. Thus, the pseudo comment @DATX is no longer valid.

Remedy: Re-compile and re-load the user program.

Examples

Interconnection possibilities using BICO technology and their significance:

Pseudo-comment	Con-nection-Type	Inter-connected with	Processed at the operator control device	
			Read	Write
@TP_L/H	I	Standard	Display value	Not possible
@TP_L/H	I	Flag	Display value	Change value
@TP_L/H	I	$ signal	Display value	Not possible
@TP_L/H	I	Virtual inter-connection	Display value	Not possible
@TP_L/H	I	—	Display value	Change value
@TP_L/H	I	@TC_	Display the number of the @TC_	Interconnect to a new number of @TC_, if present
@TP_c/d	I	Any	Display value	Not possible
@TP_c/d	I	@TC_	Display value	Not possible
@TP_L/H	O	Any	Display value	Not possible
@TP_c/d	O	Any	Display value	Not possible
@TC_	I	—	Error message when compiling in the CFC	
@TC_	O	—	Source for interconnection using BICO technology	

Legend

@TP_L/H: Parameter @TP_Lnnn or @TP_Hnnn

@TP_c/d: Parameter @TP_cnnn or @TP_dnnn

@TC_: Technological connector @TC_nnnn

Standard: The output is not a flag, not a $ signal and is not a virtual interconnection.

Any: Interconnected or not interconnected.

— : No interconnection.

Interconnections extending over different tasks

The number of newly generated interconnections between different tasks using BICO technology is limited. The largest of the following values applies for your application:

- Value 20
- 20 % of the already configured number of interconnections between tasks
- 0.25 × number of the @TC_... technological connectors configured in task n.

3.19.1.3 Status-dependent parameter changes

If selected parameters are only to be changed when the system is in specific statuses, then you can configure the following functions blocks:

- Function block PSTAT
  - to configure a device status
  - by entering a password with the authorization level enabled
- Function block PLIM
  - defines the statuses and access levels in which a parameter may be changed

Additional information
on function blocks, refer to the Reference Manual "SIMADYN D Control system, Function Block Library".

3.19.1.4 Identifying SIMADYN D components

Reserved parameters

To identify components, “DRIVE Monitor“ evaluates technology parmeters d998 (1998) and d999 (1999).

d998	Device	Special feature
80	SIMADYN D, general	The parameter range, especially extended for SIMADYN D up to 16 * 2000 parameters, applies. Parameters are possible in the basic device parameter range (0 .. 999). This means, an identification can result in a random product if a parameter just by chance coincides with the identification parameter and value of a drive converter/inverter.
134	T400 /	Parameter range = technology parameters (1000 .. 1999; 3000 .. 3999)
134	FM 458/ SRT400	Parameter ranges, the function can be set at the central FB • BASEBOARD: 0 ... 999; 2000 ... 2999 • TECHBOARD: 1000 ... 1999; 3000 ... 3999

Procedure when identifying

Prerequisite: The user selects SIMADYN D or SRT400 and goes online with the device type.

Dependig on the selected device type, DriveMonitor checks the identification parameter d998. If the identification was successful, it is not checked as to whether another device can be recognized.

1. User selects SIMADYN D: If d998 = 80, then the identification routine is considered to have been successful.
2. User selects SRT400: If d998 = 134, then the identification routine is considered to have been successful. This means that the user can only address the technology, also independently of the basic device!

The following is still valid: Parameter d999 is optional to identify the software version and release of standard software packages.

d999	Software	Examples
1AB	Angular synchronism, version A.Bx (x is used to number compatible versions)	120 → SPA440 V2.0x 123 → SPA440 V2.3x
2AB	Axial winder, version A.Bx	221 → SPW420 V2.1x
3AB	Cross-cutter/closed-loop shears control, version A.Bx	310 → SPS450 V1.0x

If the device identification is not successful, then an attempt is made to identify the known devices types.

If “DRIVE Monitor“ recognizes a different software (d999), the “Create database” option is listed in the “Device identification” dialog box. This means that a specific database can be set-up.

3.19.1.5 Units and unit texts

In order that you can assign *units* (physical quantities) to an input or output, you must configure a text string for the block I/O from the table below.

Physical quantity	Units	Text string to be configured
Length	Meters	m
	Millimeters	mm
	Kilometers	km
	Micrometers	um
Surface	Square meters	m²
	Square millimeters	mm2
	Square kilometers	km2
Volume	Cubic meters	m³
	Liters	l
Time	Seconds	s
	Minutes	min
	Hours	h
	Days	d
	Milliseconds	ms
	Microseconds	us
Force	Newton	N
	Kilo newtons	kN
	Mega newtons	MN
Pressure	Pascal	Pa
	Kilopascal	kPa
	Millibar	mbar
	Bar	bar

Physical quantity	Units	Text string to be configured
Length	Meters	m
	Millimeters	mm
	Kilometers	km
	Micrometers	um
Weight	Kilograms	kg
	Grams	g
	Milligrams	mg
	Tons	t
Energy, work	Joules	J
	Kilo joules	kJ
	Mega joules	MJ
	Watt hours	Wh
	Kilowatt hours	kWh
	Megawatt hours	MWh

Physical quantity	Units	Text string to be configured
Active power	Watts	W
	Kilowatts	kW
	Megawatts	MW
	Milliwatts	mW
Apparent power	Volt-ampere	VA
	Kilovolt-ampere	kVA
	Megavolt-ampere	MVA
	Millivolt-ampere	mVA
Speed	1 / second	1/s
	1 / minute	1/min
	1 / hour	1/h
Angle	Radian	rad
	Seconds	"
	Minutes	'
	(old) degrees	grad
	New degrees (Gon)	ngrad
Velocity	Meters / second	m/s
	Millimeters / second	mm/s
	Millimeters / minute	mm/min
	Meters / minute	m/min
	Kilometers / minute	km/min
	Millimeters / hour	mm/h
	Meters / hour	m/h
	Kilometers / hour	km/h
Volume flow	Cubic meters / second	m3/s
	Cubic meters / minute	m3/min
	Cubic meters / hour	m3/h
	Liters / second	l/s
	Liters / minute	l/min
	Liters / hour	l/h
Mass flow	Kilograms / second	kg/s
	Grams / second	g/s
	Tons / second	t/s
	Grams / minute	g/min
	Kilograms / minute	kg/min
	Tons / minute	t/min
	Grams / hour	g/h
	Kilograms / hour	kg/h
	Tons / hour	t/h

Physical quantity	Units	Text string to be configured
Torque	Newton meter	Nm
	Kilonewton meter	kNm
	Meganewton meter	MNm
Temperature	Kelvin	K
	Degrees Celsius	C
	Degrees Fahrenheit	F
Enthalpy	Joule / Kilogram	J/kg
	Kilojoule / Kilogram	kJ/kg
	Megajoule / Kilogram	MJ/kg
Voltage	Volt	V
	Kilovolts	kV
	Millivolts	mV
	Microvolts	uV
Current	Ampere	A
	Milliampere	mA
	Kiloampere	kA
	Microampere	uA
Resistance (electrical)	Ohm	Ohm
	Milliohm	mOhm
	Kiloohm	kOhm
	Megaohm	MOhm
Ratio	Percentage	%
Absolute humidity	Gram / Kilogram	g/kg
Frequency	Hertz	Hz
	Kilohertz	kHz
	Megahertz	MHz
	Gigahertz	GHz
Referred torque	Newton meter / ampere	Nm/A
Acceleration	Meter / seconds	m/s2
	Meter / seconds	m/s3

3.19.2 Parameterizing on the Application module FM 458

3.19.2.1 Terminology

- EXM448
  EXM 448 communications expansion module of the FM 458 application module
- CBP2
  COMBOARD/communications module for PROFIBUS DP

- “DRIVE ES” or “DRIVE Monitor“
  Configuring software for drives and software for parameterization

3.19.2.2 Communications behavior

The FM 458 applications module can be configured in a SIMATIC S7-400 rack together with one or two communication expansion modules EXM 448. An option module, e.g. CBP2, can be inserted in the free slot X02. The CBP2 can be used to send and receive parameter tasks.

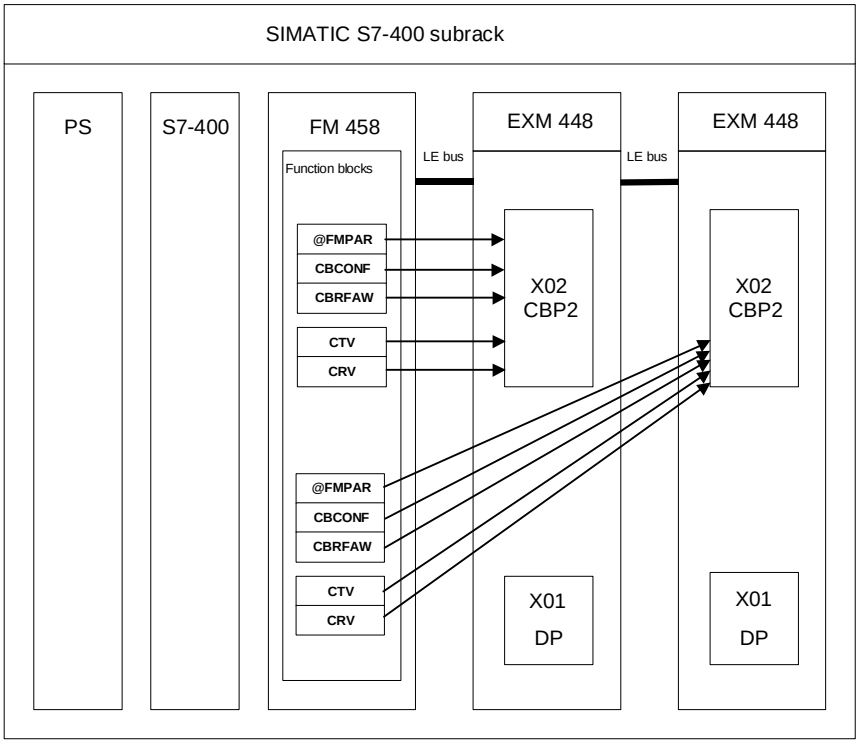


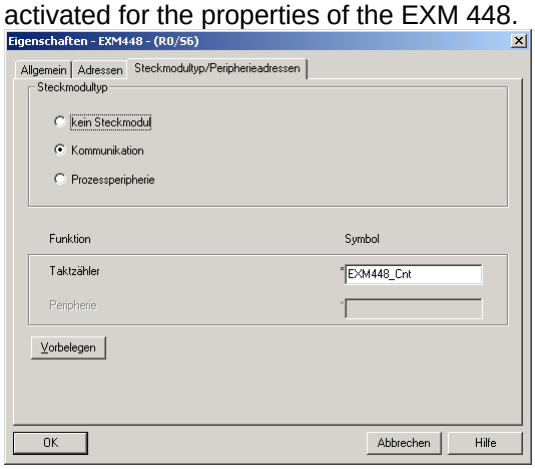
Fig. 3-98 Schematic diagram of the FM 458 application module with two EXM 448 communication-expansion modules

3.19.2.3 Generating the hardware configuration

You require the following hardware to parameterize the SIMATIC FM 458 modules:

- Subrack for S7-400
- Power supply module for the S7-400
- Central module (CPU) for S7-400
- FM 458 application module for SIMATIC S7-400
- EXM 448 communications-expansion module

In HW Config, the "Communications" plug-in module type must be activated for the properties of the EXM 448.



- CBP2 communications module (COMBOARD)

3.19.2.4 Functional scope

You must configure the following function blocks when parameterizing with “DRIVE Monitor“:

- Central block @FMPAR
  - monitors the COMBOARD
  - processes the parameter tasks
- Function block CBCONF
  - used to configure a COMBOARD
  - used to display the diagnostic data of a COMBOARD

You can configure the following function blocks for additional functions:

- Function block CBRFAW

  To receive the alarms from a COMBOARD

- CRV

  The receive block distributes values from a data interface to the block inputs of function blocks of the same CPU.
  Only max. 16 PZD words can be received and sent using a COMBOARD (e.g. CBP2).

- CTV

  The function block only acquires and sends block output values from the CPU function blocks, on which it is configured.

3.19.2.5 Operator devices which can be connected

You can use the “DRIVE ES” or “DRIVE Monitor“ configuring software to parameterize the FM 458 application module

3.20 Communications utility, display control

3.20.1 General description

Display devices

The communications utility, display control can control two types of display devices:

- OP2 operator control device
  - can display and change a maximum of 24 configured process data and maximum of 32 binary values
  - it can output SIMADYN D messages
- Digital display VD1
  - this can display a maximum of 24 configured process data

The display devices communicate with SIMADYN D via the USS bus.

Function of the communications utility

The configured data defines which display device is supplied with which process data and binary values. Messages, when configured, are always transmitted per broadcast to all of the display devices via the USS bus. A selection is made locally at the OP2 as to which OP2 receives which messages for display.
Further information
on the OP2, refer to the OP2 User Manual.

The format information for the process data and binary values is specified by the configured data. This information is transferred to a display device when this display is being initialized (e. g. after power-up). After the initialization phase, only the process data selected at the display device are cyclically transferred. For OP2, all of the binary values are also cyclically transferred.

In this fashion, cyclic telegram data transfer along the USS bus can be maintained, so that display devices and drive units can be simultaneously handled on a USS bus.

3.20.2 Hardware

Requirements

Hardware required for the display control:

- USS master interface for SIMADYN D
  - CS7/SS4 or T400

(for a description of the USS bus refer to Chapter USS master coupling)

3.20.3 Software

Configuring

The following must be configured to use a display device:

- @CSU central coupling block to commission the USS master coupling on CS7/SS4 or @USS_M on T400.
- @DIS central block to control one or several display devices on the USS bus.
- DIS... process data blocks for a display device to display and change any values, and/or
- Binary value blocks DISA1B, DISS1B for a display device to display and change binary values, and/or
- MSI standard message output blocks to output messages on an OP2.

NOTE

The @DIS central block as well as all of the associated "DIS" process data- and binary value blocks must be configured on the same CPU in the same sampling time (recommended: 30..300ms). In order to be able to display or change process data and binary values from other CPUs at a display device, this data must be transferred using other mechanisms ($ signals, process data communications).

Messages can be output, in parallel from several message output blocks, at all OP2 units. As a message output block (independent of @DIS) directly uses the USS coupling, these blocks can be configured on any CPU and in any sampling times.

Process data blocks, binary value blocks and message output blocks can be optionally configured. For instance, an OP2 can be exclusively used to output just messages.

3.20.3.1 Central block @DIS

General

The @DIS central blocks control a maximum of 31 display devices via a USS bus.

Data entry at input DIS

The display system name is specified at input DIS. Using this name, the process data- and binary value blocks reference to the display system.

The block sets-up, for each display device, one receive- and one transmit channel on the communications interface referenced by input CTS. As only USS is possible as communications interface, there are no general address inputs (AT, AR, US), but just two connections to specify which USS station addresses are to be controlled.

NOTE The blocks automatically assign channel names and address stages for the receive- and transmit channels.

3.20.3.2 Process data acquisition blocks

General

A maximum of 24 process data can be configured for each display device (OP2 or VD1). A process data acquisition block must be configured for each process data. Using a block, the same process data of several display devices can be simultaneously assigned under the same process data number.

Common connections

- **DIS**
  Reference to the display system configured by @DIS.
- **ST1, ST2**
  USS station addresses of the display devices at which the process data can be selected.
- **KEY**
  Process data number under which the process data can be displayed at the display device (for OP2, keys V1 to V12).
- **NAM**
  Name of the process data at OP2. If nothing is specified here, the following is displayed on OP2: "SIGNALnn".
- **MIN, MAX**
  Minimum and maximum to limit the input for the setpoint acquisition blocks.
- **FOR**
  - only for the real data types and SDTIME: Number of decimal places which are displayed at the OP2.
  - for older OP2 versions, information is always displayed to seven decimal places and exponents which can be divided by three.

The connection attribute, scaling factor and units at inputs and outputs of real data types (DISA.X and DISS.Y), are taken into account at the display device.

Process data acquisition block types

There are twelve various process data acquisition blocks for display devices:

- Six for setpoints
- Six for actual values

•

Name, FB type	Data type	Connections for OP2 display	Designation
DISA_B	BOOL	NAMe	"Display device, actual value acquisition"
DISA_I	INT	NAMe	
DISA_W	WORD	NAMe	
DISA_D	DINT	NAMe	
DISA	REAL	NAMe, FORmat	
DISA_T	SDTIME	NAMe, FORmat	
DISS_B	BOOL	NAMe	"Display device, setpoint acquisition"
DISS_I	INT	NAMe, MIN, MAX	
DISS_W	WORD	NAMe	
DISS_D	DINT	NAMe, MIN, MAX	
DISS	REAL	NAMe, MIN, MAX, FORmat	
DISS_T	SDTIME	NAMe, MIN, MAX, FORmat	

Table 3-69 Process data acquisition block types

Setpoint interlocking (only OP2)

If a setpoint is simultaneously configured with the same process data block for several OP2, then it cannot be simultaneously changed from each OP2.

The setpoint can be changed at that OP2 at which is was selected by first depressing the "CHG" key. As long as the setpoint is selected, and "CHG" is running, data cannot be changed at other OP2 devices. If an attempt is made to change the value, the user obtains an appropriate system message.
Further information
on the OP2, refer to the OP2 User Manual.

The setpoint function blocks have connections XAL and ENI, which can be used to display an alternative setpoint input at the OP2; but this setpoint cannot be changed. You will find configuring examples for this in the Reference Manual Function block library for setpoint blocks (DISS...).

3.20.3.3 Acquisition blocks for binary values (only OP2)

General

A maximum of 32 binary values can be configured at each OP2. A binary value block must be configured for each binary value. In this case, using one block, the same binary value can be assigned to several OP2 devices simultaneously under the same binary value number:

Common connections

- **DIS**
  Reference to the display system, configured using @DIS.
- **ST1, ST2**
  USS station addresses of the OP2 operator control unit, at which the binary value can be selected.

- **KEY**
  Binary value number which can be selected under the binary value at OP2 (binary value numbers 1 to 4 correspond to keys B1 to B4).

- **NAM**
  Designator for the binary value at OP2. If nothing is specified here, then the following is displayed at the OP2: "SIGNALnn".

- **TRU, FAL**
  Designator for the logical conditions of the binary value at OP2 (TRU = True = Logical 1; FAL = False = Logical 0). If nothing is configured here, then the following is displayed at the OP2: "0" and "1".

Binary value function block types

There are two types of binary value function blocks:

- One for setpoints
- One for actual values

FB type name	Data type	Connections for OP2 display	Designation
DISA1B	BOOL	NAMe TRU (true text) FAL (false text)	"Display device, binary actual value acquisition"
DISS1B			"Display device, binary setpoint acquisition"

Table 3-70 Binary value function block types

3.20.3.4 Message output blocks (only OP2)

General

- The message is directly output at an OP2 using a message output block via the USS coupling.
- A message is transferred, per broadcast, to all OP2 units connected to the USS bus.
- The message for display can be selected at each OP2. This selection is made by configuring the message classes (prefix).
- A maximum of 16 message output blocks can be configured (limited by the number of broadcast channels for the USS coupling).

Data entry at address input AT

Data entry at the address input of a message output block:

AT: **"channelnam.1.99"**

- **channelnam**
  Freely-selectable channel name (this must be unique on the communications interface)

- **1**
  Address stage 1 = 1 signifies a special display device telegram (refer to the Chapter, USS master coupling)

- **99**
  Address stage 2 = 99 signifies a broadcast address (refer to Chapter USS master coupling)

NOTE

- A maximum of the first 56 characters of the message text are output at the OP2.
- For messages with value, a maximum of the first 28 characters are output. A longer message text will be cut-off.

Message output block MSI

The MSI message output block must be configured to output messages. In this case, connections SSF (submit standard format), SNV (submit message number value) and STM (submit text for messages) must be configured as follows:

Possible data entries at connections SSF, SNV, STM of the message output block MSI:			
SSF (hex format	SNV (prefix/suffix)	STM (text)	Evaluation and output at the OP2:
0	0	1	Message, only with text: This is always output at the OP2 (with text).
0	1	1	Message with prefix/suffix and with text: The prefix is evaluated as message class. If the message class is permissible, the message is output with text. Otherwise, it is rejected.
0	1	0	Message without text: The prefix is evaluated as message class. If the message class is permissible, the message is output with prefix/suffix. Otherwise, the message is rejected.
0	0	0	(illegal combination; message is rejected)

Table 3-71 Possible data entries at connections SSF, SNV, STM of the message output block MSI

The message class (prefix) of a message is configured at the message acquisition blocks (connection RP) (refer to the Chapter Communications utility, message system).

The permissible message classes for an OP2 are locally configured at the OP2

Further information
on the OP2 operator control device, refer to the User Documentation "SIMADYN D, hardware description".

3.20.4 Application information

General

The "DIS" function blocks are structured, so that they operate together within an optimized time frame. The configuring rules (all function blocks in the same sampling time) guarantee that the processing steps are executed in precisely the correct sequence within one sampling time:

1. Telegram received from the display device (using @DIS)
2. The receive telegram contents are evaluated (using process data- and binary value blocks)
3. The transmit telegram contents are prepared (using the process data- and binary value blocks)
4. Telegram is transmitted to the display device (using @DIS in the next sampling time)

The subordinate USS coupling operates asynchronously (bus circulating time).

3.20.4.1 Computation times

General

The computation times of the function blocks are independent of that of the application. As a display device system can process between one and 31 stations, the computation time differs.

The computation times of the function blocks for a display device as well as the additional computation time for each additional display device in µs are shown in the following tables.

	@DIS	DISAx	DISSx	DISA1B	DISS1B	DISS11
One display device	360	20	50	20	30	30
Each additional display device	150	0	0	0	0	0

Table 3-72 Computation time in µs

The computation time of a process data setpoint block can be several sampling times longer for certain operations (e. g. saving a value in the change memory).

3.20.4.2 Data transfer times

General

The response times when displaying data at an OP2 should not exceed 300 milliseconds, otherwise this will appear too slow for the operator. This time is significantly influenced by the USS bus circulating time and the sampling time in which the blocks are configured. Thus, it is recommended, that both times are kept well below 300 milliseconds.

An overview of the bus circulating time as a function of the configured baud rate, configured number of stations and transferred messages is shown in the following table:

Baud rate (kbaud)	Number of stations	Bus circulating time without messages (ms)	Max. message run time (ms)
187,5	1	10	22
	28	280	
	30	300	

93,75	1	12	34
	22	264	
	25	300	
19,2	1	30	135
	6	180	
	10	300	
9,6	1	52	240
	6	312	

Table 3-73 Bus circulating time

NOTE A configured station which still is not available on the USS bus extends the bus circulating time by 20 milliseconds.

Initialization

If an OP2 is powered-up, then to start off with, the descriptive data of the configured process data and binary values from SIMADYN D are transferred to the OP2. The maximum time for this initialization is, for a bus circulation time of 300 milliseconds, approximately 40 seconds.

3.20.5 Configuring example

Description

The example describes an "OP2SYS" display system with three operator control devices. The three operator control devices have the station addresses 0, 8 and 22 at the USS bus.

Only the function blocks relevant for OP2 are listed here. It is also necessary, for example, to configure a @CSU.

Central block @DIS

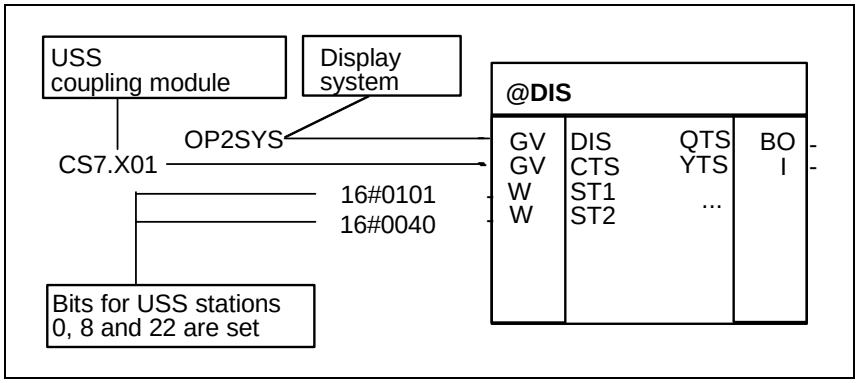


Fig. 3-99 Central block @DIS

- **Actual value acquisition to display on all three OP2 devices, selectable using key V1**

  – The following is output at OP2 together with the configured connection attributes at actual value input X: Scaling factor=1; units=0/00 (dependent on the actual value):
  PEPSI = x.xxxxxx 0/00

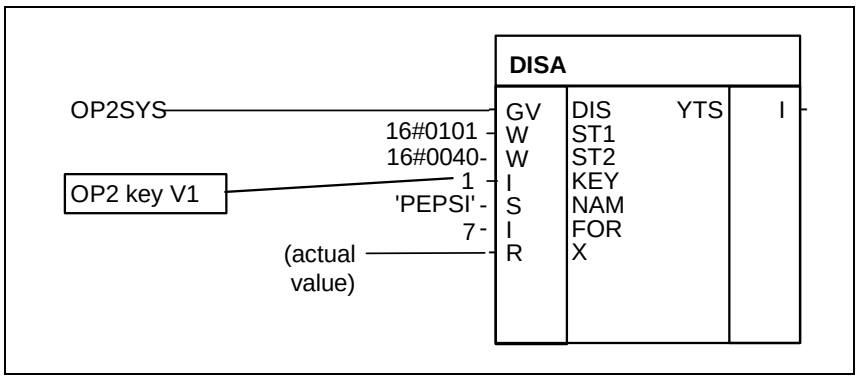


Fig. 3-100 DISA

- **Setpoint acquisition for display and changing on two OP2 devices (stations 0 and 22), selectable using key V2**

  – The following is output at OP2 together with the configured connection attributes at setpoint output Y: Scaling factor=1; units=km/h: SPEED = x.xxxxxxx km/h

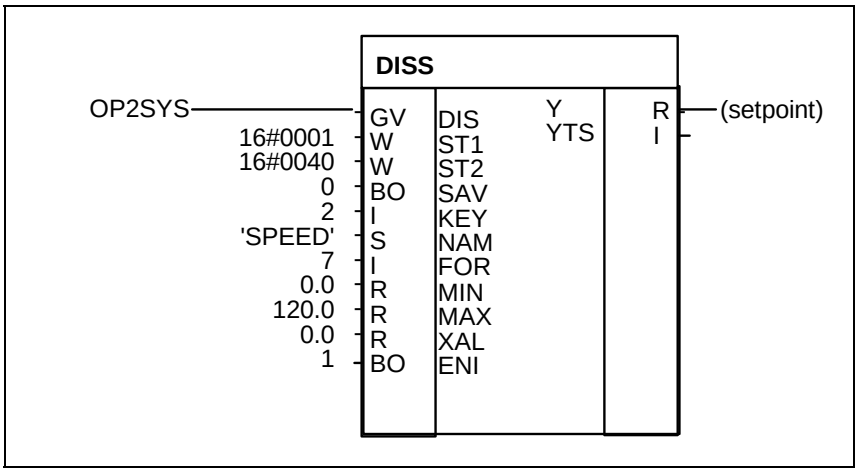


Fig. 3-101 DISS

- **Binary setpoint acquisition for display and changing at an OP2 (station 22) under binary value number 7**

  – The following is output at the OP2 (extended binary value processing):
  WINDOW
  OPEN

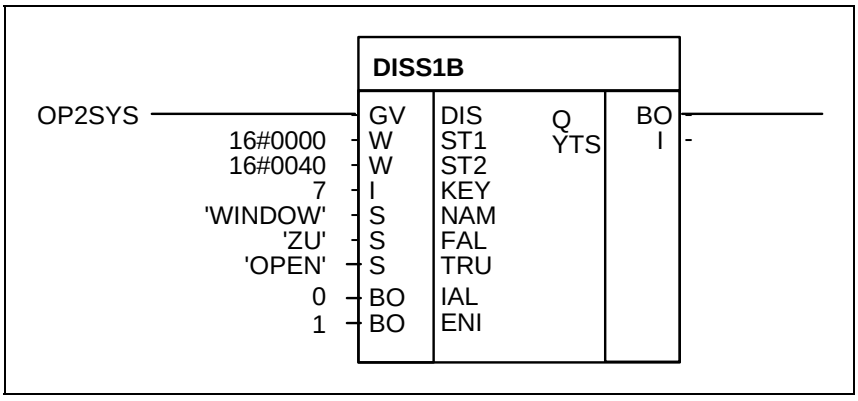


Fig. 3-102 DISS1B

3.21 Communications utility, message system

General

The message system allows the user to log certain events which he has selected. A description of these events is collected in the message sequence buffer and is then made available to the user via a data interface.

Configuring

The message system operates purely on the CPU. Precisely one central block and at least one message evaluation block must be configured. There are no configuring rules regarding the number of blocks.

Function blocks for the message system

The message system consists of 3 types of function blocks:

- **Central block @MSC**
  The central block sets-up the required data structures and administers them. It is also responsible in evaluating communication- and system error messages.
- **Message entry blocks MER ...**
  Message entry blocks generate messages when an input changes. Message entry blocks can mutually interrupt each other. Thus, the messages do not have to be entered in the message sequence buffer in the sequence in which they occurred.
  The message entry blocks differ by:
  - the number of messages which can be generated.
  - the capability of being able to process additional incoming process conditions/statuses in the form of measured values.
- **Message evaluation blocks MSI ...**
  Message evaluation blocks output messages, generated by the message entry blocks, via a data interface and make them accessible to the user.

3.21.1 Entry logic of the message entry blocks

3.21.1.1 Message entry blocks for an activated message

Entry logic

For message entry blocks, which only generate an activated message, the following conditions must be fulfilled for message entry:

- input EN must be set.
- a positive edge must be available at input I1.
- connection Q1 or SM must be reset.

If the conditions are fulfilled, a message is generated and connection Q1 is set.

If the conditions are not fulfilled, then, if connection SM is reset, connection Q1 is also reset.

3.21.1.2 Message entry blocks for an activated and a de-activated message

Entry logic

For message entry blocks, which generate an activated and a de-activated message, the following conditions must be fulfilled for message entry:

- input EN must be set.
- for an activated message, a rising edge must be available at input I1 and connection Q1 or SM must be reset.
- for a de-activated message, a falling edge must be available at input I1 and connection Q2 or SM must be reset.

If these conditions are fulfilled, then:

- for a rising edge, an activated message is generated and connection Q1 is set.
- for a falling edge, a de-activated message is generated and connection Q2 is set.If these conditions are not fulfilled, and if connection SM is reset, connections Q1 and Q2 are reset.

Special features for MER16, MERF16, MER0, MERF0

For message entry blocks MER16, MERF16, MER0, MERF0, which have a vector as message connection, and which generate 16 or 32 messages, for message connection IS1 and output connection QS1 or QS2, the appropriate bit positions must fulfill the conditions of the entry logic.
Further, these blocks have a QN output, which indicates whether a message was generated.

3.21.2 Configuring example for a message system

Prerequisites for a message system

- Subrack
- At least one CPU in the subrack
- A data interface is available with the name ”D01”

Function blocks required

In the example, only the actually required blocks for the message system are listed. Central communication blocks (e. g. for the data interface) are not listed.

The configured message system consists of:

- 1 central block @MSC
- 2 entry blocks (MER and MERF0)
- 2 message evaluation blocks (MSI and MSIPRI)

Name and message buffer

The name of the message system is ”MELD”. This name is configured at all CMS connections of the message blocks. The message buffer can accommodate 30 messages (connection NOM at @MSC), is located in a volatile RAM (connection SAV at @MSC) and is enabled for message entries (connection MUN at @MSC).

Assigning message and block

Generated messages can be assigned to blocks using the RP- and RRS connections, whereby each block of the message system has at least one RP connection. Proceed as follows:

- **Prefix 0**
  Designates a message which is generated by @MSC (communications- and system error messages). Thus, connection RP of @MSC is assigned the value 0. @MSC automatically generates the suffix, depending on the message type.

- **Prefix 1**
  Designates a message, which is generated by MSI (overflow messages). Thus, MSI assigns a value of 1 to connection RP. MSI automatically generates the suffix (number of messages which have overflowed).

- **Prefix 2**
  Designates a message which was generated by MSIPRI.

- **Prefix 3**
  Designates a message, which was generated from a message block (MER or MERF0). Thus, connection REP of MER and MERF0 is assigned the value 3. The suffix is not automatically generated as for the other blocks. In this case, the connections are available, at which the suffix can be configured. 33 various messages are generated in the example (1 MER message, 16 activated messages MERF0, 16 de-activated messages MERF0), which are numbered from 0 - 32:

  - The message of block MER is assigned suffix 0 (RS connection MER).
  - The 16 activated messages of block MERF0 are assigned suffix 1-16 (RS1 connection MERF0).
  - The 16 de-activated messages of block MERF0 are assigned suffix 17-32 (RS2 connection MERF0).

- **Suffix**
  For block MERF0, for the suffix a basis value is specified. The bit number of the message-generating bits of message signal vector IS1 is added to this basis value.

Functional combination of the messages

Using a prefix and suffix, it is not only possible to uniquely assign the messages to the generating blocks, but it is also possible to functionally combine the messages. In the configuring example, the MER and MERF0 blocks generate messages with the same prefix, which indicates a logical association.

Channel on the data interface

In the configuring example, both message evaluation blocks set-up a channel at the data interface D01 in the "select" mode (thus, the same channel name can be configured).

Measured value input and message signals

The measured value input of block MER is not connected in the particular example. At the measured value input, a process condition is normally applied. The message signals of function block MERF0 act similarly.

Generating and reading-out messages

Messages are generated by a rising edge at connection I1 of block MER or by a changing value at input IS1 of block MERF0. The message evaluation block immediately reads-out the first message from the message buffer and transfers into the data channel as both blocks are "enabled" (input EN=1). Additional messages are only transferred into the data channel when the previous message has been read-out of the channel.

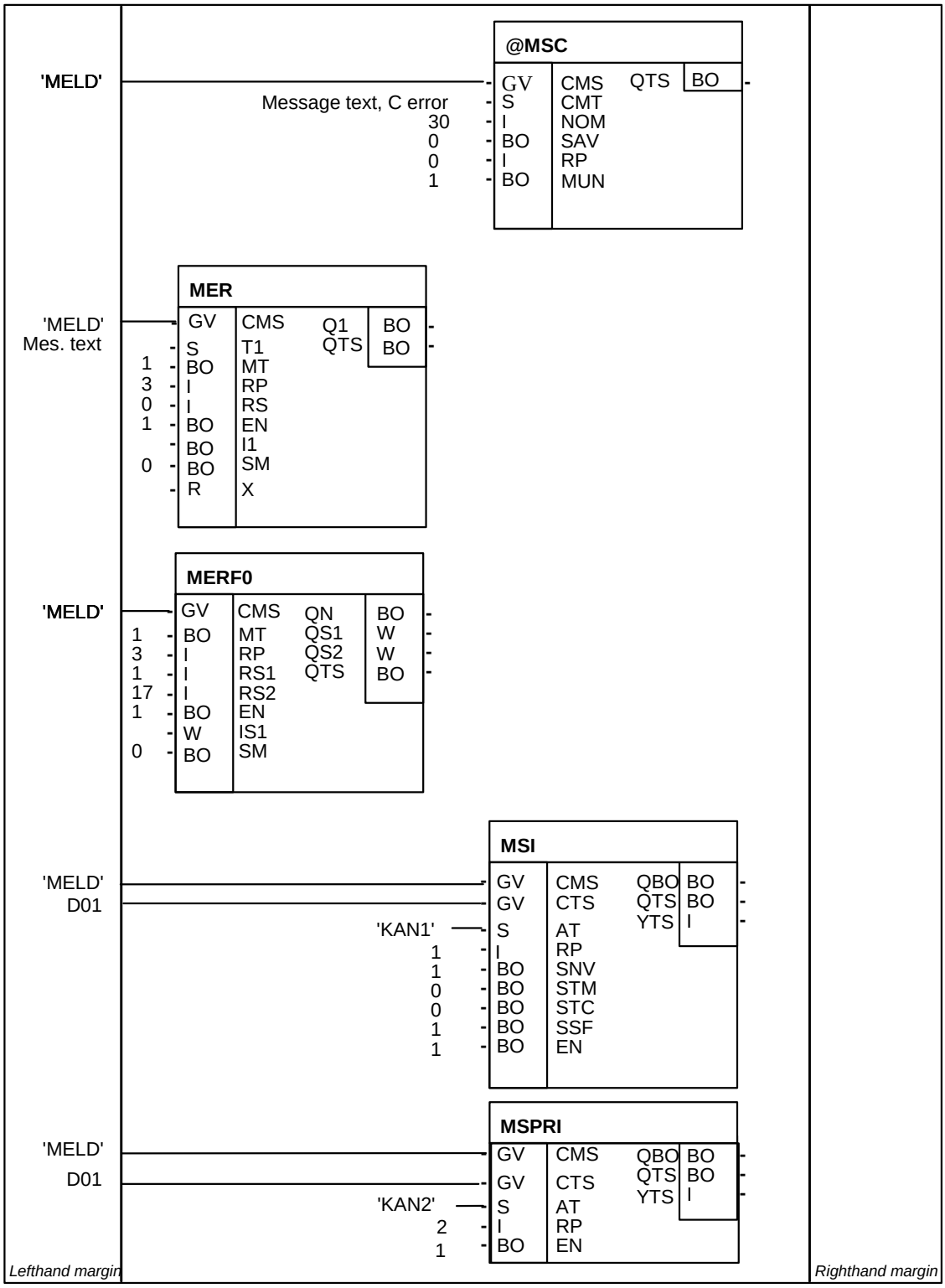


Fig. 3-103 Configuring example, communications utility, message system

3.21.3 Output formats of the message evaluation block MSI

3.21.3.1 Structure of an error- or alarm message

General

The message evaluation block MSI has four inputs to select the format:

- input SNV
- input STM
- input STC
- input SSF

The message format is important for the receiver of a message and its interpretation.

Message text length

Input STC defines the message text length. It is set to a constant length (60 characters) using STC = 1. If a message text is shorter than the maximum length or is not available, it is filled with blanks. The advantage is the constant number of data which is to be transferred. This connection has no effect on the remaining structure of the message and the message type description.

Message text format

Inputs SNV, STM and SSF are evaluated once during the initialization phase and then define the format of the messages output. The messages are output at the channel, specified at input AT at the data interface specified at input CTS.

3.21.3.2 Overview of the message formats

Spontaneous ID

The spontaneous ID has a constant value of 0 and is of no significance.

Sequence number

The sequence number is provided for reasons of reliability and counts the number of messages transmitted so that the receiver can identify which messages have been lost. The sequence number lies in the range from 0-255. When the sequence number has reached the maximum value of 255, when the next message is transmitted, the minimum value 0 is used.

Message type description

Essentially a differentiation is made between the standardized and hexadecimal formats. For a standardized format, the individual values are transferred in the IEEE 754 or ISO 646 standard, which defines a normalized 32-bit floating point notation. The messages, both in the standardized as well as in the hexadecimal format, include a message type description which provides information about the format, selected by the initialization inputs and other parts of the message. The message type description is a bit vector, which should be interpreted as follows:

- Bit 0: If this bit is set, message numbers are output (copy of input SNV).
- Bit 1: If this bit is set, a message text is output (copy of input STM, unless the message is empty).

- Bit 2: If this bit is set, the messages are output in the standardized format, otherwise in the hexadecimal format (copy of input SSF).
- Bit 3: If this bit is set, a measured value is present.
- Bit 4: If this bit is set, then a units text is present. The units text can only be present if there is also a measured value. If there is no measured value or units text, the appropriate message errors are of no significance and are in an undefined condition.
- Bit 5-7: Unassigned

Message type

The message type consists of a character, which specifies the message event type, whereby the following is defined: "S" system error, "C" communications error, "F" error messages and "W" warning messages. The first two message types are only generated by the message system central block.

Message prefix

Corresponds to the input value at RP of the entry block.

Message suffix

Corresponds to the input value at RS of the entry block.

Measured value units and scaling factor

In the hexadecimal format, the measured value description consist of:

- a 32-bit scaling factor which is output in the floating format
- the measured value acquired by the acquisition block
- a measured value data type (SIMADYN D data type as ASCII character sequence)
- an 8-character measured value unit

HEX format and standardized format

As the precise data format must be specified in the hexadecimal format when initializing data transfer, and on the other hand, the measured value can vary in the size of the notation (0,2 or 4 bytes), for measured values, 4 bytes are always transferred. If the measured value occupies less than 4 bytes, which can be recognized at the measured value data type, then the subsequent bytes cannot be assigned.

In the standardized format, only the scaled measured value and the 8-character long measured value units are transferred.

Message instant

The message instant is transferred in the hexadecimal format in the MMS format, time and date (reference point 1.1.84).
In the standardized format, the message instant is transferred as ASCII character sequence, which includes date (day, month, year) and time of day (hours, minutes, seconds, milliseconds). Date and time of day are separated by a hyphen. The character sequence is 24 characters long (example: ”01.05.1993 08:01:15:0045”).

Message text

The message text is always transferred as ASCII character sequence. In this case, length information is not transferred. This is calculated from the total number of data received. The message text can be a minimum of 60 characters long.

3.21.3.3 Structure of an overflow message

Overflow message

If the message sequence buffer overflows, then the MSI/MSPRE generates an overflow message:

- The overflow message is the warning type ('W').
- The prefix includes the value at input RP of function block MSI which generates the message.
- The suffix includes the number of messages which have been lost.
- There is no measured value. This is indicated in the message type description.
- The time, at which the message evaluation block generated the overflow message, is entered as message instant.
- The "sequence buffer overflow" text is output as message text if input STM of the function block MSI is set.

3.21.3.4 Structure of a communications error message

Communications error message

The central block evaluates the communication errors occurring in the system and generates the following communication error messages:

- A communications error message is message type C error ('C').
- The prefix includes the value at input RP of the central block which generated the message.
- The suffix includes the error number of the C-error message (this is always positive).
- If a measured value is not available, then this is indicated in the message type description.
- The text, configured at input CMT at the central block is output as message text, if input STM of function block MSI is set.
- If the communications error field has overflowed, after all of the C-error messages have been output, a message is generated which includes, as suffix, the negative number of the messages which have been lost. After this message, MSI does not output any additional C-error messages. The instant at which the central block identified the communications error field overflow, is entered as message instant.

3.21.3.5 System error message structure

System error message

A system error message has essentially the same structure as a communications error message. The only differences are the "message text" where the "system message" is always used, as well as the message type ('S'). Further, a maximum of one system error message is generated, which is identified during the initialization phase of the central block.

As suffix, an ID is entered by the system error, which has the following significance:

Value, suffix	Significance
1	5 V power failure
2	15 V power failure
3	Software processing faulted
4	Error when accessing the L-bus communications buffer memory
5	Error when accessing the C-bus communications buffer memory
6	Error when accessing the standard periphery
7	Error when accessing the special periphery
8	Undefined L-bus access
9	Undefined C-bus access
10	(not used)
11	Hardware fault which cannot be identified
12	(not used)
13	Fault/error which cannot be identified
14	Fault message (ready internal) from the local expansion bus (LE bus)
15	Error when accessing the local periphery (LP bus)
16	Overrun of the system bus controller

Table 3-74 Suffix, system error message

3.21.3.6 Detailed description of the message formats of function block MSI

General

The description of the message formats consists of 3 parts:

- Assigning initialization inputs SNV, STM and SSF
- Basic format and maximum length of the message. This length corresponds to the size of the channel logged-on by MSI.
- Net data structure which is required to initialize the channel.

- Input STC connection is not listed here. For STC = 1, the length specification for the message text always corresponds with the maximum length; for STC = 0, it corresponds to the actual message text length.

SNV=TRUE (message numbers available) STM=TRUE (message text available) SSF=TRUE (standardized format)				
Contents	**Message structure (max. 108 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Prefix	Floating-Point	3. variable unit	Floating-Point	3
Suffix	Floating-Point			
Measured value	Floating-Point			
Measured value dimensions text	8 characters	4. variable unit	Visible-String	92
Message instant	24 characters			
Message text	max. 60 characters			

Table 3-75 Standard format with number and text

SNV=FALSE (message numbers not available) STM=TRUE (message text available) SSF=TRUE (standardized format)				
Contents	**Message structure (max. 100 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Measured value	Floating-Point	3. variable unit	Floating-Point	1
Measured value dimensions text	8 characters	4. variable unit	Visible-String	92
Message instant	24 characters			
Message text	max. 60 characters			

Table 3-76 Standard format without number with text

SNV=TRUE (message numbers available) STM=FALSE (message text not available) SSF=TRUE (standardized format)				
Contents	**Message structure (max. 48 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Prefix	Floating-Point	3. variable unit	Floating-Point	3
Suffix	Floating-Point			
Measured value	Floating-Point			
Measured value dimensions text	8 characters	4. variable unit	Visible-String	32
Message instant	24 characters			

Table 3-77 Standard format with number without text

SNV=FALSE (message numbers not available) STM=FALSE (message text not available) SSF=TRUE (standardized format)				
Contents	**Message structure (max. 48 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Measured value	Floating-Point	3. variable unit	Floating-Point	1
Measured value dimensions text	8 characters	4. variable unit	Visible-String	32
Message instant	24 characters			

Table 3-78 Standard format without number and text

SNV=TRUE (message numbers available) STM=TRUE (message text available) SSF=FALSE (HEX format)				
Contents	**Message structure (max. 92 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Prefix	Unsigned16	3. variable unit	Unsigned16	2
Suffix	Unsigned16			
Measured value scaling factor	Floating-Point	4. variable unit	Floating-Point	1
Measured value	4 Octets	5. variable unit	Octet-String	6
Measured value data type	2 Octets			
Measured value dimensions text	8 characters	6. variable unit	Visible-String	8
Message instant	Time and date	7. variable unit	Time and Date	1
Message text	max. 60 characters	8. variable unit	Visible-String	60

Table 3-79 Hexadecimal format with number and text

SNV=FALSE (message numbers not available) STM=TRUE (message text available) SSF=FALSE (HEX format)				
Contents	**Message structure (max. 88 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Measured value scaling factor	Floating-Point	3. variable unit	Floating-Point	1
Measured value	4 Octets	4. variable unit	Octet-String	6
Measured value data type	2 Octets			
Measured value dimensions text	8 characters	5. variable unit	Visible-String	8
Message instant	Time and date	6. variable unit	Time and Date	1
Message text	max. 60 characters	7. variable unit	Visible-String	60

Table 3-80 Hexadecimal text without number with text

SNV=TRUE (message numbers available) STM=FALSE (message text not available) SSF=FALSE (HEX format)				
Contents	**Message structure (max. 32 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Prefix	Unsigned16	3. variable unit	Unsigned16	2
Suffix	Unsigned16			
Measured value scaling factor	Floating-Point	4. variable unit	Floating-Point	1
Measured value	4 Octets	5. variable unit	Octet-String	6
Measured value data type	2 Octets			
Measured value dimensions text	8 characters	6. variable unit	Visible-String	8
Message instant	Time and date	7. variable unit	Time and Date	1

Table 3-81 Hexadecimal format with number without text

SNV=FALSE (message numbers available) STM=FALSE (message text not available) SSF=FALSE (HEX format)				
Contents	**Message structure (max. 28 bytes)**	**Net data structure**	**Data format**	**No. of data**
Spontaneous ID	Unsigned8	1. variable unit	Unsigned8	2
Sequence number	Unsigned8			
Message type descrip.	1 Octet	2. variable unit	Octet-String	2
Message type	1 Octet			
Measured value scaling factor	Floating-Point	3. variable unit	Floating-Point	1
Measured value	4 Octets	4. variable unit	Octet-String	6
Measured value data type	2 Octets			
Measured value dimensions text	8 characters	5. variable unit	Visible-String	8
Message instant	Time and Date	6. variable unit	Time and Date	1

Table 3-82 Hexadecimal format without number and text

3.21.3.7 Output format of the message evaluation block MSPRI

General

Contrary to the message evaluation block MSI, the format of the messages of the MSPRI evaluation block can be freely selected. Here, only one format is output. Thus, there are no connections to select a format when configuring the block. The MSPRI block has been especially developed to output messages on a printer. All of the messages are output as text and with line feed. A message consists of a maximum of two lines.

Structure of the 1st line

Character of the 1st line	Significance	Output format
1-24	Date/time	Day.Month.Year, Hour:Minute:Second:Millisecond
25-27	Text: ”P:”	
28-32	Prefix	Max. 5 characters and right justified
33-35	Text: ”S:”	
36-40	Suffix	Max. 5 characters and right justified
41-45	Text: ”Type:”	
46	Message type (’C’,’F’,’W’ or ’S’)	One character
47-50	Text: ”Nr:”	
51-53	Sequence number	Max. 3 characters and right justified
54	Text: ” ”	
55-67	Measured value (optional: this is only entered if the message contains a measured value)	Is output as floating value in the following sequence: • sign (positive = "+", negative = "-") • number of places before the decimal point followed by a decimal point and 6 places after the decimal point • exponent, started with the character ’e’ • sign (positive = "+", negative = "-") as well as 2 exponent positions
68	Blanks (optional)	
69-76	Measured value unit (optional: is only entered if the message contains a measured value)	8 characters
77, 78	Special characters, CR and LF	Line feed

Table 3-83 Structure of the MSPRI evaluation block message, 1st line

Structure of the 2nd line

The second line contains the message text, and is only output if there is a message text. Otherwise this is completely eliminated.

Character of the 2nd line	Significance	Output format
1-60	Measured value text (optional)	Variable length
61, 62	Special characters, CR and LF	Line feed

Table 3-84 Structure of the MSPRI evaluation block message, 2nd line

Example of a message output

”01.05.1993 08:01:15:0045 P: 123 S: 10 Typ: W Nr: 25 -1.123456e+12 ms ”
”This is a message text”

Table 3-85 Example of a message output

NOTE Overflow-, communication error- and system error messages have the same logical structure as for block MSI.

3.22 Communications utility parameter processing

3.22.1 Master configuring

3.22.1.1 Description of scope

General

A PKW interface (parameter ID value) can be used between SIMADYN D and SIMOREG or SIMOVERT drive converters using the communications utility, parameter processing for variable-speed drives. Drive converter- and technology parameters can be read and changed via the PKW interface.

Coupling

Process data are transferred and parameters handled for the coupling between the drive converters and SIMADYN D. On the SIMADYN D side, process data is transferred using the transmit- and receive function blocks (CTV/CRV).

Parameter handling

@DPH and DPI function blocks, are used for parameter handling. They are used to read and change drive converter- and technology parameters, and they can also receive parameter change reports from the drive converters. The function blocks for parameter handling (in the following known as PKW blocks) can be used independently of the existing SIMADYN D couplings. However, it is necessary to refer to the correct protocol by appropriately configuring.

Function blocks

The PKW blocks do not have a direct connection at a data interface of a coupling module. Data transfer is always realized using transmit- and receive blocks (CTV, CRV).

The PKW interface is sub-divided into two block types:

1. **Blocks to supply transmit- and receive blocks.**
   These blocks have the main task to convert the parameter tasks and responses into a format corresponding to the definition (parameter ID, index and parameter value as well as parameter change report), and to transfer these to the transmit blocks, or receive them from the receive blocks. Further, the received parameter change reports are output at this block type. This block type is designated as PKW central block @DPH in the following (Device Parameter Handling).
2. **Blocks for the man-machine interface (MMI).**
   The tasks are specified here in a comprehensible form and the device/drive converter responses displayed. This is configured. By cascading this block type, an automatic task sequence can be configured. This block type is known in the following as parameter block DPI (Device Parameter Information.

The interconnection and the information transfer between both block types is not visible and cannot be influenced by the user/configuring engineer.

Configuring

In order to process parameters for a drive converter (read, change parameter values and acknowledge parameter change reports), precisely one PKW central block and at least one parameter block should be configured. A parameter block is always precisely assigned one central block. For example, if parameter handling is to be configured for 5 drive converters, then 5 central blocks must be configured, and as many parameter blocks are required for each central block. The number of parameter blocks for each central block can be different and is defined by the application.

There are no regulations regarding the block sampling time. All PKW blocks can also be configured in different sampling times.

3.22.1.2 Supported couplings

General

The following couplings are supported:

- USS Master with CS7/SS4
- PROFIBUS DP with CS7/SS52

Using these couplings, for example, the following drive converters can be parameterized:

- SIMOVERT drive converter 6 SE 12
- SIMOREG drive converter 6 RA 24
- SIMOVERT Master Drive 6 SE 70

The following parameter handling does not take into account the various scaling factors and notation types of parameter values in the various SIMOREG and SIMOVERT drive converters.

3.22.1.3 Telegram structure

General

Communications to the drive converters is realized using telegram (PPOs). A telegram can be sub-divided into the PKW (parameter ID value) and PCD (process data). The PKW component uses the first 3 words (6 octets) or 4 words (8 octets). After this component, the process data can be specified; this will no longer be discussed in this document. The length of the PKW component is defined both on the drive converter side as well as on the SIMADYN D side. When using the 3-word interface, only single-word tasks are possible; for the 4-word interface, also double-word tasks.

3.22.1.4 Mode of operation of the PKW blocks

Information flow

The information flow between the individual function blocks is configured as follows:

- A task (by appropriately configuring the input connections) is formulated at a parameter block.

- As soon as the appropriate parameter block is to be executed (when cascading several parameter blocks), it transfers its task to the central PKW block.
- The cascading defines when a parameter block is to be executed and when it can transfer its task.
  (A task is transferred, if the block has been activated, i.e. if the input EN is a logical 1, and the value at input IC has changed).
- A parameter block remains active (i.e. it is being executed) until it receives a response regarding its task from the central PKW block. Then it activates the following parameter block, configured in the cascade, by inverting its cascade output QC.

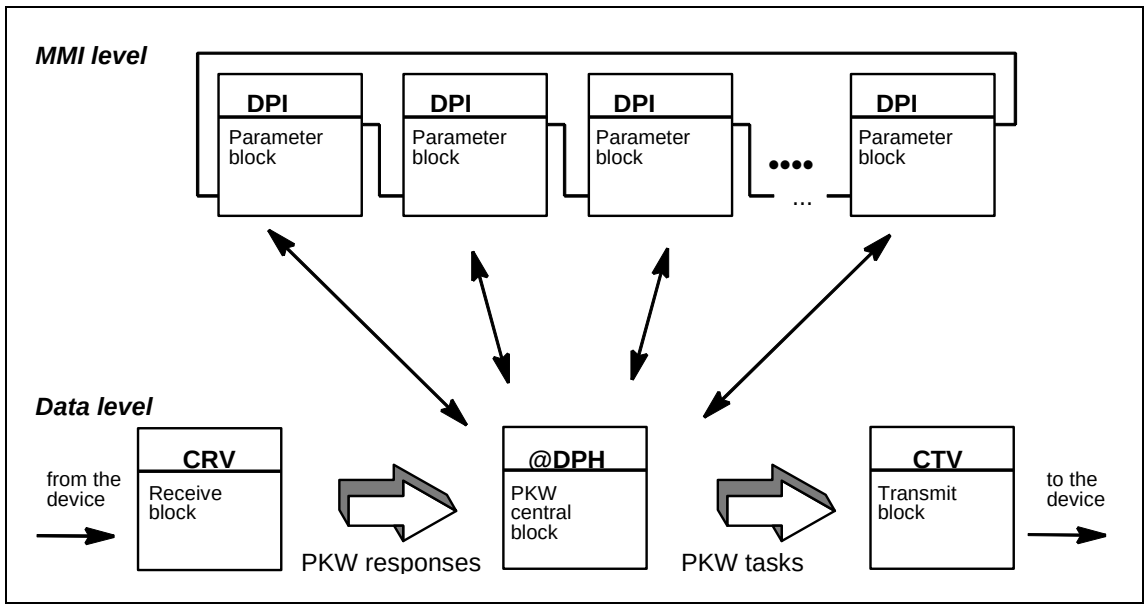


Fig. 3-104 Mode of operation of the PKW blocks

Delay time limiting

Delay time limiting, i.e. limiting the delay between the task transfer and the response being accepted is not possible for parameter blocks, but only for the central block. The parameter blocks wait, unconditionally, for a response from the central PKW block. The configuring engineering must ensure, that several parameters cannot simultaneously, transfer tasks to a central PKW block (he must also ensure that there is no overlapping).

Response processing

The central PKW block first processes a response. If differentiates whether it received a parameter response or a parameter change report from the associated receive block. It transfers a response to the currently active parameter block; it outputs a parameter change report at its own I/O.

Task processing

After processing the response, the central PKW block processes a task. It converts the task, received from the parameter block, formally

corresponding to the PPO type, and transfers it, using the virtual communication connections, to the associated transmit block.

Monitoring counter

After the task has been transferred, the central PKW block starts a monitoring counter. The response must be received by the central PKW block within this TIMEOUT, otherwise it is considered as ended by the central PKW block (with the appropriate information to the parameter block).

PKW interface

Drive converters can handle PKW interfaces, 3- or 4-words long, depending on the drive converter. The PKW interface on the SIMADYN D side can handle both of these formats. The length definition is realized using initialization inputs PHL at the central PKW block @DPH and cannot be changed during operation.

In order to handle the PKW interface, the PKW component in the telegram must be processed. To realize this, the @DPH central block of the communications utility, parameter processing from variable-speed drives, inputs (XW1, XW2, XWS and XWL) and output (YW1, YW2, YWS and YWL) which must be connected to the standard transmit /receive blocks CTV, CRV via virtual connections (refer to the Chapter Communications utility, process data).

3.22.1.5 Configuring example

Hardware structure

- Subrack
- CPU
- CS7 module with SS52 communications module
- A SIMOVERT drive converter is connected to the SS52 communications module via PROFIBUS DP.

Description of the configured software

The SIMOVERT drive converter is to be operated using the communications utility, parameter processing, from variable speed drives, whereby two parameter blocks are to be configured.

The @CSPRO central coupling block is first required when using the CS7/SS52. In addition, block CRV and block CTV are configured, which handle data transfer from and to the drive converter. Blocks CRV and CTV are connected to the @DPH central block via virtual connections.

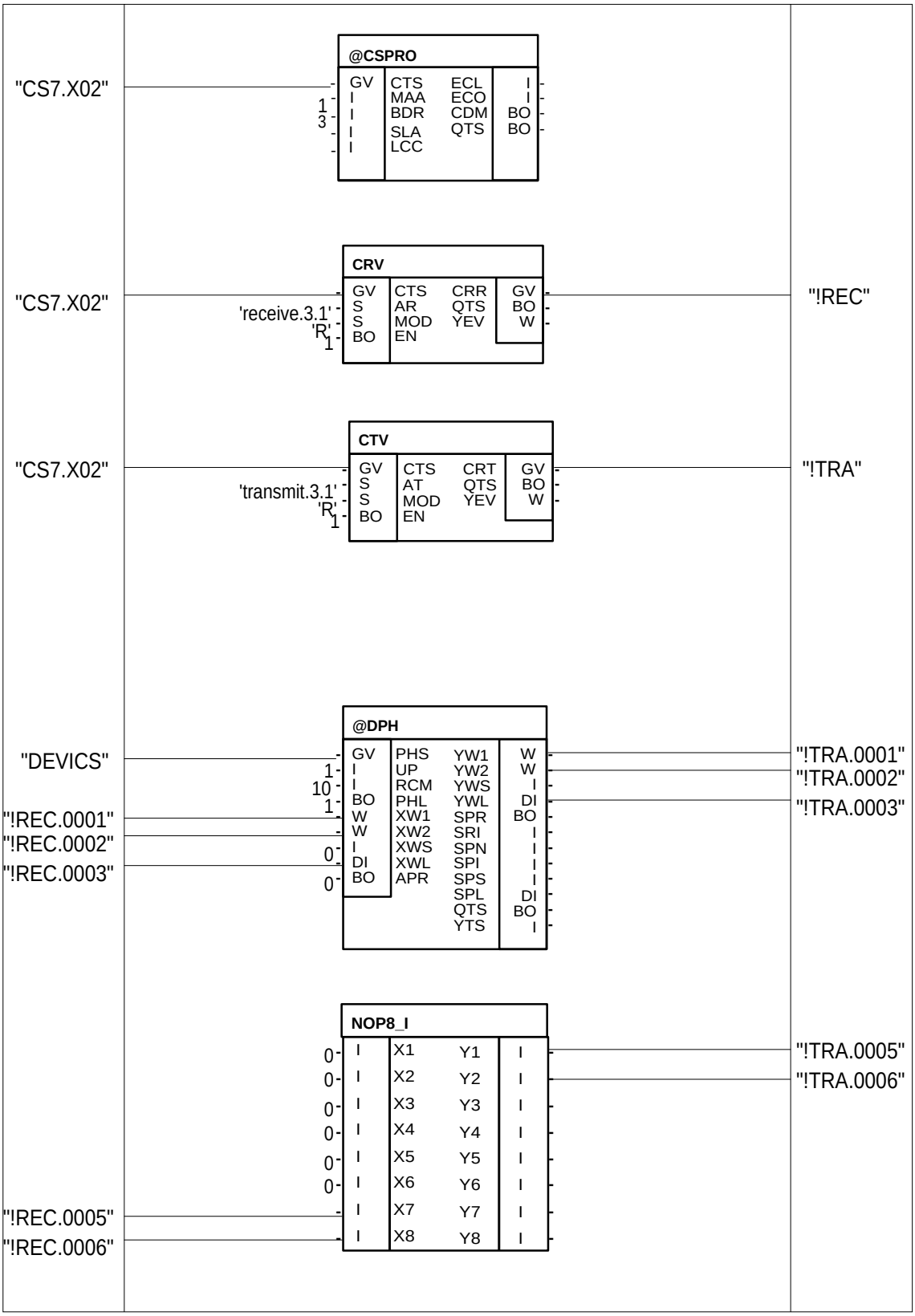


Fig. 3-105 Part 1 of the complete system, including @CSPRO (central block PROFIBUS DP)

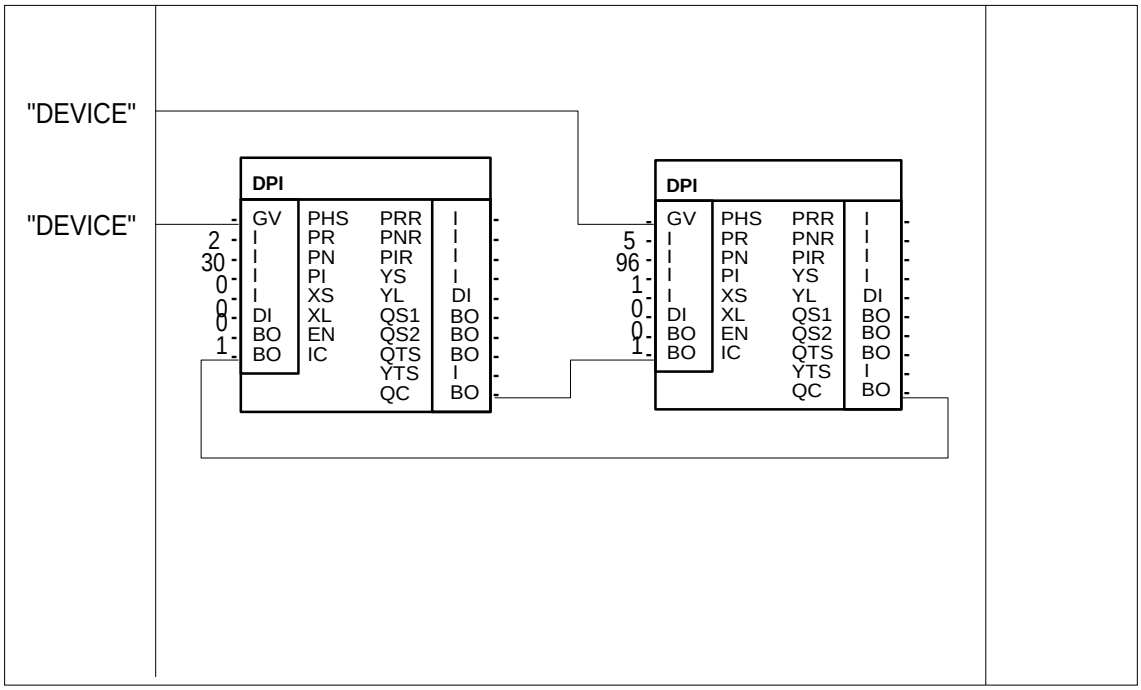


Fig. 3-106 Part 2 of the complete system including the @CSPRO (central block PROFIBUS DP)

The following points must be observed when configuring:

- The PROFIBUS DP protocol is selected with UP=1.
- The value RCM=10 specifies that a response to a task must be received within 10 sampling times; otherwise a TIME-OUT message is generated. RCM = 0 indicates that time monitoring is not required (no TIMEOUT).
- A 4-word PKW interface is configured at @DPH using PH1 = 1. In this case, connections XWL and YWL are valid. With PHL = 0, a 3-word PKW interface is configured, and connections XWS and YWS are valid.
- In this example, 2 additional words are used for process data. The process data are generated by the PZD block.
  4 words PKW + 2 words PZD results in PPO type 1).
- The virtual connection REC of block CRV is connected with the inputs XW1, XW2 and XWL of the @DPH block via virtual connection names. The sequence number is important.
- The outputs YW1, YW2 and YWL of block @DPH are connected with the virtual connection TRA of block CTV via the virtual connection name. The sequence number is important.
- Parameter change reports are automatically acknowledged by specifying APR=1. Parameter change reports, received from @DPH, are not output at output connections, but are immediately acknowledged.

- The PHS connections of block DPH and parameter blocks DPI1 and DPI2 have the same name - "DEVICE". Thus, the parameter blocks are assigned to the central block.
- Output QC of DPI1 is connected to input IC of DPI2. Further, output QC of DPI2 is connected to input IC of the DPI1. Thus, the cascading connections are connected with one another in a ring.
- Output QC of block DPI2 is initialized with 1. Thus, a negation is injected into the cascading ring. Without this initialization, a parameter block would never be able to issue a task.
- Both parameter blocks are enabled, i.e. the connections are 1.
- A task is created at both parameter blocks by specifying a constant value. For block DPI1, it involves reading the value of parameter 30; the DPI2 block issues a read task for the indexed parameter 96 with index 1.

Mode of operation

In the configuring above, the tasks, available at blocks DPI1 and DPI2 are cyclically processed. Thus, parameter 30 and indexed parameter 96 are cyclically read with index 1. The outputs of block DPI are not processed in the example which, in a specific application would of course be the case.

The mode of operation of the complete system is as follows:

- Output QC of DPI2 is initialized with 1.
- As output QC of the DPI2 is connected with input IC of block DPI1, input IC has changed, as this is internally initialized with 0.
- DPI1 issues a task and waits for the response.
- If the device responds to the task, then DPI1 provides the response at the outputs and negates its output QC. Thus, input IC of block DPI2 changes.
- Block DPI2 issues its task, waits for a response, which is output at the outputs of the block, and in turn, negates its output QC.
- The DPI blocks, interconnected in a ring-type structure, are processed once and then the cycle starts again.

If a block is disabled (input EN set to 0), then this does not restrict the other DPI blocks in the ring, as the block transfers a change at input IC to its output QC, without actually issuing a task.

3.22.1.6 Task/response IDs

Overview

In this chapter, the possible tasks, which could be formulated by the configuring engineer at the DPI blocks, re-specified. Further, the possible responses are specified for each task. In this case, it is also explained which inputs and outputs are relevant for the tasks/responses. The entry XS/XL in the column means that, dependent on input PHL of the assigned central block @DPH, either connection XS (PHL is 0) or XL (PHL is 1) is significant. Entries, designated with x in the table, mean that the connection here must be assigned, or is assigned, a sensible value.

Task ID PR	Parameter number PN	Parameter index PI	Parameter value XS/XL
0 - No task	0	0	0
1- Request parameter normalization factor	x	0	0
2 - Request parameter value	x	0	0
3 - Change parameter value, 2-byte format	x	0	x
4 - Change parameter value, 4-byte format	x	0	x
5 - Request parameter value, array	x	x	0
6 - Request parameter value, array, 2-byte	x	x	x
7 - Request parameter value, array, 4-byte	x	x	x
8 - Change parameter value and save in the EEPROM 2-byte	x	0	x
9 - Change parameter value and save in the EEPROM 4-byte	x	0	x
10 - Change the parameter value and save in the EEPROM array, 2-byte	x	x	x
11 - Change the parameter value and save in the EEPROM array, 4-byte	x	x	x

Table 3-86 Task ID PR

Response ID PRR	Parameter number PNR	Parameter index PIR	Parameter value YS/YL
0 - No response	0	0	0
1 - Transfer parameter normalization factor	x	3	x
2 - Transfer parameter value (2 bytes)	x	0	x
3 - Transfer parameter value (4 bytes)	x	0	x
4 - Transfer parameter value (array, 2 bytes)	x	x	x
5 - Transfer parameter value (array, 4 bytes)	x	x	x
6 - Task cannot be executed (with error code)	x	x	x
7 - PKW interface has no change rights	x	x	x

Table 3-87 Response ID PRR

Possible response

The next table explains which response ID is used to respond to an issued task ID. In addition, TIMEOUT is possible for all tasks, which in this case is output at YTS.

Task ID PR	Possible response IDs PRR
0	0,6
1	1,6
2	2,3,6
3	2,6,7
4	3,6,7
5	4,5,6
6	4,6,7
7	5,6,7
8	2,6,7
9	3,6,7
10	4,6,7
11	5,6,7

Table 3-88 Task ID PR, response ID PRR

3.22.1.7 Task/response assignments

Sequence

If the @DPH central block set-up a task at its outputs, issued from a DPI block, then it waits until this task is responded to in the specified TIMEOUT. (Initialization input RCM, there is no TIMEOUT for RCM=0.). In this case, the value RCM specifies the number of sampling times which block @DPH waits for a response from the issued task before a TIMEOUT message is generated. The inputs of the @DPH block are checked at each cycle in order to define the response. If a response is present at the inputs, which matches the task which was issued, then this is transferred to the DPI block.

3.22.1.8 Cascading

Sequence

By changing input IC with input EN set, a task is transferred to the central block. If the response is received, or if input EN is not set, then output QC is set.

A ”Round Robin” topology can be configured using several DPI blocks by connecting the QC outputs with the IC inputs; in this case, the interconnected DPI blocks can issue, one after the other, a task to the central block. In the configuring example, block DPI1 would first issue a task to the device; if DPI1 was to receive a response to this task (in this case, it could also involve a TIMEOUT), then it negates its output QC. Thus, DPI2 becomes active. By interconnecting to form a ring (QC from DPI2 connected with IC from DPI1), it is ensured that only one DPI is active. However, we would like to expressly point out that a non-activated DPI block (connection EN is 0) does not diminish the ring functioning, as a negation of input IC is also repeated at output QC.

The ring should be initialized, so that a cascaded negation is generated. As the DPI blocks internally initialize input IC with 0, the cycle can be started by initializing a QC output with INIT = 1.

Prerequisites

When interconnecting the cascade circuit, the prerequisites are as follows:

- All DPI blocks with the same device names (initialization input PHS) should be connected with one another in a ring form via the IC/QC connections.
- The output QC of a DPI block in this ring, should be initialized with 1.
- The DPI blocks of this ring should be configured in the same sampling time as the associated central block. If this is not observed, this doesn't result in erroneous operation, but however, has the disadvantage that computation performance is unnecessarily used.

3.22.1.9 Parameter change report processing

Description

The device can send parameter change reports. If a parameter change report was sent, the normal task/response processing is interrupted until the parameter change report is acknowledged. Variable-speed drives can acknowledge parameter change reports from communication utility parameter processing in two different ways:

- The communications utility, parameter processing from variable-speed drives (APR=1) automatically acknowledges parameter change reports. The configuring engineer is not informed when a parameter change report is received.
- The user acknowledges the parameter change report (APR=0). In this case, the user is informed about the parameter change report as the parameter change report is applied to the appropriate outputs of the central block. The user acknowledges the parameter change report by setting input APR to 1. If this is then followed again by a manual parameter change report acknowledgment, then connection APR should be again set to 0.

3.22.1.10 Cyclic tasks

Sequence

The drive converter cyclically processes the task which has been issued until the drive converter receives a new task. For responses, which contain parameter values, the drive converter responds by repeating the response telegram and that, always with the actual value. The PKW blocks on the other hand provide each task with precisely one response. If cyclic tasks are to be simulated, then input IC of the parameter block should be cyclically negated .

3.22.1.11 Temporary error messages from the DPI blocks

General information

If a task or response was not able to be correctly processed by a DPI block, then it indicates this at its outputs. The following outputs are used:

- **QTS**
  The QTS output indicates whether the block is operating error-free or, has disabled itself due to a problem. If output QTS is 0, the block has disabled itself. In this case, output YTS indicates the error cause.

- **QS1**
  If a task was issued, this output indicates whether the task was transferred to the central block (logical 1). If the task was not able to be successfully transferred, output YTS indicates the error cause. In this case, the block does not disable itself. The values have the following significance:

  - **0x6714:** An invalid task ID is present at input PR. Valid task IDs: 0 -11
  - **0x6715:** An invalid parameter number is available at input PN. Valid parameter numbers: 0 - 2047.
  - **0x6716:** An invalid index is available at input PI. Valid values: 0 - 254.
  - **0x6717:** A double word task is available at the 3-word PKW interface length.

- **QS2**
  If a response has been received, this connection indicates as to whether the response was correctly received (logical 1) or an erroneous response was received. If there is an error, the cause of the error is indicated at connection YTS. The block does not disable itself. The significance of the values are as follows:

  - **0x6718:** The drive converter did not provide a response within the TIMEOUT time configured at the central block.

3.22.1.12 Important drive converter settings

Parameter setting

The following parameter settings should be made at the drive converter:

- The correct interface protocol must be set at the interface which is used (USS slave, PROFIBUS DP).
- The baud rate must be set.
- The correct number of PKW words must be selected at the interface which is used.
- The correct number of PZD must be set at the interface which is used.

3.23 For change tasks, the parameter change rights of the drive converter must be set at the configured interface. Network

3.23.1 Terminology

Terminology, which is used in these Configuring Instructions, are explained in this Chapter.

Data interface	The data transfer area can be located on all coupling modules (interface modules) and the CPU.
Interface channel	Bi-directional data channel, configured using an US input.
iP module	Intelligent peripheral module, in this case: Overall term for the CSH11, CS7/SS4, CS7/SS5 modules
Network node	Subrack, on which a @NMC function block is configured.
Network group	Network nodes, which are connected with one another via a rack coupling (CS12/13/14, CS22).
(Network) nodes	Network nodes.
Target nodes	Node, which is the destination of a particular telegram.
Island	Network group, which includes one or several iP modules.
Adjacent island	Network group, which is to be reached from an island via an iP module
Unused channels	Channels, which were logged-on, but which can no longer be used
Network-capable channel	Channel, whose channel name consists of the subrack-, module- and optional connector name.
Administration channel	Channel, logged-on from the @NMC via which network administration data are sent.
Data transfer channel	Channel, logged-on from the @NMC, via which user data is sent if the network can be freely selected.

3.23.2 Description

The rigid network implements a channel connection via network nodes. In this case, the sender and receiver can be located on various data interfaces, which are not directly connected with one another. The network transparently establishes the connection between sender and receiver so that it appears that the channels are located on the same data interface.

The rigid network is configured via function blocks. In this case, the @NMC (Network Master Control) is the "heart" of the network. It must always be configured.

- The @NMC should be configured on all of the subracks, which are to be logged-on in the network.
- A basic prerequisite for error-free network operation is to configure subrack names which are unique throughout the network.

- All CS22 modules, connected to a CS12/13/14 module, must have different module names.
- Module names must be 6 characters long, and the last character must fulfill the syntax of the module names.
- When configuring a function block @NMC, the channel names "NETCONT" and "NETCHxx" (with x = digits from 0 - 9) are reserved, and may not be used by the user.
- This configuring syntax is not checked and is the sole responsibility of the configuring engineer.

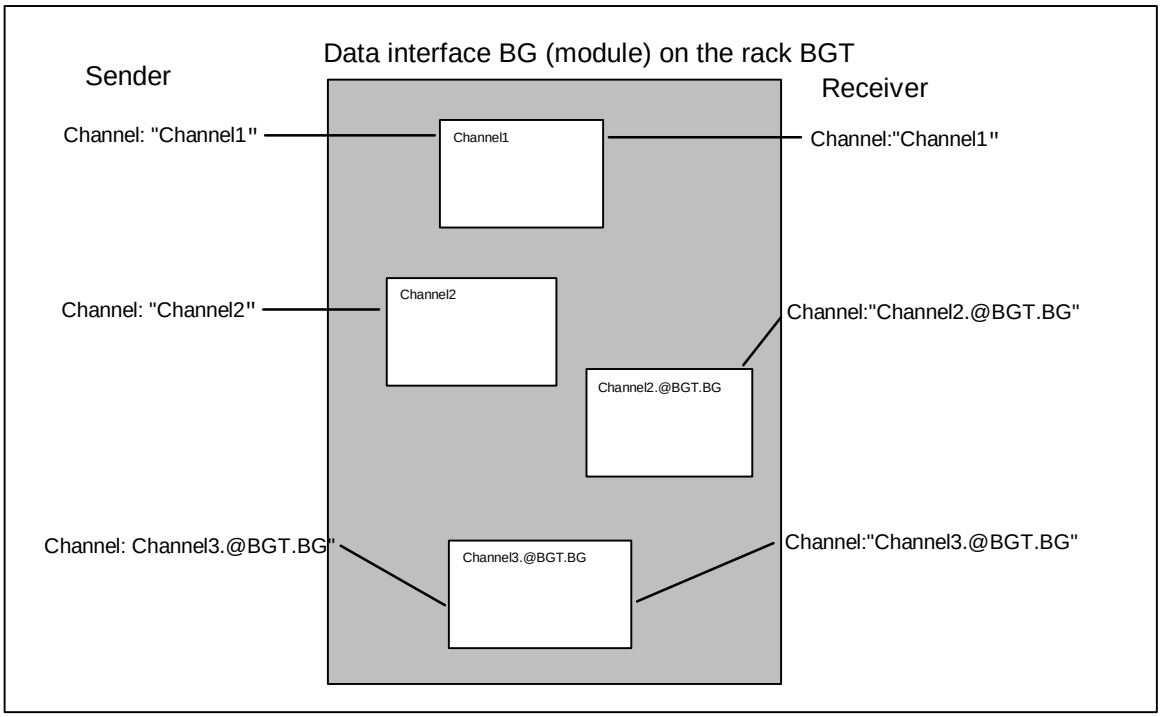
Perfect network operation cannot be guaranteed if this configuring syntax and regulations are not followed.

3.23.3 Rigid network

3.23.3.1 Address data in the rigid network

Channels, which are fed via several subracks, must fulfill specific conventions (syntax), so that they can be handled from the rigid network.

- An address, which is to be viewed from the network, must always have the following syntax
  "Channel name.@BGT name.module name"
  or in the form
  "Channel name.@BGT name.module name.SST name"
  This form is also known as the network address.
  In this case, the BGT name represents the subrack names, BG name, the module names and the SST name, the interface name (connector). The address can additionally include address stages.
  The network no longer tracks channels, which only have the form *"channel name"* (and optional address stages).
  If two channels exist with the same name, where only one consists of the channel name, and the other contains a complete network address, then it involves two different channels, which can lie adjacent to one another on a data interface. The following diagram clearly illustrates this.



- A network channel includes a *source address* and a *target address*. The source address specifies where the sender writes its data and the target address specifies where the receiver reads the data from the channel. Thus, when configuring, the target address should be specified for a sender, and the source address for a receiver.

  – For a **handshake-** or **refresh channel** (one sender, one receiver), the partner address should be specified.
  Example:
  BGT1 (subrack 1) and BGT2 (subrack 2) are coupled to one another via a rack coupling. Data interface BG1___A is located on BGT1, and data interface BG2___A on BGT2. A sender and a receiver are to communicate via the "Channel" channel (**handshake-** or **refresh channel**). If the sender is located at BGT1, then the channel name should be specified at its AT input with "Channel.@BGT2.BG2___A" and on BGT2, at the receiver, "Channel.@BGT1.BG1___A" should be specified at its AR input. Also refer to the figure, case 1).
  The corresponding is valid for bi-directional connections (US inputs).

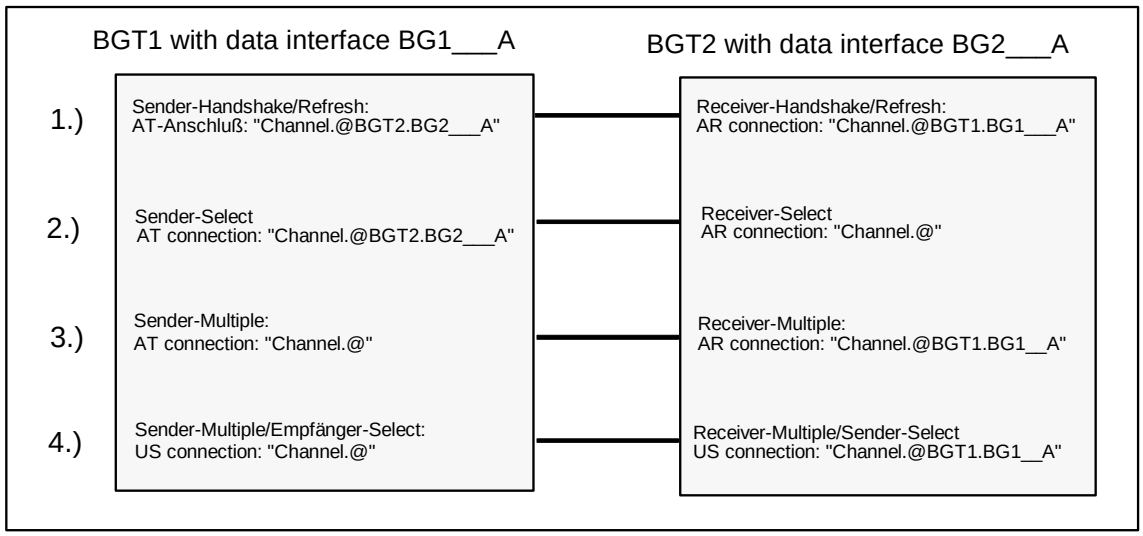
  – For a **select channel** (several senders, one receiver), a source cannot be specified, as the sender cannot be uniquely defined. The receiver, which has the source address at its AR input cannot specify this, as the source is not uniquely defined. **In addition to the channel name, the receiver only specifies the characters '@' at its AR connection**. (Refer to the Fig. case 2).

  – For a **multiple channel** (one sender, several receivers), a destination cannot be specified, as the receiver cannot be uniquely defined. **The sender, which specifies the target address at its AT connection, cannot make a clear definition here, as the target cannot be uniquely determined. In addition to the**

channel name, the sender only specifies the '@' character at its AT connection. (Refer to Fig. case 3.)

- For a **bi-directional select/multiple-connection,** the sender multiple/receiver selection cannot make any specification. *Case 2.) and 3.) simultaneously occur in this case*. **In addition to the channel name, the sender-multiple/receiver select only specifies the '@' character at its US connection**. (Refer to Fig. case 4.).

The following diagram clearly illustrates the situation.



3.23.3.2 Assigning the data interfaces to the configured NTCs

The NTC has the task to search for network channels. In this case, it cyclically searches for the data interfaces, assigned to it from @NMC.

The @NMC function block automatically determines whether an NTC function block was successfully configured. If this is the case, then it distributes the configured data interfaces to the configured NTCs. It proceeds as follows:

It consecutively assigns the data interfaces for all function blocks NTC. If all of the NTC data interfaces have been assigned, and if non-assigned data interfaces are still available, it starts again at the first NTC. The NTC are handled in the log-on sequence; the data interfaces according to increasing slot number. If there are more NTC function blocks than there are data interfaces, the superfluous NTC go into the "*OFF*" condition.

It does not make sense to configure NTC function blocks in different sampling times, as generally it cannot be determined which NTC are assigned to which data interface.

3.23.3.3 Assigning the copying relationships of the NTC to NTD

An NTC function block can be assigned to several NTD function blocks. The NTC transfers a correctly logged-on channel to an NTD, which then handles the actual data transport. The copying relationships (links) are then consecutively transferred to the NTD function blocks. If all of the NTDs were assigned a copying relationship (link), the first NTD is re-selected. The NTD are handled in the sequence in which they were logged-on. It does not make sense to configure those NTD function blocks which are assigned to an NTC in different sampling times.

3.23.3.4 Route selection and errors

If the NTC finds a network channel, it must first define a route to the destination. Only the shortest route to the destination is considered. If there are several "shortest" routes, up to four routes are checked. If a channel cannot be logged-on up to the target node, this is not signalled to the utility FB, as principally, a subrack could still be powered-up, whereby a route would be possible to the destination.

If send- and receive channels have different channel modi or log-on parts, then this is signalled to the sender and receiver using an appropriate acknowledge index.

Network connections which have been established once, are kept, until the subrack, on which the channel is physically located (i.e. that subrack, which accommodates the CS12/13/14 module), is re-organized or shutdown.

If a subrack is powered-down and powered-up again in operation, existing network connections are automatically re-established.

3.23.3.5 Initialization of a rigid network

While the connection to a rigid network is being established, it is not permissible that a subrack which accommodates a CS22 board, on which a network connection is set-up fails. In this case, the associated CS12/13/14 module must be re-organized.

3.23.3.6 Channel modes

All four channel modi (handshake, refresh, select, multiple) are supported in the rigid network. This has effects, especially for the "select" and "multiple" modes: For several of these senders (select) or receivers (multiple), these can be located on various subracks, without having to have had channels being logged-on a multiple number of times. This is explained in more detail in the configuring example for the network status.

3.24 Communications utility process data

Application

The communications utility, process data supports "pure" data transfer in the transmit- and receive directions, i.e. the function blocks only transfer process data. The data itself is neither evaluated nor logically interpreted.

There are two block classes for data transfer:

- receive- and transmit blocks: CTV and CRV
- channel marshalling blocks: CCC4 and CDC4

The CRV and CTV blocks can handle most of the communication applications.

3.24.1 Receive- and transmit blocks

General

There is one receive- and one transmit block. They are called CRV (communication receive virtual) and CTV (communication transmit virtual).

Using a receive- or transmit block a telegram is configured, which is transferred from or to a coupling module. The structure and contents of the telegram are defined when configuring the virtual connections.

3.24.1.1 Virtual connections

General

A virtual connection is an "invisible" connection between block connections. There is no interconnection drawn at the configuring interface, and only a margin connection is created.

The configuring engineer defines which values are to be transferred from block outputs or to block inputs. He does this using "connection name receive/transmit" at the receivers or transmitters and the "virtual connection name" and the "sequence number" at the block inputs or block outputs to be processed.

Connection name

The connection name consists of an exclamation mark ("!") and a maximum of 6 characters (upper case letters or numbers). The character sequence is located directly after the exclamation mark (e.g. "!SEND"). The exclamation mark does not have to be configured as it is automatically generated.

A virtual connection consists of:

- virtual connection name
- sequence number

Connection name and sequence number are separated by a point (e.g. "!SEND.0056"; the point (period separator) between the connection name

and the sequence number does not have to be configured as it is automatically generated).

Data types

Virtual connections can be configured at I/O with the following data types:

- BOOL (BO), BYTE (BY)
- WORD (W), DOUBLE WORD (DW)
- INTEGER (I), DOUBLE INTEGER (DI)
- REAL (R) and SDTIME (TS)

NOTE

Virtual connections cannot be configured at I/O, data types STRING (S) or GLOBAL VARIABLE (GV).

Telegram structure

The virtual connections with the same connection name (data) define a telegram with a specific structure. The sequence of the data within the telegram is defined by the sequence number. The data with the lowest number is located at the start of the telegram; that with the highest number, at the end. The sequence number defines the relative position of the data in the telegram. Gaps in the sequence numbers are ignored.

Configuring example

Receiving and transmitting with virtual connections.

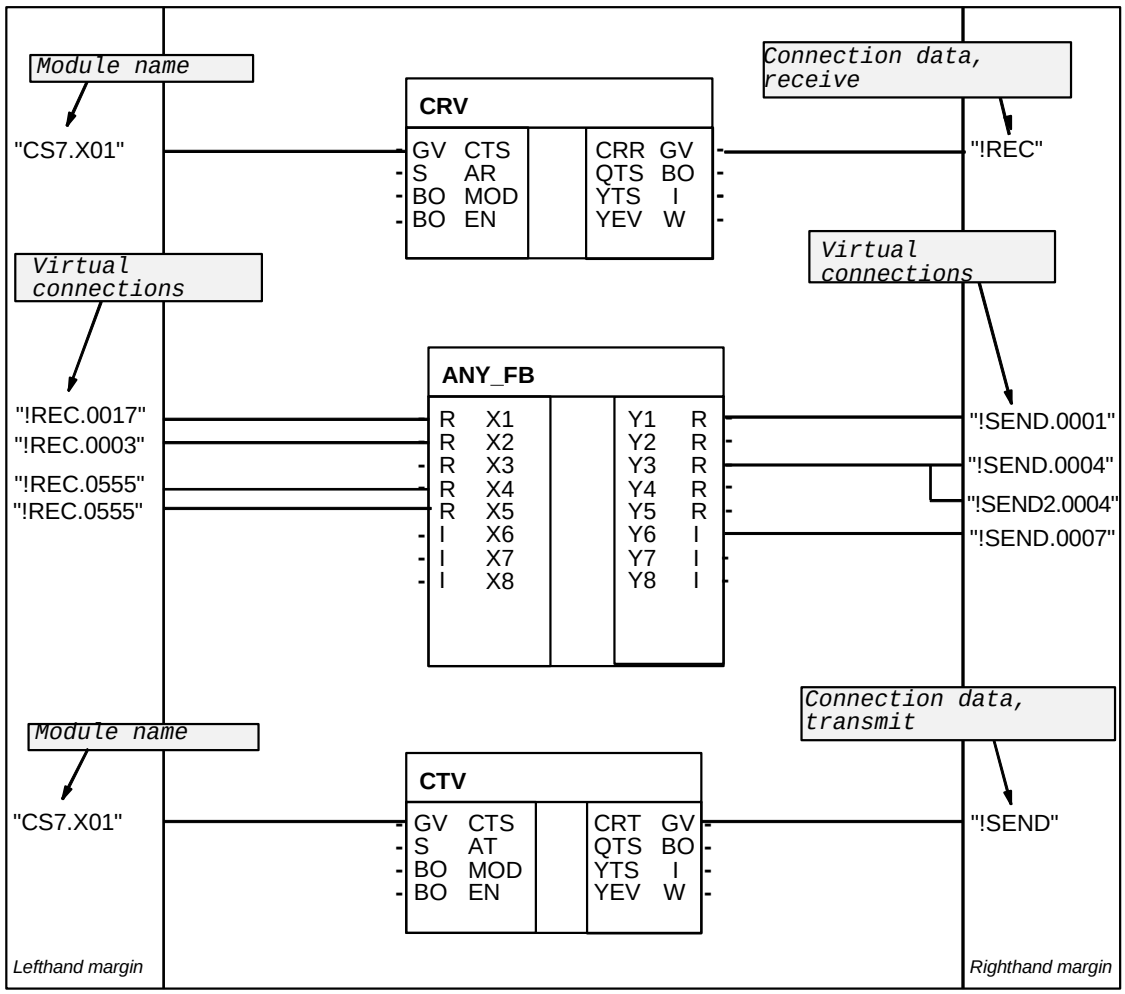


Fig. 3-107 Configuring: Receiving and transmitting with virtual connections

Configuring rules with reference to the example:

- The virtual connections, which belong to a virtual connection name, can be configured at block I/O with different data types (ANY_FB.Y1 "REAL" and ANY_FB.Y6 "INTEGER") and in any sequence.
- Virtual connections (receive) at block inputs can be configured a multiple number of times if the inputs have the same data type. These inputs are supplied with identical data. (ANY_FB.X4 and X5)
- The same virtual connection (transmit) with identical connection name and sequence number may not be configured a multiple number of times at block outputs.
- Several different virtual connections (transmit) can be configured at a block output (ANY_FB.Y3). The connections can differ, both in the connection name as well as in the sequence number.

Telegram structure of the connection name/data "!REC" from the example:

Connection	Virtual connection	Data type	Length
ANY_FB.X2	!REC.0003	R	4
ANY_FB.X1	!REC.0017	R	4
ANY_FB.X4/X5	!REC.0555	R	4
			Total length = 12 bytes

Table 3-89 Telegram structure of the connection name/data "!REC"

Telegram structure of the connection name/data "!SEND" from the example:

Connection	Virtual connection	Data type	Length
ANY_FB.Y1	!SEND.0001	R	4
ANY_FB.Y3	!SEND.0004	R	4
ANY_FB.Y6	!SEND.0007	I	2
			Total length = 10 bytes

Table 3-90 Telegram structure of the connection name/data "!SEND"

The structure of the configured telegram appears in similar form in the CFC reference data in the view "cross-references, operands" or in the CPU MAP listing (of the CFC) under "virtual connections". The configuring can be checked using these lists.

NOTE

- The virtual connection names are known on the CPU. Data from various function charts can be combined to form a telegram; however, this is not possible from various CPUs.
- Data is processed by the receive/transmit blocks in their sampling time. The sampling times of the blocks with virtual connections have no influence on the telegram processing cycle.
- The configuring engineer is responsible in ensuring that the telegram structure and length are compatible with that of the coupling partner (refer to the chapter Mode of operation of the couplings). These regulations are dependent on the secondary coupling. If an error situation develops, the receive/transmit block disables itself and makes an entry in the communications error field (e.g. PROFIBUS DP or subrack coupling), or, communications are not established (e.g. Industrial Ethernet).

3.24.1.2 I/O of the CRV, CTV blocks

Inputs CTS The configured coupling module name via which communications is to be realized, is specified at input CTS of the block. For CS7 or T400 modules, it is also necessary to specify the connector (X01, X02 or X03).

Input AR, AT The address parameter for communications is specified at input AR, AT. It consists of a channel name and the optional address stages. The significance of the address parameters is dependent on the coupling used. (e.g. PROFIBUS or DUST).

Input MOD The data transfer mode is configured at the MOD input (e.g. "R" for refresh or "H" for handshake)

Input EN Input EN defines whether data is to be transferred in the current operating cycle.

Inputs CRR, CRT The virtual connection name, receive or send is configured at input CRR or CRT.

3.24.2 Channel marshalling blocks CCC4 and CDC4

Application Channel marshalling blocks are used to split-up or combine channels.

3.24.2.1 Group block CCC4

General The CCC4 function block (Communication Collect Channel 4) combines up to 4 channels to form one. The channels may have different address data, be located at different interfaces and have different data transfer modi as well as channel lengths.

Prerequisites In order that the function block can operate, at least 2 channels must be combined (CT1- and CT2 input data are mandatory).

Data entries at connections CT3, CT4 If only 2 channels are to be combined, then a "0" (zero) should be configured at initialization inputs CT3 and CT4. In this case, connections AR3, AR4, MO3, MO4, LT3 and LT4 are no longer evaluated.

Data entries at input CTS, AT, MOD The transmit channel is specified at inputs CTS, AT and MOD. The length of the net data to be transmitted is obtained from the sum of the receive data. Receive channels 1-4 are combined, one after the other to form a large net data block.

Example

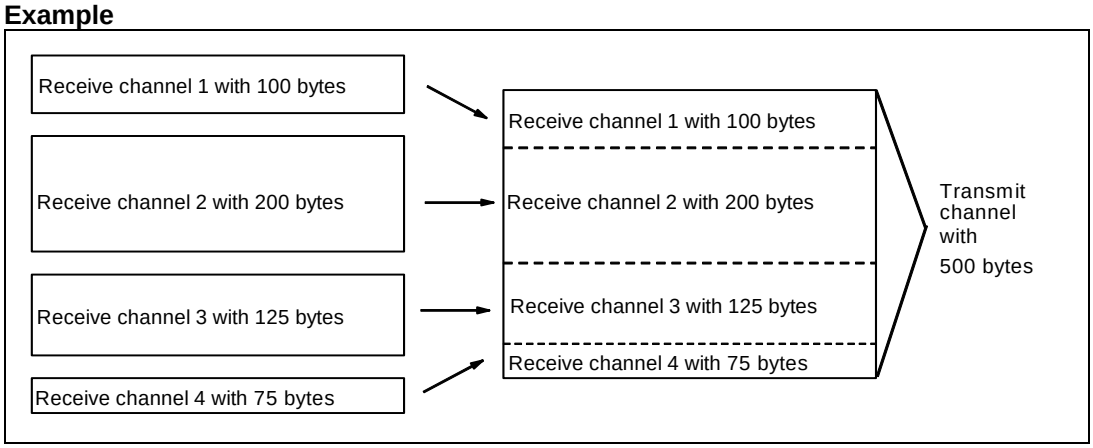


Fig. 3-108 Combining 4 receive channels to form a transmit channel

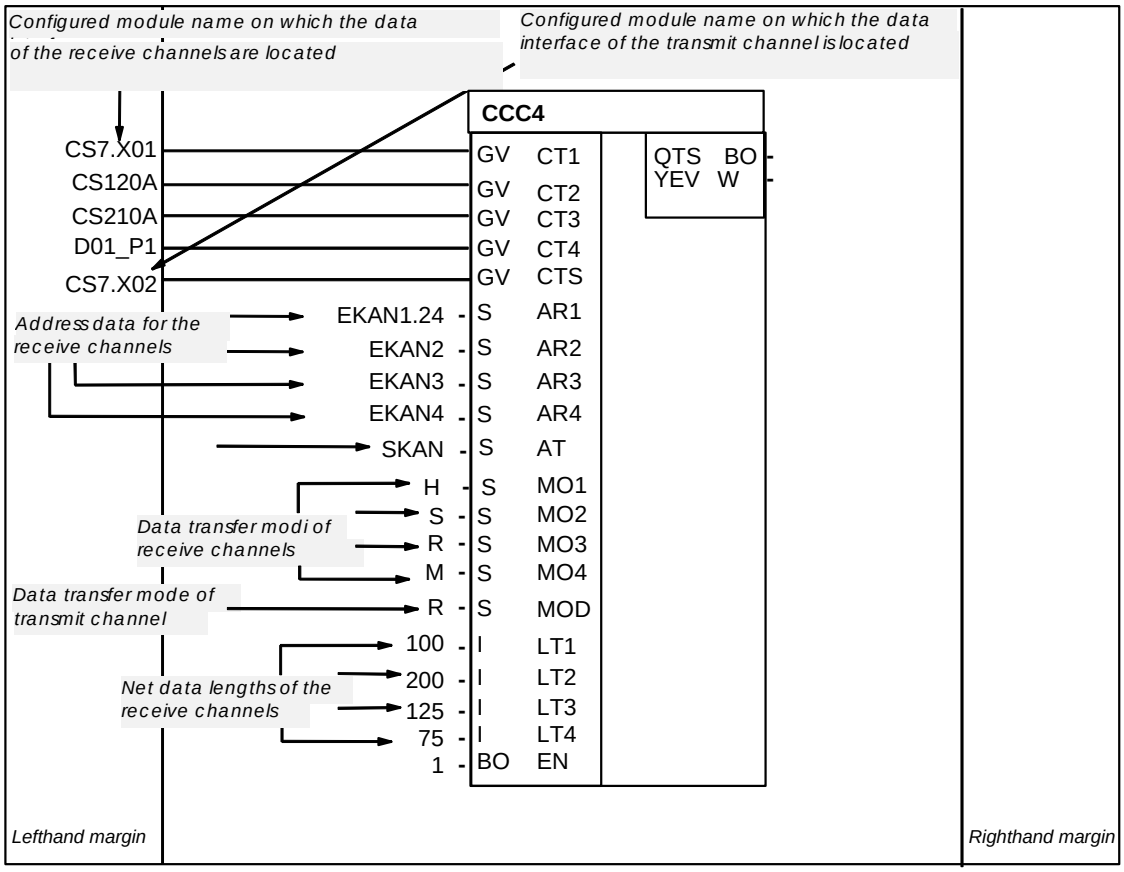


Fig. 3-109 Configuring example: CCC4 connections when combining 4 channels

3.24.2.2 Distribution block CDC4

General

The function block CDC4 (Communication Distribute Channel 4), sub-divides a channel in up to 4 channels. The channels may have different address data, be located on different data interfaces, and have different data transfer modi as well as channel lengths.

Prerequisites

In order that the function block can operate, the receive channel must be sub-divided into at least 2 transmit channels (CT1- and CT2 input data are mandatory).

Data entries at inputs CT3, CT4

When sub-dividing a channel into only 2 channels, a "0" (zero) must be configured at initialization inputs CT3 and CT4. AR3, AR4, MO3, MO4, LT3 and LT4 are, in this case, no longer evaluated.

Data entries at inputs CTS, AT, MOD

The receive channel is specified at inputs CTS, AT and MOD. The length of the net data to be received is obtained from the sum of the transmit data.

NOTE

If one of the transmit channels is configured in the handshake mode and precisely this channel is not read-out on the receive side, then the CDC4 function block cannot operate until this one channel has been read-out. In this case, the block is temporarily inhibited.

3.24.2.3 Compatible net data structure

For blocks CCC4 and CDC4, the net data are unstructured (data type, octet string). Thus, they are compatible to any net data structure. In order that the transmitter and the associated receiver can correctly synchronize with one another, only the net data lengths must be identical.

3.24.3 Diagnostic outputs

General

After each processing cycle, the result of the processed data interface(s) is output at the YEV output of the transmit- and receive blocks as well as the channel marshalling blocks (CTV, CRV, CCC4, CDC4). The YEV output is the WORD type; the 16 bits are sub-divided into three areas:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Channel statuses (only CCC4, CDC4)				Channel assignment (only CCC4, CDC4)				Fault cause							

Table 3-91 Diagnostic outputs

3.24.3.1 Fault/error cause

Hexadecimal value

The possible fault/error cause is displayed in bits 0-7 in the form of a hexadecimal value (this should not be evaluated bit-coded):

Hex. Value	Significance	Counter-measure
0	No fault/error, data transfer was successful.	
1	Block was permanently disabled after initialization due to a configuring error or after an internal error (refer to the communications error field or YTS output for detailed information).	Correct configuring.
2	Communications partner not ready or the communications link was physically interrupted (refer to YTS for more detailed information).	Check coupling partner, cables and connector.
3	Communications partner is not transmitting/receiving (depending on the enable input of the communications partner). The function block is not transmitting/receiving because the communications partner has signaled that it is not transmitting data.	Activate the communications partner
4	Only for transmitters: Data cannot be transmitted. Normally, in the handshake/select mode: The communications partner has still not read-out the last data; seldom in the refresh mode: Communications partner is presently reading).	Configure the transmitter to be slower or the receiver to be faster.
5	Only for receivers: No new data could be received (the communications partner hasn't transmitted any new data since the last data was received).	Configure the receiver to be slower or the transmitter faster.
6	Inconsistent data (subrack coupling: when shutting down the master subrack)	None (proceed with new initialization)
7	Only select transmitters: channel occupied. Another function block is presently transmitting.	All select transmitters can coordinate via the enable input.
8	Only multiple receivers: Reception erroneous. Data read-out took too long; in the meantime, the transmitter has already written new data into the channel.	Configure receivers in a faster (higher-priority) sampling time.
9	Still being initiated. Transmit/receive operation was therefore not able to be started.	

Table 3-92 Fault/error cause

Comments to numbers 4 and 5

In the handshake mode, these numbers can sporadically occur which is quite acceptable. This is because full synchronization between the communications partner is not always possible. Receivers and transmitters should operate approximately in the same cycle.

In the refresh mode, these numbers should not occur if the transmitter is always faster than the receiver.

3.24.3.2 Channel assignment

General information

The area is only used by the CCC4 and CDC4 function blocks. In this case, a number indicates which channel is involved with the error (bits 0-7). As the channel marshalling block can process up to five channels, the numbering is as follows:

Number	Channel
0	Main transmitter/receiver (corresponding to CTS-, AT- or AR-connection data).
1	Transmit/receive part 1 corresponding to the CT1- and AT1- or AR1 connection data)
2	Transmit/receive part 2
3	Transmit/receive part 3
4	Transmit/receive part 4

Table 3-93 Channel assignment

3.24.3.3 Channel statuses

General

The area is only used by function blocks CCC4 and CDC4. This indicates which channels are not operating error-free.

In the "channel statuses" range it is specified on which channel faults were identified when processing the channel

This area is bit-structured:

- 1=no fault
- 0=fault

Bit	Channel
11	Transmit/receive part 1
12	Transmit/receive part 2
13	Transmit/receive part 3
14	Transmit/receive part 4
15	Main transmitters/receivers

Table 3-94 Channel statuses

3.24.4 Introduction – "Pointer-based communication blocks"

Up to D7-SYS Version 6, serial or parallel data transfer operations for SIMATIC control systems were configured using the so-called "virtual communication couplings" methods (shown in CFC charts e.g.: "!VNAME.0001").

Exception: The fiber-optic cable drive coupling SIMOLINK is configured using special SIMOLINK blocks.

From D7-SYS Version 6, communication links, for example PROFIBUS-DP, SIMATIC-CPU ↔ FM 458-1 DP as well as for SIMATIC TDC or T400 and SIMADYN D can be alternatively configured using communication blocks which have become recently available.

In this case, interface data is accessed from the CFC screen using new blocks, which are inter-connected using a special pointer interface.

Both of these configuring methods (virtual interconnections and pointer-based communications) can be used together on the same hardware platform, in the same configuring (application software) and even for the same interface.

3.24.4.1 Principle mode of operation

Telegram blocks (CRV_T, CTV_P and S7RD_P, S7WR_P) allow access to the receiving or to the sending data blocks (telegrams) by providing a pointer to the particular data block.

This pointer is connected to read/write blocks (DRD…, DWR…). Together with an offset, a write block can save the data at its input connection at the required location in the buffer. A read block then retrieves the appropriate data from the specified location of the receive buffer and makes it available at its output.

This means that in principle, a virtual interconnection is replaced by a (read/write) block and a "normal" CFC connection.

3.24.4.2 Applications

Large data quantities

Pointer-based communications are especially advantageous where large amounts of data are involved. For large amounts of data, it is simpler and faster to configure and change and interconnections are more flexible.

Access to the I/O area (P bus) for FM 458-1 DP

128 bytes can be transferred from the FM 458-1 DP to the S7-CPU in each direction via the I/O area of the P bus.

Using the new S7RD_P/S7WR_P blocks, all 128 bytes can be copied into a buffer using a block and that with an optimized computation time. This buffer can then be accessed flexibly using read/write blocks via the pointer interface. Indexed access is also possible

Sub-areas can also be accessed using offset and length data.

Saving data in a data block

Data can be saved in a data memory which can be universally used. This data memory can then be accessed using read/write blocks via a pointer interface. Several similar buffers can be set-up in this data block. This means, for example, that recipes can be easily saved and called-up.

3.24.4.3 Features of pointer-based communications

- When generating CFC charts, the configuring time and costs are reduced,
  especially if very many virtual connections had to be generated.
- Connections to the telegram data can be newly inserted and changed online (pointer, buffer offset).
- Communication connections can be copied with or within chart blocks and centrally changed with them. This means that it is especially simple and quickly to configure, for example, similar communication links to a large number of drives.
- Telegram buffer data can be accessed indexed using 2 offset data. This means that extremely simple modular programs (e.g. chart blocks) can be generated and used.
- Larger data quantities can be transparently processed (e.g. blockwise) (copied), e.g. using the copy block CPY_P in data block DB_P.
- For FM 458-1 DP:
  - using "B-Receive" (BRCV) high quantities of data can be transferred from the S7-CPU to the FM 458-1 DP via the K bus.
  - 128 bytes can be simply configured and quickly transferred with low computation overhead via the I/O area of the P bus.
- A special read/write block is available for every data type (BYTE, INT, DINT, REAL).
- Before accessing REAL data, the type is checked.

For all platforms and interfaces of the SIMATIC control systems

- These configuring possibilities can be principally used for all of the SIMATIC control system platforms. This means FM 458-1 DP, SIMATIC TDC, T400 and SIMADYN D. The reason for this is that block processing is independent of the subordinate (secondary) hardware.

- For the same reason, this type of block communications can be principally used for all types of serial and parallel data transfer routes, where today "virtual communications" are used.

3.24.4.4 Associated function blocks

The blocks which can be used are arranged under the family names "ZeigrKom" or "PointCom" in the CFC block Catalog.

In order to be able to simply identify and easily assign to this block group, the blocks, whose function already corresponds to existing blocks, and which now output a pointer for this application, have a "_**P**" (pointer) at the end of the name.

Type name	Function
CPY_P	Copying buffer areas
CRV_P	Telegram block, receive (interface processing)
CTV_P	Telegram block, send (interface processing)
DB_P	Data block
DRD	Data Read REAL
DRD_D	Data Read DINT
DRD_I	Data Read INT
DRD_8	Data Read 8*REAL
DRD_8D	Data Read 8*DINT
DRD_8I	Data Read 8*DINT
DRD_BY	Data Read BYTE
DWR	Data Write REAL
DWR_D	Data Write DINT
DWR_I	Data Write INT
DWR_8	Data Write 8*REAL
DWR_8D	Data Write 8*DINT
DWR_8I	Data Write 8*INT
DWD_BY	Data Write BYTE
S7RD_P	Receive 128 bytes via a P bus (only for FM 458-1 DP)
S7WR_P	Send 128 bytes via a P bus (only for FM 458-1 DP)
BRCV	Block data receive via S7 connection (only for FM 458-1 DP)

3.24.4.5 Pointer interface

For pointer-based communications, **a pointer is transferred to the telegram data buffer** between the blocks involved:

This pointer is actually a pointer which includes a structure, which in addition to the pointer to the net data also has information for monitoring purposes. This data includes, for example, the sampling time, block class, byte/word swap. It has the connection comment "ZeigPuffer".

3.24.4.6 Configuring information and instructions

- The telegram blocks as well as the read/write blocks must be configured in **the same sampling time** in order to ensure consistency (this is checked when initializing).

- **Offset data** must be carefully entered.
  a) For pointer-based communications, the configuring engineer must precisely observe the offset (in bytes) of the 16-bit value (INT) or 32-bit value (REAL, DINT) to be addressed.
  b) The offset must always be smaller than the buffer size.
  Before accessing buffer data, a check is made as to whether the area (range) has been exceeded because of an offset which has been set too high.

- If data is transferred to a PROFIBUS-DP station or to a SIMATIC CPU, then bytes (for INT) and, where relevant, words of the value to be transferred (for REAL, DINT) must be swapped.
  The read/write blocks have a "Swap" connection – SWP – for this specific purpose.

- In order to transfer telegrams via an interface, initially, it is sufficient to just configure the telegram block with the appropriate lengths data (CRV_T, CTV_P and S7RD_P, S7WR_P). Read/write blocks still don't have to be configured. This means that the interface can be tested or the computation time load through the interface configured using, for example, few resources.

3.24.4.7 Examples of CFC screenshots

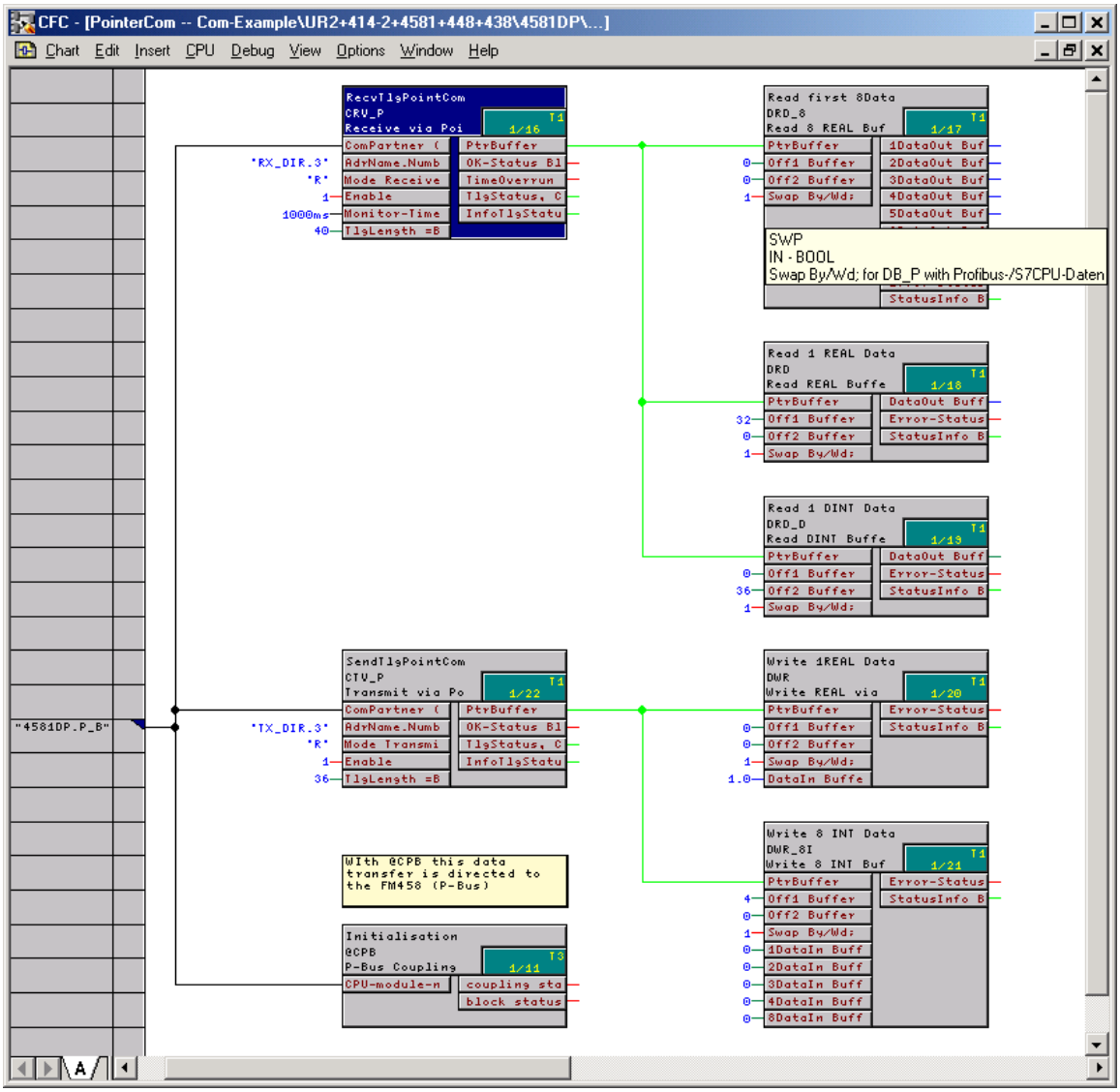


Fig. 3-110 CFC screenshot: Data transfer with telegram blocks and read/write blocks; here, for the interface P bus of the FM 458-1 DP (@CPB); bytes/words must be swapped due to the data management on the SIMATIC-CPU: SWP(Swap)=1

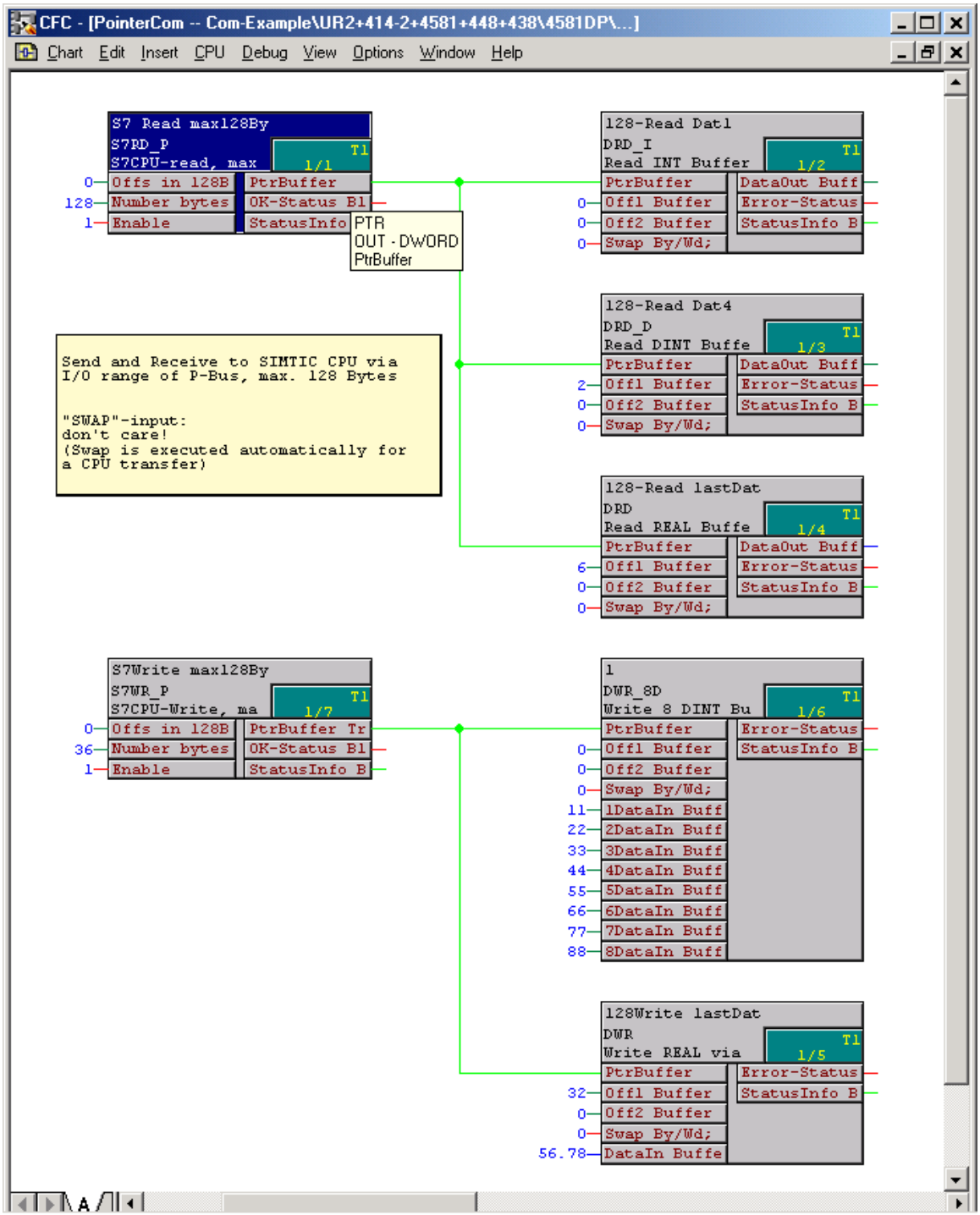


Fig. 3-111 CFC screenshot: Data transfer SIMATIC-CPU ↔ FM 458-1 DP via P bus I/O area

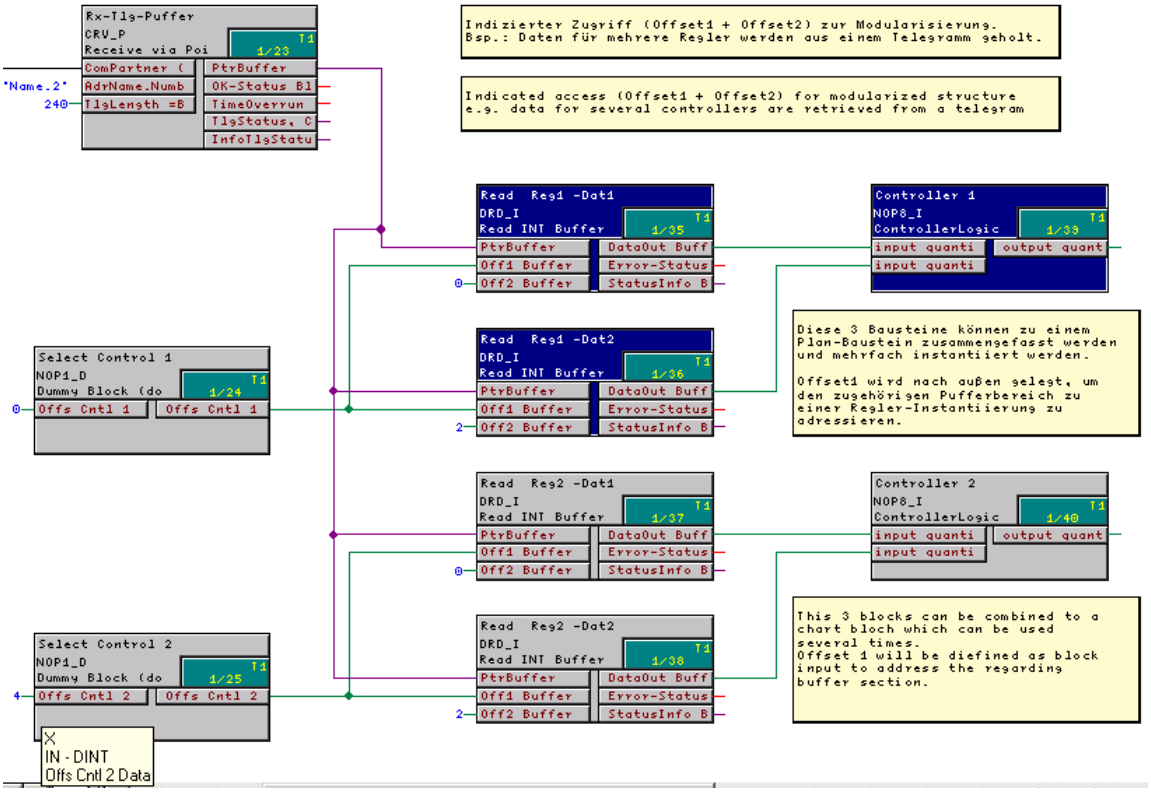


Fig. 3-112 CFC screenshot: Indexed addressing of the telegram data with 2 offsets

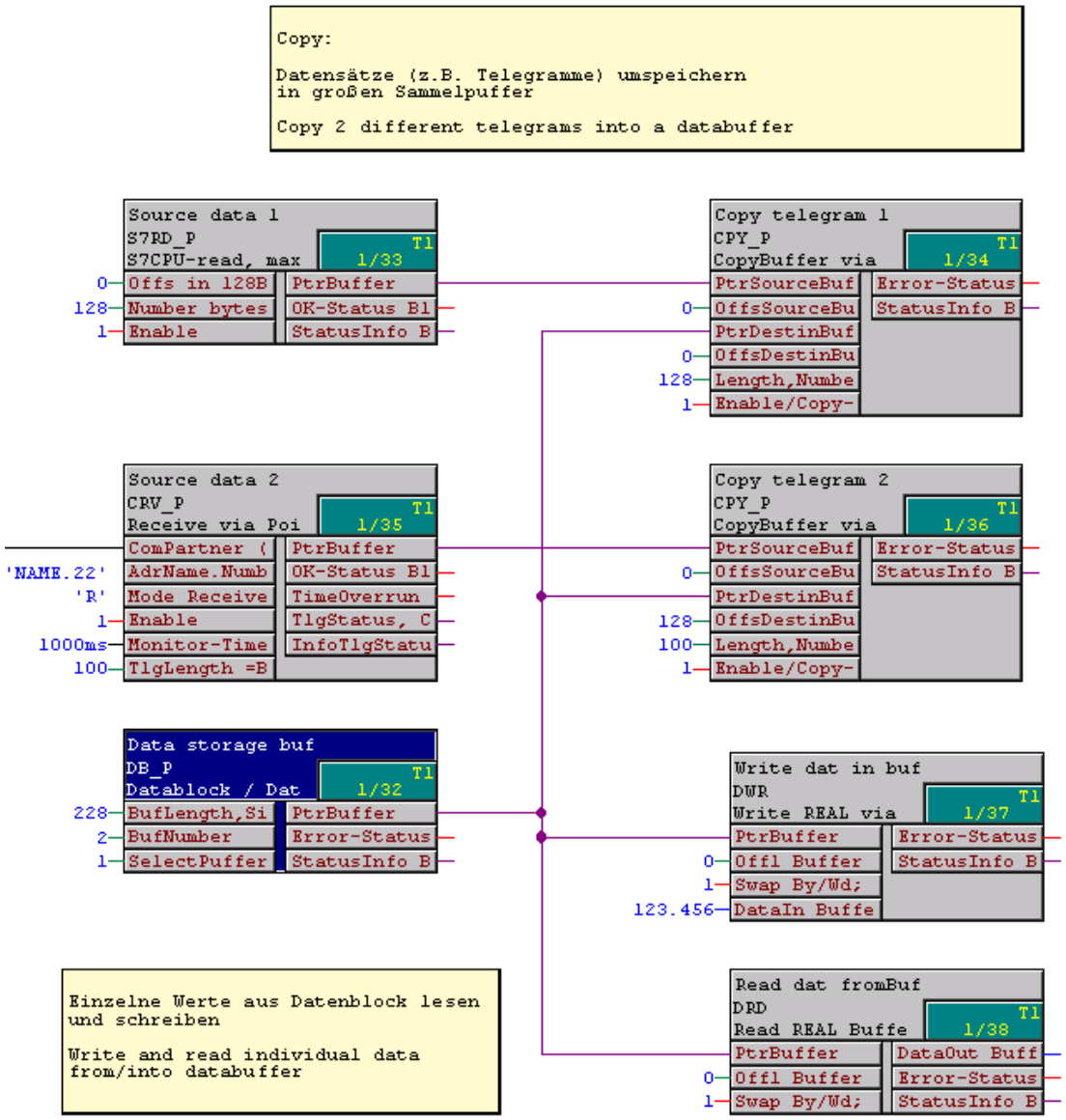


Fig. 3-113 CFC screenshot: Re-saving 2 received telegrams in a data block and single accesses to the data memory

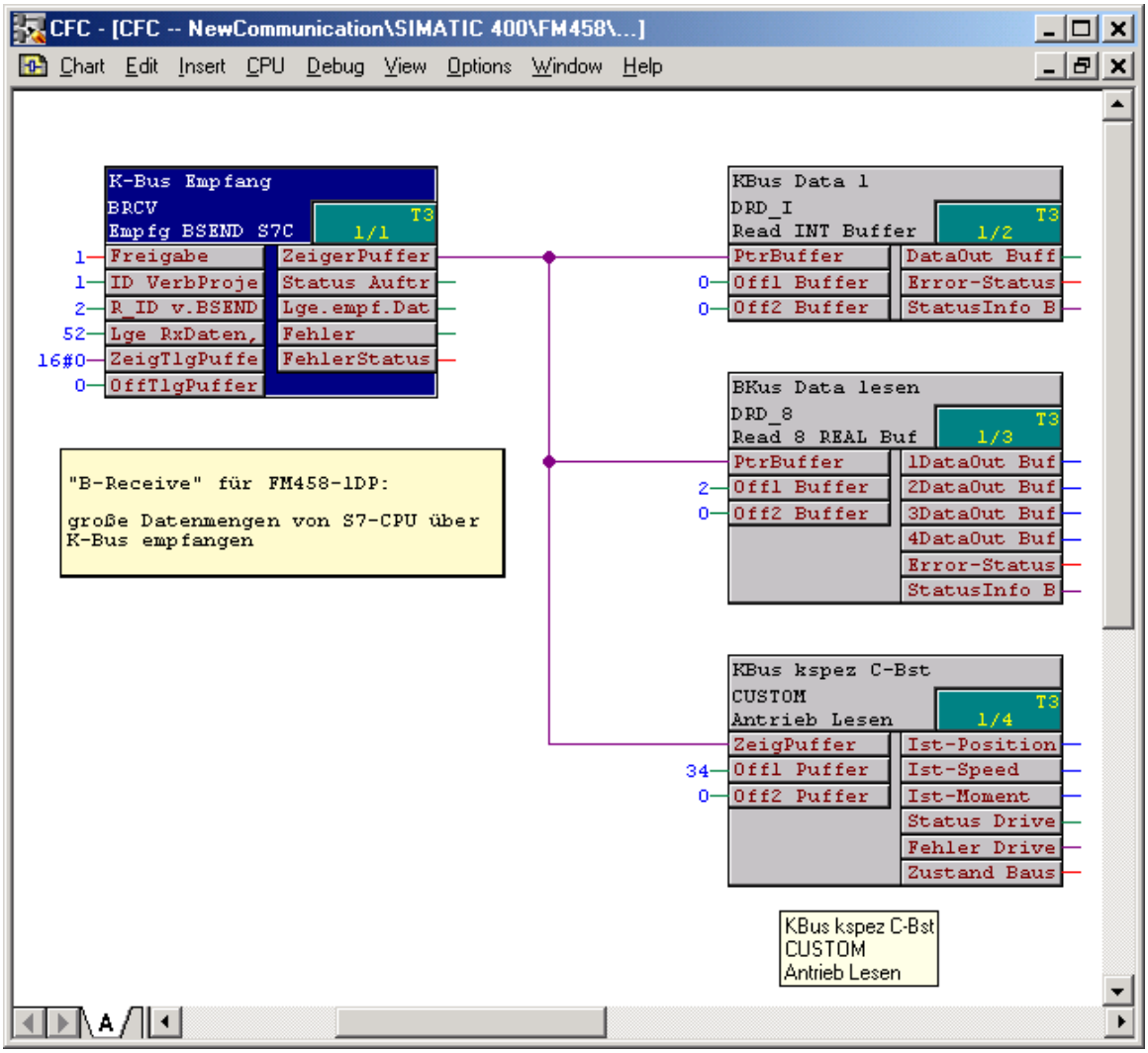


Fig. 3-114 CFC screenshot: Large data quantities received from a SIMATIC CPU via K bus using BRCV

3.25 Communications utility service

Brief description

- Provides a pool of information functions so that the user has access to system information on the CPU.
- Resource for start-up (commissioning) and debugging.

Start-up

The configured data (setpoints/actual values) are displayed and/or changed here, as well as the software optimized (interconnections, controller times modified.

Debugging

Causes of system faults (crash, run-up problems) and disturbances, where the cause is within the CPU module, can be determined here.

All of the communication utility, service activities are controlled via tasks, which are received via a coupling (corresponding to the data entries at the CTS and US inputs).

Operator control devices for the communications utility, service:

- Windows 95/NT-PC with CFC (e.g. in the test mode)
- Windows 95/NT-PC with SIMATIC Manager
- Windows 95/NT-PC with basic IBS (basic commissioning tool)

Local service

Using CFC, SIMATIC Manager or the basic service tool, it is possible to access a CPU via the local RS232 interface of the CPU. No additional configuring is required.

NOTE

You can read-out the CPU module information using the CFC and the SIMATIC Manager.
Additional information
ont he CPU module, refer to the User Documentation "SIMADYN D, Basis software D7-SYS", Section "Diagnostics".

Central service

Each CPU of this subrack can be accessed via a DUST1- or MPI coupling configured in the subrack.

The following must be configured:

- One per subrack:
  - DUST1 coupling: One SS4 module and a central block DUST1 coupling "@CSD01" or
  - MPI coupling: One SS52/MPI module and a central block MPI coupling "@CSMPI"
- At least one per CPU:
  - "SER" service function block.

Additional information
Refer to the Chapter "DUST1 coupling" and Chapter "MPI coupling" for details on the DUST1 and MPI couplings.

3.25.1 Function block SER

Data entries at the connections

"SER" function has a coupling connection. It can be configured several times for each CPU.

The **CTS** input designates the coupling module and the interface via which an operator control device is connected.

A channel name and address stage 1 is specified at input **US**.

- **Channel name**
  - max. 6 characters
  - ASCII characters with the exception of "point" and @
  - the channel name on a data interface must be unique.
- Enter "." after the channel name
- **Address stage 1**
  - CPU slot number. The operator control program addresses the CPU via this number.
  - The data entry must have two digits: e.g. "01", "02", ..., "24".

Example: Configuring with CFC

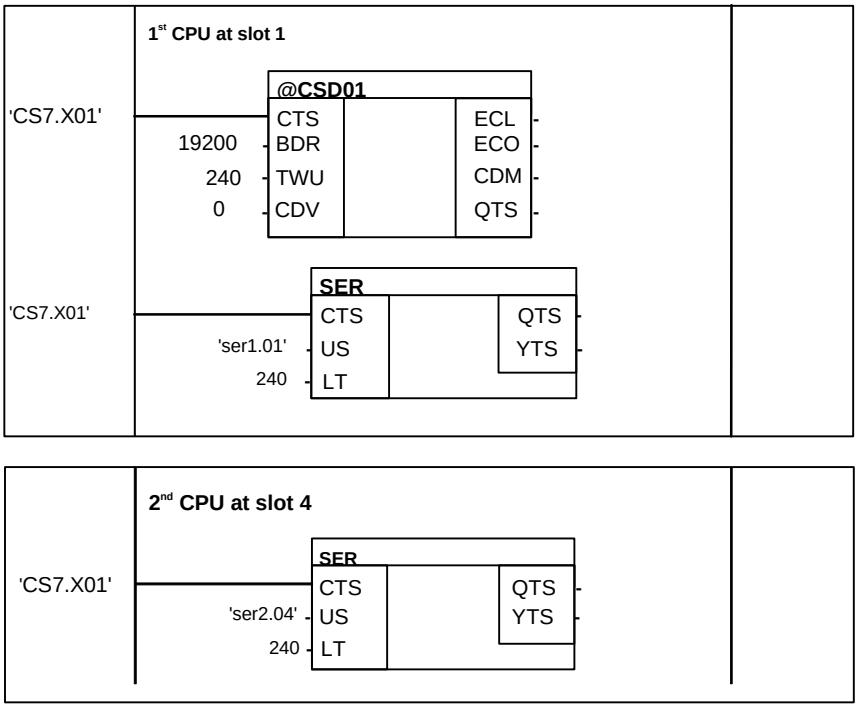


Fig. 3-115 Example: Configuring with CFC

3.25.2 System load, response times

General

Service is actually processed in a sampling time of approximately 32 ms. (The sampling time, specified at the SER blocks is therefore not decisive for processing.) In the sampling time used, the service blocks have a certain computation time available, and more precisely, a maximum of one basic clock cycle (T0).

NOTE

The ratio of the basic clock cycle T0 to the sampling time used defines the CPU performance available and therefore the system load.

Example 1

Basic clock cycle T0=1ms; selected sampling time=32ms

- Every 32 ms, 1 ms is reserved for the service utility
- System load=1 ms / 32 ms=0.03125=3.125 %

Example 2

Basic clock cycle T0=2ms; selected sampling time=16ms

- Every 16 ms, 2ms is reserved for the service utility
- System load=2 ms/16 ms=0.125=12.5 %

Computation time

The computation time available is evenly distributed among all of the service blocks (there is no priority). This means, that as long as time is available, if possible, all SER blocks are executed once. An SER block processes a maximum of one task per each clock cycle. If the reserved computation time isn't fully used, for example, as there is no task to process, then this computation time is made accessible to the system.

Resource distribution

For multiple configuring and simultaneous access to system resources which are only available once (e.g. EEPROM), the first to request a resource is the first to receive it. All others are rejected and an error message is output, at the latest after 1 s ("resource occupied").

3.26 Communications utility time of day synchronization

General

The communications utility, time of day synchronization allows a unified system time to be provided over several SIMADYN D subracks.

Time

The following can be used as time source:

- a time transmitter can be connected via an "Industrial Ethernet" (SINEC H1).
- the MM3 communications buffer module
- the CPU inserted to the far left in a subrack

The time is distributed:

- within a SIMADYN D subrack via a communications buffer module
- to other SIMADYN D subracks via the subrack coupling

Function block

Precisely one function block RTCM should be configured per subrack to distribute the system time.

Further information
to configure function blocks, refer to the user documentation "SIMADYN D, Function Block Library".

The following function blocks are used to read-out the system time:

- RTCABS: absolute time in the date/time of day format
- RTCREL: relative time in seconds since 01.01.88

These blocks can be configured as required.

3.27 Communications with SIMATIC Operator Panels

Introduction

A configuring engineer will be shown how to implement a coupling from SIMADYN D to a SIMATIC OP7 using this configuring software example.

NOTE

Proceed in a similar fashion when configuring couplings to the OP27, OP37 SIMATIC Operator Panels and the TP37 SIMATIC Touch Panel.

The example described here, includes all of the available SIMADYN function blocks, and shows how they are essentially used. The functional scope of the configuring software example has been consciously kept extremely low, so that you can quickly get to grips with the subject. It is simply possible to expand the functionality and/or the hardware components. However, the information provided in the applicable function block documentation must be observed.

The designations used for data blocks, flags, variables etc. have been randomly selected, and are only binding for this particular configuration software example.

NOTE

- When saving values which have been changed using SIMATIC Ops, this is realized on the SIMADYN D CPU in the SAVE area.
- When the battery back-up fails, the configured value at the input is used as default.

Prerequisites

The structure of these configuring instructions represents the sequence of the various operating steps, with which the complete configuring software can be generated. However, it should only be considered as a recommendation, and is not mandatory.

We are assuming that you know how to handle the SIMATIC Manager (including HWConfig and CFC), configuring SIMADYN D as well as configuring OP7 with ProTool/Lite.

Literature which is available on these subjects:

- SIMADYN D User Manuals
- SIMATIC Equipment Manual OP7/17
- SIMATIC HMI, User Manual
  ProTool/Lite configuring software

3.27.1 Configuring example

Functional scope

The configuring software example supports the following OP7 functions:

- Reading and writing variables
- Output of operating messages

- Output of alarm messages including acknowledgment
- Interrogating the function keyboard
- Updating date and time

Hardware

The following equipment and components are selected and located as follows for the configuration example:

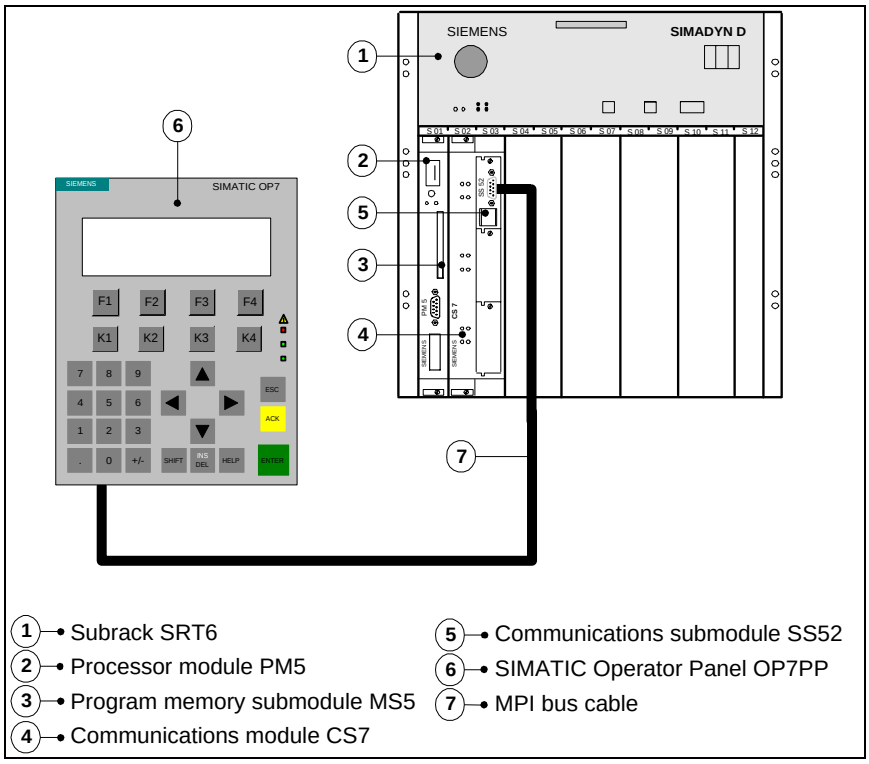


Fig. 3-116 Setting-up the configuring example

3.27.2 Configuring SIMADYN D

General information

All of the configuring, which involves SIMADYN D, is made in the SIMATIC Manager. The work is divided into the "Selecting components in HWConfig" and "Configuring with CFC" sections.

3.27.2.1 Selecting the components in HWConfig

The configuration example is configured in HWConfig. The standard program inputs can be accepted. The only changes involved:

- Sampling time **T4** of the PM5 = **64ms**

- Highest MPI address of the SS52 = **126** (126 is entered as standard in ProTool/Lite)

The following hardware configuration can be seen after work has been completed in HWConfig:

Slot	Name	Type	Order number
1	**D01_P1**	**PM5**	**6DD1600-0AJ0**
1.1	D01_1	MS5	6DD1610-0AH0
2	**D0200C**	**CS7**	**6DD1662-0AB0**
2.1	D02_1	SS52-MPI	6DD1688-0AE2
2.2			
2.3			
4			
5			
6			

Fig. 3-117 Screenshot of the completed HWConfig menu

3.27.2.2 Configuring with CFC

After executing "Save and compile" in the "HWConfig", the "D01_P1" symbol was inserted in the SIMATIC Manager below the "SIMADYN D station".

Inserting a new chart

A new chart, called "OP7" is added, in the associated chart container, to the existing charts "@SIMD1" and "@SIMD2". All of the additional configuring work will now be made in a new chart called "OP7".

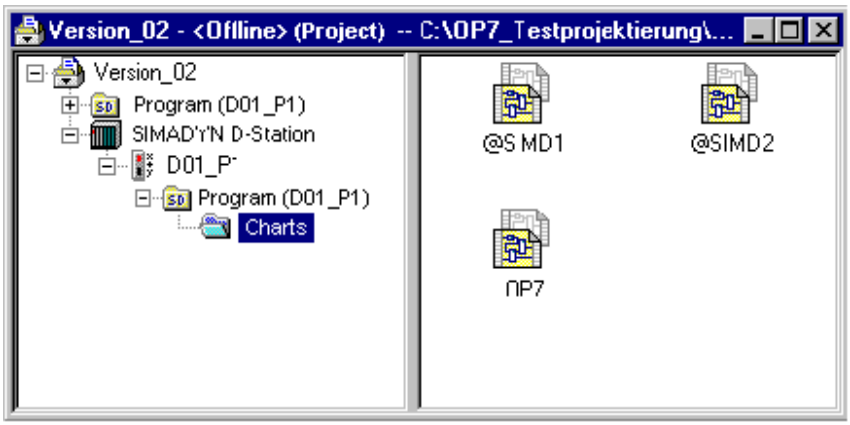


Fig. 3-118 Screenshot of the completed chart container

Agreements

- All of the function blocks to be configured are configured in the sequence level T4.
- If not explicitly listed, the standard assignments of the function block connections are kept.

- Only the relevant connections are listed in the following configuring tables.

3.27.2.2.1 Initializing the OP7

Brief description

The function blocks **@CSMPI** and **S7OS** are connected to the configured coupling module (SS52-MPI on CS7) via the **CTS** inputs. This establishes the connection between SIMADYN D and OP7.

Configured software

FB	Connection	Connection assignment (significance)
@CSMPI	CTS	**D0200C.X01** (global operand, module name)
S7OS	CTS	**D0200C.X01** (global operand, module name)
	US	**testop.01** (address parameter)

Table 3-95 Connection assignment @CSMPI and S7OS

CFC chart

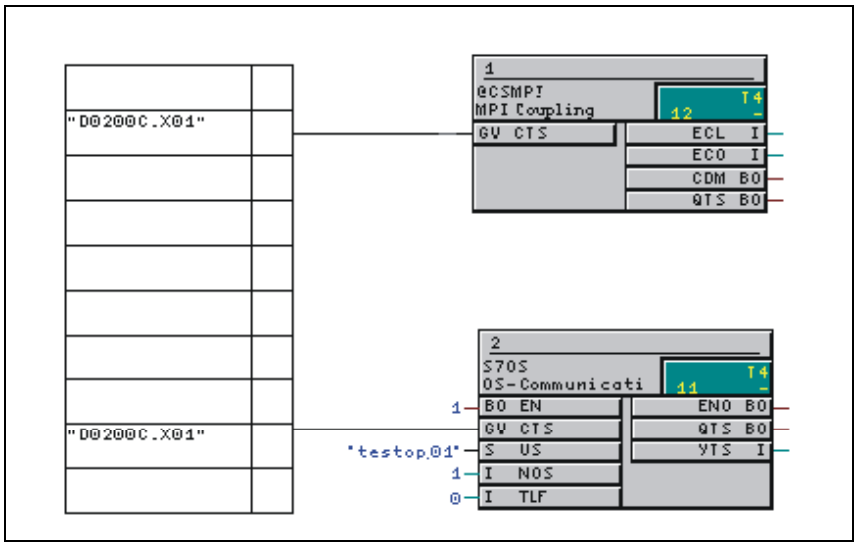


Fig. 3-119 Initializing the OP7 on the MPI bus

3.27.2.2.2 Reading function block connections (I/O)

Brief description

A counter was configured for this function, which continually increments from the initial value ("0") up to a final value ("50"). It then automatically resets itself and starts again from the beginning. Output **Y** (counter status) of the **CTR** is interlocked with a global operand (OP connection), whose contents are read-out at OP7.

NOTE

The flag No., specified under SIMADYN D for the OP connection, must also be assigned the configured variables under ProTool/Lite.

Configuring software

FB	Connection	Connection assignment (significance)
BF	T	**500ms** (time constant)
CTR	LU	**50** (counter upper limit)
	Y	Symbol name: **Z_output** Flag No.: **MW10** (global operand, OP connection)

Table 3-96 Connection assignment, BF and CTR

CFC chart

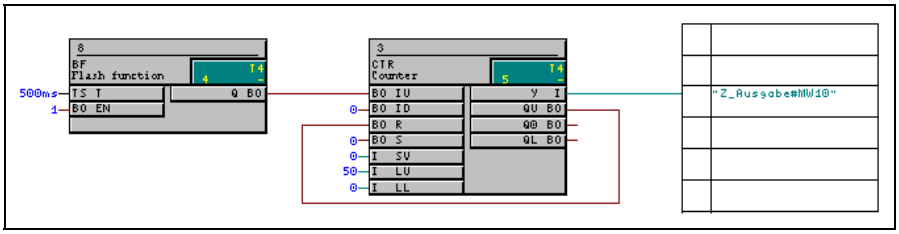


Fig. 3-120 Reading function block connections

3.27.2.2.3 Writing function block connections

Brief description

A value from OP7 is read-in using a global operand (OP connection), fed through a dummy block (NOP1_I), and is sent back to the OP7 with an additional global operand (OP connection); it is read-out from the OP7.

NOTE

The flag No. for the OP connections, specified under SIMADYN D, must also be assigned the configured variables under ProTool/Lite.

Configured software

FB	Connection	Connection assignment (significance)
NOP1_I	X	Symbol name: **OP_SOLL** Flag No.: **MW20** (global operand, OP connection)
	Y	Symbol name: **OP_IST** Flag No.: **MW30** (global operand, OP connection)

Table 3-97 Connection assignment, NOP1_I

CFC chart

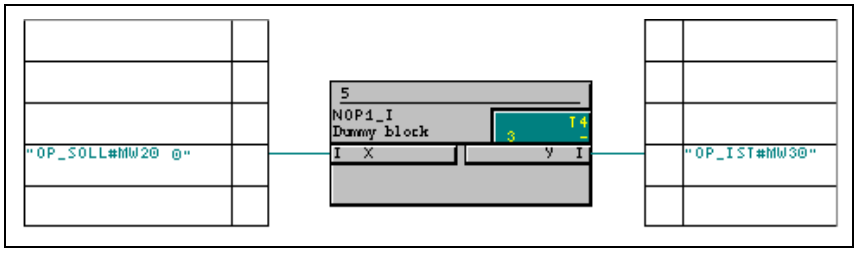


Fig. 3-121 Writing into function block connections (I/O)

3.27.2.2.4 Configuring events

Brief descriptions

If the counter starts a new count loop, an event is output. Output **QO** of function block **CTR** outputs the signal. This signal is extended (FB PDF), converted from the "boolean" format into the "word" format (FB B_W), and transferred to function block **S7EMA** as the first event message word.

The S7EMA is assigned a virtual data block number for the user data area "event messages" via a global operand (OP connection).

NOTE

The data block No., specified under SIMADYN D for the OP connection, must also be assigned the configured area pointer for event messages under ProTool/Lite.

Configured software

FB	Connection	Connection assignment (significance)
PDF	I	Function block **CTR**, output **QO** (event message signal)
	T	**5000ms** (time constant)
B_W		(Conversion from boolean to word)
S7EMA	XDB	Symbol name: **BM** Data block No: **DB1** (global operand, OP connection)

Table 3-98 Connection assignment, @CSMPI and S7OS

CFC chart

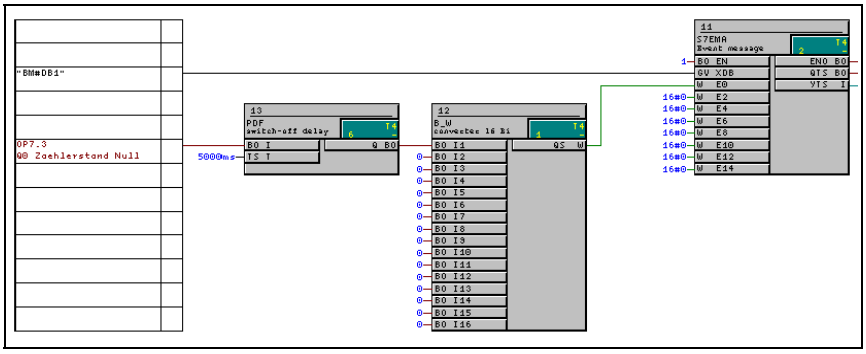


Fig. 3-122 Configuring event messages

3.27.2.2.5 Configuring alarm messages

Brief description

If the counter starts a new count loop a alarm message is output (at the same time as the event message) . Output **QO** of function block **CTR** supplies the signal. This signal is converted from the "boolean" format into the "word" format (FB B_W), and is transferred to function block **S7AMA** as the first event message word.

S7AMA is assigned a virtual data block No. for the user data area "alarm messages" via a global operand (OP connection).

NOTE

The data block No. for the OP connection, assigned under SIMADYN D, must also be assigned the configured area pointer for alarm messages under ProTool/Lite.

Configured software

FB	Connection	Connection assignment (significance)
B_W	I1	Function block **CTR**, output **QO** (signal for the alarm message)
S7AMA	XDB	Symbol name: **SM** Data block No.: **DB10** (global operand, OP connection)

Table 3-99 Connection assignment, B_W and S7AMA

CFC chart

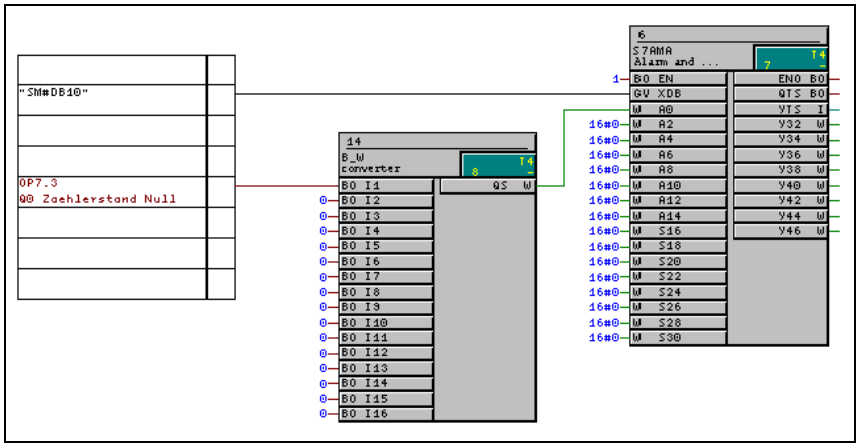


Fig. 3-123 Configuring alarm messages

3.27.2.2.6 Configuring the function keyboard

Brief description

The configuring of the function keyboard includes, on the SIMADYN D side, only the **S7FKA** function block. The actual assignment of the key functions is realized under ProTool/Lite.

S7FKA is assigned, via a global operand (OP connection) a virtual data block No. for the user data area "function keyboard image".

NOTE

The data block No., assigned under SIMADYN D, for the OP connection, must also be assigned the configured area pointer for the function keyboard under ProTool/Lite.

Configured software

FB	Connection	Connection assignment (significance)
S7FKA	XDB	Symbol name: **FK_Tast** Data block No.: **DB20** (global operand, OP connection)

Table 3-100 Connection assignment, S7FKA

CFC chart

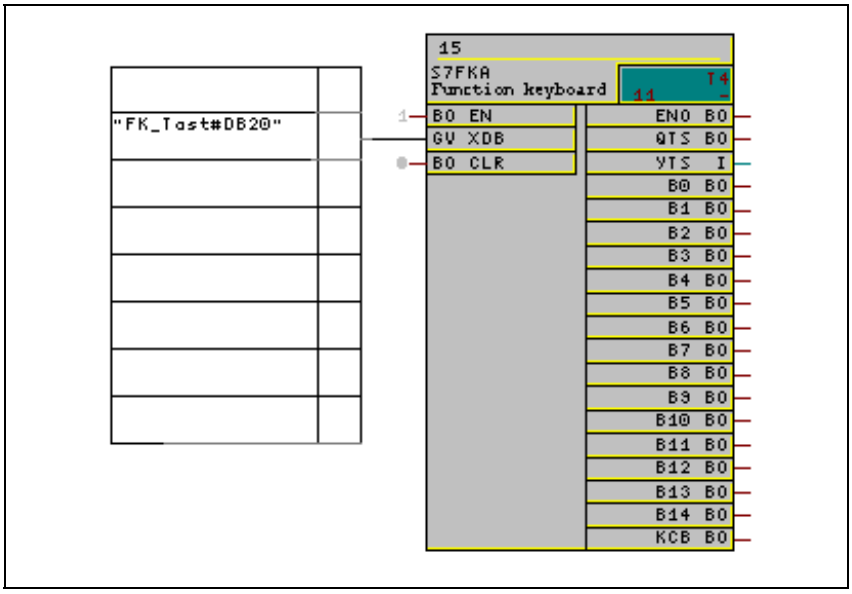


Fig. 3-124 Configuring the function keyboard

3.27.2.2.7 Configuring the interface area

Brief description

The time and date of the OP7 is cyclically updated by SIMADYN D using this function. S7IA is assigned, via a global operand (OP connection) a virtual data block No. for the user data area "interface area" .

NOTE

The data block No., assigned under SIMADYN D, for the OP connection, must also be assigned the configured area pointer for the interface area under ProTool/Lite.

Configured software

FB	Connection	Connection assignment (significance)
S7IA	XDB	Symbol name: **SB** Data block No: **DB30** (global operand, OP connection)

CFC chart

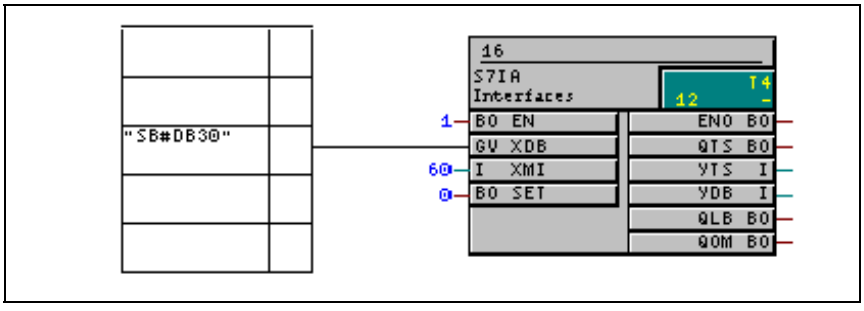


Fig. 3-125 Defining the interface area

3.27.2.3 Importing the symbol table

General information

While configuring the CPU in HWConfig an empty symbol table is automatically set-up, which will later accept the symbol names configured using CFC. The file with the symbol names must then be imported into the symbol table when the CFC has been configured.

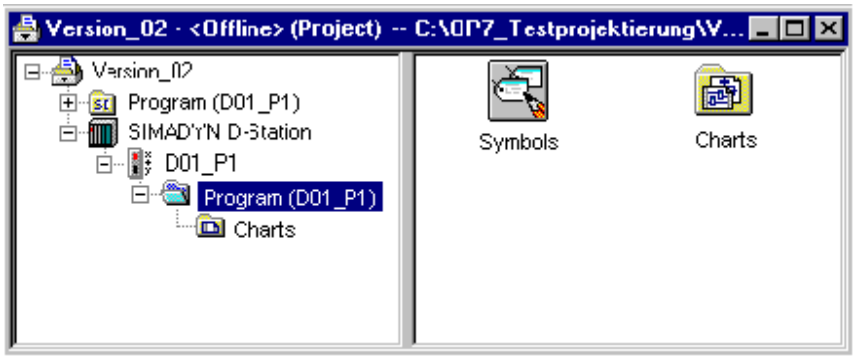


Fig. 3-126 "Symbol" icon in the chart container

Symbol editor

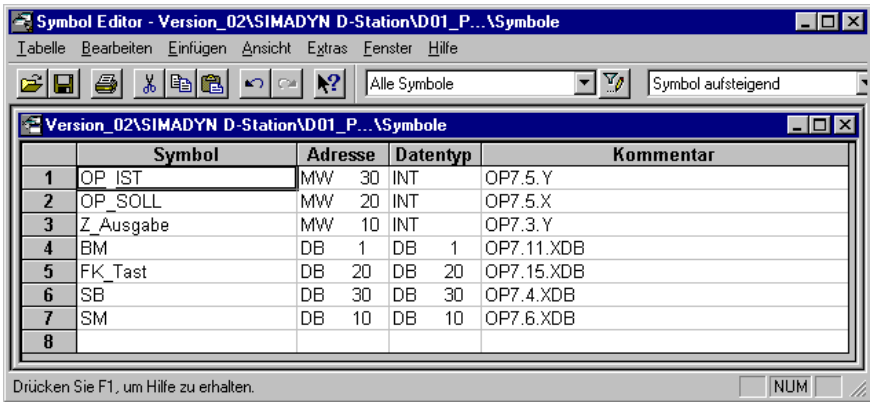
The symbol editor is opened from the chart container by double-clicking on "Symbols".

The symbol file (symbol.asc) is loaded in the symbol table using the menu command "Import table...".

NOTE

If changes are made in the symbol file in the CFC between two compilations, then a message to this effect is output. This message can also be taken from the actual memory path of the symbol file.

The following diagram shows the complete symbol table of the test software after having been imported:



	Symbol	Adresse	Datentyp	Kommentar
1	OP_IST	MW 30	INT	OP7.5.Y
2	OP_SOLL	MW 20	INT	OP7.5.X
3	Z_Ausgabe	MW 10	INT	OP7.3.Y
4	BM	DB 1	DB 1	OP7.11.XDB
5	FK_Tast	DB 20	DB 20	OP7.15.XDB
6	SB	DB 30	DB 30	OP7.4.XDB
7	SM	DB 10	DB 10	OP7.6.XDB
8				

Fig. 3-127 Symbol table with imported symbol file

The symbol table is saved and the operation completed using "Save table".

3.27.3 Configuring the OP7 with ProTool/Lite

General information

The configuring of OP7 is not described in detail here. If not explicitly mentioned, when configuring, the standard settings can be taken from ProTool/Lite.

NOTE

For error-free communications, it is absolutely necessary, that the flag- and data block numbers, configured in CFC, are transferred for the individual functions, unchanged, into ProTool/Lite.

Symbol table

CFC generates a symbol table, in which all of the flags and data blocks used are saved. This symbol table must be imported for the configuring work for ProTool/Lite.

The symbol names, configured in CFC for the OP7 configuring, can now be used in ProTool/Lite.

Configuring software

Configured software with displays (including variables to read and write values), event- and alarm messages as well as configured function keys must be generated for the OP7.

The following table provides an overview of the required configuring components with the associated values, harmonized and adapted to the CFC configured software:

Configured software	Setting
Control	**SIMATIC S7-300/400**
MPI settings	Communications partner slot: **1**
Variables to read the function block connections (I/O)	**Symbol name: Z_Ausgabe (VAR_1**: Format "**INT**", type "**A**" area "**M**", **MW10)**
Variables to write into the function block connections (I/O)	**Symbol name: OP_SOLL (VAR_2**: Format "**INT**", type "**E**" area "**M**", **MW20)** **Symbol name: OP_IST (VAR_3**: Format "**INT**", type "**A**" area "**M**", **MW30)**
Area pointer, event messages	**Symbol name: BM (DB1**, **DBW0**, length "**8**" words**)**
Area pointer, alarm messages	**Symbol name: SM (DB10**, **DBW0**, length "**8**" words**)**
Area pointer, acknowledge PLC	**DB10**, **DBW16**, length "**8**" words
Area pointer, acknowledge OP	**DB10**, **DBW32**, length "**8**" words
Area pointer, function keyboard	**Symbol name: FK_Tast (DB20**, **DBW0**, length "**1**" word**)**
Area pointer, interface area	**Symbol name: SB (DB30**, **DBW0**, length "**16**" words**)**

3.27.4 Application information

3.27.4.1 Computation times

General information

The computation times of the function blocks are dependent on the application.

The computation times of the function blocks for an OP7 are listed in the following table. Each additional configured OP7 correspondingly increases the computation time.

	S7OS	S7EMA	S7AMA	S7FKA	S7IA
One OP7	120	2	33	22	18
Each additional OP7	55	2	33	22	18

3.28 Communications with WinCC (MPI)

Overview

You can handle and monitor the proces variables of your SIMADYN D station using WinCC. A WinCC station is connected to SIMADYN D using an MPI subnet via a CS7/SS52 MPI.

Prerequisites

- Configure your hardware in HWConfig, so that your SIMADYN D station is equipped with a minimum of one CS7- carrier module, which includes, as a minimum, one communications submodule SS52.
- The communications interconnection using the MPI subnet must be configured in the SIMATIC manager.

Additional information
on the network configuration, refer to "Hardware Configuring with STEP 7".

Configuring

You will require the following components so that you can use WinCC for operator control and monitoring of your SIMADYN D station:

- CFC in order to declare function block I/O as process variables,
- WinCC itself to configure the WinCC station.

Additional information
on operator control and monitoring, refer to the User Documentation SIMATIC D7-SYS, STEP 7 option packages for D7-SYS , chapter “CFC”.

Initialization

Use the following function blocks to initialize the MPI link:

- One @CSMPI central coupling block must be configured for each SS52-MPI.
- One communications block S7OS must be configured for each SIMADYN D CPU and SS52-MPI module, which is to be addressed using a WinCC station.

These function blocks are configured as follows in the CFC:

FB	Connecti on	Connection assignment	Example
@CSMPI	CTS	*Global operand*: Subrack name of the CS7 carrier module/connector number with which the SS52 MPI module is inserted in the CS7	D0200C.X01
S7OS	CTS	refer to @CSMPI	D0200C.X01
	US	*Address parameter*: Channel name/slot number of the CPU	wincc1.01
	NOS	*Constant:* each WinCC station requires a channel	1

Table 3-101 Connection assignment @CSMPI and S7OS

NOTE

- WinCC saves changed values in the SIMADYN D-CPU in the SAVE area.
- When the battery back-up fails, the configured value of the input is used as default value.

3.29 Communications with WinCC (SINEC H1)

Introduction

This User Manual shows you how you can couple WinCC to SIMADYN D via a SINEC H1 coupling using a simple example of the configuring software. All of the necessary configuring steps (including the hardware- and software requirements) are described. The handling of the necessary software tools is not described here, but a reference is made to the appropriate User Manuals.

3.29.1 Prerequisites

Software

SIMADYN D channel-DLL	**Software prerequisites** • WinCC-Systemsoftware: from version 4.02 for Windows 95 und Windows NT 4.0 • SIMATIC-NET-Driver (Industrial Ethernet): TF-1613 / Windows NT 4.0 **Order No. (SIMADYN-D-PMC Industrial Ethernet)** 2XV9450-1WC43-0AX0 **Further information** Siemens AG Industrial Solutions and Services IT Plant Solutions I&S IT PS 3 Werner-von-Siemens-Straße, 60 91052 Erlangen Contact: your IT4Industry Team Phone: +49 (91 31) 7-4 61 11 Fax: +49 (91 31) 7-4 47 57 E-Mail: info@it4industry.de WWW: http://www. it4industry.de
Tools	**PROBI:** The configuring package PROBI is component of every SIMADYN D-PMC licence.
	SINEC NML configuring tool for CSH11

Table 3-102 Software prerequisites

NOTE

The SIMADYN D-PMC channel-Dll can only be used in conjunction with WinCC V4.02. For the configuring example used here, the channel DLL must be operated with SIMADYN D PMC Ethernet Layer 4 (Win95/NT4.0, TF1613 V3.1). The software is installed via a setup routine, which is provided on the product software floppy disk.

The PMC channel DLL can only be inserted in the tag management from WinCC, if the associated communications driver SIMATIC NET TF1613 is installed. Installation is realized via a setup which is provided on the CD-ROM of the SIMATIC NET product version.

Hardware

PC configuring station:

SIMATIC NET plug-in cable 727-1 for INDUSTRIAL ETHERNET l network card SIMATIC NET CP1613

Table 3-103 Hardware prerequisites

NOTE A CP1613 must be installed in the PC.

SIMADYN D hardware

System:	SIMADYN D	
Subrack:	SR12.1	12 slots with fan
Slot 1:	PM6	CPU (with local service interface)
Slot 1.1:	MS51	4 Mbyte Flash memory module
Slot 2:	MM11	Communications buffer module
Slot:	CSH11	SINEC H1 interface

Table 3-104 Hardware design for the configuring example

3.29.2 Process variables

A SIMADYN D station must be configured and parameterized and a test chart generated using the CFC configuring tool. The hardware configuration is described under **Point 26.1 (SIMADYN D hardware design)**. We will not discuss in detail here how SIMADYN D software is generated using the CFC. If you require further information refer to the SIMADYN D Configuring Instructions [4].

3.29.2.1 SIMADYN D software

The CFC chart for the WinCC link does not have to be realized on a separate chart, but is however recommended as this is more transparent. The following function blocks are required for the coupling between SIMADYN D and WinCC for process variables:

- LI - LAN interface block
- VM visualization block
- VI interface block

- VC concentrator block
- CI interface block
- SER02 communications block

The blocks are connected as follows:

(Only the relevant I/O are described)

FB LI

I/O name	Significance	Example
CTS	Name of the interface used (CSH 11)	D0300C
AT	Channel name : ATC01 level 4 : #4 SDCOR1 : NML connection name (refer to the NML configured software)	´ATC01.#4SDCOR1´
AR	Channel name : ATC01 level 4 : #4 SDCOR1 : NML connection name (refer to the NML configured software)	´ARC01.#4SDCOR2´
NA	Maximum number of parallel jobs from WinCC	15
NC	WinCC ID	0
COM	Communications medium H1	0
CCV	Connection with VM, connection CVP	<VM.CVP
CCF	No connection with the FM block	-16#0
CCB	No connection with the MM block	-16#0

FB VM

I/O name	Significance	Example
NA	Sum of the jobs reserved for the VM	40
NL	No. of LI blocks	1
NV	No. of VI blocks	1
MEM	Default	0
TGL	Default	0
CVP	Connection with LI.CCV,VI.CCV	>(LI.CCV,VI.CCV)

FB VI

I/O name	Significance	Example
CTS	Processor name	D01_P1
AT	Send channel name to the VC	´CMDVCH`
AR	Receive channel name from the VC	ACKVCH´
CCV	Connection with VM, connection CVP	´VM.CVP´

FB VC

I/O name	Significance	Example
CTS	Processor name	D01_P1

AT	Send channel name to the VI	´ACKVCH´
AR	Receive channel name from the VI	´CMDVCH´
NC	No. of connected CIs	1
CVP	Connection with CI, connection CCV	>(CI.CCV)

FB CI

I/O name	Significance	Example
CTS	Processor name	D01-P1
AT	Send channel name to the SER02	´CMDH´
AR	Receive channel name from the SER02	´ACKH´
ADT	Data channel name from the SER02	´DATH´
CCV	Connection with VC, connection CVP	<VC.CVP

FB SER02

I/O name	Significance	Example
CTS	Processor name	D01-P1
AT	Send channel name to the CI	´ACKH´
AR	Receive channel name from the CI	´CMDH´
ADT	Data channel name to the CI	´DATH´
CLT	Length, send channel	116
CLR	Length, receive channel	524
CLD	Length, data channel	432
TPD	For operator control and visualization (HMI)	0
NL	Maximum number of MWLs (measured value lists)	40
NV	Max. number of measured values (connections)	500

NOTE In addition, the @CMM central block must be configured for the buffer memory module and the @CSH11 central coupling block.

FB @CSH11

I/O name	Significance	Example
CTS	Name of the interface used (CSH 11)	´D0300C´
MAA	Industrial Ethernet address (SIMADYN D)	080006010002
CDV	Memory re-structure (1)	0

FB @CPN

I/O name	Significance	Example
CTS	Processor name	´D01_P1´
CDV	Memory re-structure (1)	0

3.29.2.2 Configuring WinCC

For the particular example, it is sufficient to use a basic WinCC configuring software with several input/output fields.

We will not discuss the WinCC configuring software here. If you require further information refer to the comprehensive WinCC Configuring Manuals. We recommend the Getting Started SIMATIC WinCC Manual for an introduction into configuring WinCC.

3.29.3 Binary events

Simadyn D configuring software

No additional configuring is required for process value visualization for the binary event technique with WinCC. The selection regarding which bit of a variable initiates which message is realized exclusively in WinCC. The configuring rules to output process variables remain.

WinCC configuring software

In addition to configuring software for the process variables, an ALARM logging configuring software must be generated. We will not discuss the WinCC configuring software here. If you require more detailed information, refer to the comprehensive WinCC Configuring Manuals. We recommend the Getting Started SIMATIC WinCC Manual for an introduction into configuring WinCC.

3.29.4 SIMADYN D messages

3.29.4.1 SIMADYN D configuring software

To output messages from SIMADYN D to WinCC, the WinCC block MM is required in addition to configuring the process value output :

- MM message manager

The blocks are connected as follows :

(Only the relevant connections are described)

FB MM

I/O name	Significance	Example
CTS	Processor name	D01_P1
AR	Channel name (This is identical with the AT connection of the MSI block)	EMPFKANA
NZ	No. of cycles per data transfer	5
NL	No. of connected LI blocks	1
MEM	Diagnostics triplet	0
TGL	Diagnostics triplet	0

CVP	Connection with LI, connection CCV	>LI.CCV

NOTE In addition, the following must be configured: Central message block @MSI, message output block MSI and the message block MERF0.

FB @MSI

I/O name	Significance	Example
CMS	Message system name	MYMELD
CMT	Message text (this is not output)	""
NOM	No. of messages which can be saved	200
SAV	Message buffer, buffered RAM	0
RP	Prefix for communication errors	0
MUN	Enable for message entries	1

FB MSI

I/O name	Significance	Example
CMS	Message system name	MYMELD
CTS	Coupling module name	D01_P1
AT	Address parameter	EMPFKANA
RP	Prefix for overflow messages	0
SNV	Output, message number	1
STM	Output, message text	0
STC	Output, message text constant length	1
SSF	Output format	1
EN	Enable	1
MUN	Enable for message entries	1

FB MERF0

I/O name	Significance	Example
CMS	Message system name	MYMELD
MT	Message type	1
RP	Prefix	0
RS1	Suffix, incoming message	10001
RS2	Suffix, outgoing message	00005
EN	Message enable	1
IS1	Message trigger	16#0
SM	Save message	0

3.29.4.2 WinCC configuring software

In addition to the configuring software for the process variables, an ALARM logging configuring software must be generated. The WinCC configuring software will not be discussed here. If you require information refer to the comprehensive WinCC Configuring Manuals. We recommend the Getting Started SIMATIC WinCC Manual for an introduction into configuring WinCC. The assignment of the SIMADYN D message numbers to the message blocks (RS* connections) to the message numbers, generated by WinCC, can only be identified by the "PMC message no", which is generated from the message numbers of the signal list.

3.29.5 Generating the address book using the CFC editor

To generate the signal list for WinCC, ADRIMP requires the symbol information of the SIMADYN processors. For each CPU, SIMADYN D generates an ASCII file, which contains this information. The file name consists of the subrack names and the CPU number, separated by a "_". ".ADR" is used as extension.

The address book is generated by calling-up the required project chart, and selecting the menu items Options - Settings compilation.... Then mark the Option, Create address book, and enter OK. Call-up the menu items Chart compilation. The address book is now created when compiling. The path of the generated address book is then located via the menu items Options - Report.

Restrictions

The old STRUC G syntax is assumed when generating the address book. The following restrictions must be observed with respect to the CFC syntax :

- Only upper case letters are permitted for the name
- Chart name: Max 6 characters, the first character must be a letter
- Module name: Max 6 characters, the first character must be a letter

- Connection name: Max 3 characters, the first character must be a letter
- $ signal name: Max 6 characters, the first character must be a letter
- Scaling range: 0.00001 -- 99999

3.29.6 NML configuring software for CSH11

The configuring tool NML is required to configure the bus for the CSH11 coupling module (with integrated CP1470).

The handling of the NML configuring tool will not be discussed here but if you require further information refer to the NML-CP Manual.

The following configuring software is suitable for establishing a connection between WinCC and SIMADYN D via a CSH11 module using the SINEC H1 protocol (Industrial Ethernet level 4).

Configuring software example

Siemens AG SINEC NML V 3.01 Documentation communications 19.02.1998

- Node type: CP 147x
- Node name: roland
- Page: 1 / 1

Basic node data

- Interface type: CP 147x
- Interface name: CP 147x
- Interface profile: CSH11_E4_2000
- Bus address: 080006010002 (SIMADYN D)
- Transport connection.: 6
- Application designation.: 26
- Data basis length: 5888 bytes
- No. of FVTs: 1

Communication relationships

1. Transport connection SDCOR1

- Local TSAP-ID: AG_WINCC
- Remote TSAP-ID: WINCC_AG
- Remote bus address: 080006010001 (PC)

- Connection set-up: active -> dyn.
- Connection type: E4-connection
- Connection path: Bus
- Profile name: e4_handshake
- No user application relationship assigned

2. Transport connection: SDCOR2

- Local TSAP-ID: WINCC_AG
- Remote TSAP-ID: AG_WINCC
- Remote bus address: 080006010001 (PC)
- Connection set-up: passive <- dyn.
- Connection type: E4-connection
- Connection path: Bus
- Profile name: e4_handshake
- No user application relationship assigned

Using the **Transfer** utility, it is possible to load the communications description, which was previously generated using the communications configuring software, into the CSH11 module.

3.29.7 Address list import tool ADRIMP

In order that WinCC can interpret the addresses of the SIMADYN D path names, the ADRIMP address list tool is required. The ADRIMP address list tool allows text address lists (TALI) to be listed in the WinCC data base. A precise description is provided in the User Manual Communications Driver SIMADYN D-PMC for WinCC.

3.29.7.1 Prerequisites

A variable definition file must exist, and the SIMADYN D address book must have been previously generated. The variable definition file and the address book must be located in the same path. The generation path can be different, but should also be generated in this path to enhance the software transparency.

3.29.7.1.1 Generating the variable definition file

The variable definition file is a text file, which must be generated by the user. The variable definition file consists of two defined header lines (1. and 2.), followed by the assignment of symbolic names to the SIMADYN D connection path names. The symbolic names can be freely selected, but should be the same as those used in the WinCC text fields to ensure transparency.

Excerpt from the variable definition file

E.g.: winccvar.txt

1.) [VDM:wincc]

2.) [PN:A000_1,C:\wincc\vardatei]

3.) MOTOR_EIN,ANBIND.CI.CCV

MOTOR_AUS,ANBIND.CI.YTS

3.29.7.1.2 Generating and importing a new signal list

Prerequisites

Before generating and importing the signal list, the SIMADYN D PMC driver must be installed in the WinCC configuring software.

- Call-up the WinCC configuring software
- Click-on tag management
- Click-on the menu item "Add new driver"
- Select the SIMADYN D PMC Ethernet.chn

If no WinCC configuring software is started before ADRIMP starts, when importing the signal list, the last configuring software which was used, is used.

Execution

- Call-up ADRIMP
- Select the "File" menu item
- Select the "Probi" menu item
- Search for the variable definition file (e.g.: winvar.txt)
- Define the generation path
- Generate the signal list (e.g.: wincc.txt)
- Exit Probi

Note **ADRIMP automatically imports the signal list into the tag management of the appropriate WinCC data administration.**

3.29.7.1.3 Importing an existing signal list

- Start WinCC with the required project
- Call-up ADRIMP
- Select the "File" menu item
- Select the "Open" menu item
- Select the signal list (e.g.: wincc.txt)
- Exit ADRIMP

NOTE **ADRIMP automatically imports the signal list into the tag management of the appropriate WinCC data administration.**

3.29.7.2 Checking the generated tag management in WinCC

Check the imported data, their symbolic names, data formats and SIMADYN D path names:

- Call-up the WinCC configuring software
- Select the variables tag management
- Click-on the logical connection (corresponds to the VDM name)
- Select SIMADYN D PMC ETHERNET
- Select SD- PMC (CP1613-1)
- Select the logical connection names

The logical names and SIMADYN D path names, defined in the variables file, is displayed. The data formats are also displayed. WinCC can now access these variables.

3.29.8 Communications set-up, SIMADYN D-WinCC

3.29.8.1 Connecting cable

The physical connection between SIMADYN D and WinCC is realized via the SIMATIC NET plug-in cable 727-1 for INDUSTRIAL ETHERNET

3.29.8.2 Activating WinCC

In order to establish communications between SIMADYN D and WinCC, the imported data of the WinCC database must be assigned to the input/output fields of the graphic configuring software. This is realized by selecting the appropriate fields in the Graphics Designer and clicking on the interactive configuration dialog. Each field can be assigned one of the imported variables. After this assignment has been made, the File menu item is selected in the main menu, and the data are saved. Before starting runtime, the connection properties must be set.

In the Control Center

- Click-on tag management
- Click-on SIMADYN D PMC
- With the righthand mouse key click-on SD-PMC (CP1613-1)
- Click-on properties
- Click-on the properties, Channel Unit
- Click-on the connection

Enter the Ethernet address for the AG (PLC) (refer to the NML configuring software)

Receive function : Enter a dedicated TSAP-ID (refer to NML Configuring)

Send function : Enter a dedicated TSAP-ID (refer to NML Configuring)

- Confirm with OK
- Select "File" in the Control Center
- Click-on activate

WinCC is now ready to transfer data between SIMADYN D and WinCC

3.29.8.3 Activating SIMADYN D

Power-up the configured subracks. After the subracks have run-up, the connection has been established between SIMADYN D and WinCC. Data is now cyclically transferred between SIMADYN D and WinCC.

4 Changeover from STRUC V4.x to D7-SYS

Overview

4.1 Function blocks

The following essential features have changed with the introduction of SIMADYN D7-SYS from STRUC Version 4.x.

- 16-bit function blocks are no longer used
- Assigning names to function blocks and their connections
- Function block names/designations
- DATX attributes have been adapted
- Data types of function blocks have been modified

4.1.1 Assigning names to function block types and connections

The philosophy for assigning names to function block types is that the abbreviations are observed which are allocated by the CFC. The function block type designations are oriented to easy to remember rules.

The maximum length of a block type name is 6 characters. The basic name of the function block type is generally three characters long. An extension can be used for derivatives.

Function block types without extension have the standard data type „Real“ e. g. PWM instead of PWM_R. The logic block types are the exception. These have the standard data type „Bool“ e. g. OR instead of OR_B.

NOTE The "standard data type" term refers to the "main function" of the function block types.

For versions with other data types, this is noted in the "extension" (e. g. AND_W for an AND module type with WORD data type connections). The extension is normally one character long.

Data type	BOOL	INTEGER	DOUBLE INTEGER	REAL	SDTIME *	WORD	STRING **	GLOBAL **
Extension	*_B	*_I	*_D	*_R	*_T	*_W	*_S	*_G

* SIMADYN D TIME

** At the time of going to print, these data types had still not been used.

Table 4-1 Data type extensions

The byte and double-word data types are an exception. In order that they can be uniquely identified, they are defined using two characters (refer to the Section "Changing the data types for function blocks").

Data type	Byte	Double word
Extension	*_BY	*_DW

Table 4-2 Exceptions of data type extensions

4.1.2 Control blocks

STRUC V.4.x	**CFC with D7-SYS**	**Pre-assignment *('---' = 0)**	**Comment**
Control blocks			
PT10F1	PT1	---	With setting function; new inputs SV, S; function: Yn+1=SV for S=1
DT10F	DT1	---	With setting function; new inputs SV, S; function: Yn+1=SV for S=1
DIF0F	DIF	---	---
PC_3F	PC	QU = 1; QL = 1;	---
INT0F	INT	---	---
PIC2F	PIC	QU = 1; QL = 1;	---
LIM0F	LIM	QU = 1; QL = 1;	---
DEZ0F	DEZ	---	---
DEL0F	DEL	---	---
RGE0F	RGE	---	---
RGJ0F1	RGJ	---	---
PMW0F	PMW	---	---
FUZ001	FUZ_I	---	X1..10 as "INT" (previously "N2"); Y1..4 as "INT" (previously "N2")
FUZ01F	FUZ	---	---
PT10F	---	---	Eliminated; replaced by PT1
STC0F	---	---	Eliminated; not replaced

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-3 Changes in the control blocks

4.1.3 Arithmetic blocks

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Arithmetic blocks			
ADD2F	-	---	Eliminated; replaced by ADD
-	ADD	---	New; generic at the input side
ADD4F	-	---	Eliminated; replaced by ADD
ADD8F	-	---	Eliminated; replaced by ADD
ADDI	-	---	Eliminated; replaced by ADD_I
-	ADD_I	---	New; generic at the input side
ADDI4	-	---	Eliminated; not replaced
SUB0F	SUB	---	---
SUBI	SUB_I	---	---
MUL0F	-	---	Eliminated; replaced by MUL
-	MUL	---	New; generic at the input side
MULI	-	---	Eliminated; replaced by MUL_I
-	MUL_I	---	New; generic at the input side
MULI4	-	---	Eliminated; not replaced
DIV0F	-	---	Eliminated
DIV0F1	DIV	X2 = 1	---
DIVI	DIV_I	X2 = 1	---
SQR0F	SQR	---	---
SII0F	SII	---	---
AVA0F	AVA	---	---
MAS0F	-	---	Eliminated; replaced by MAS
-	MAS	---	New; generic at the input side
MIS0F	-	---	Eliminated; replaced by MIS
-	MIS	---	New; generic at the input side
PLI6F	PLI10	---	10 instead of previously 6 points
PLI2F	PLI20	---	---
SIN0F	SIN	---	---
ASINF	ASIN	---	---
COS0F	COS	Y = 1	---
ACOSF	ACOS	Y = π/2	---
TAN0F	TAN	---	---
ATANF	ATAN	---	---

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-4 Change in the arithmetic blocks

4.1.4 Logic blocks

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Logic blocks			
AND12	AND12	---	---
AND2	-	---	Eliminated; replaced by AND
-	AND	I = 1; Q = 1;	New; generic at the input
AND22	-	---	Eliminated; replaced by AND_W
-	AND_W	IS = 65535 QS= 65535;	New; generic at the input side
AND4	-	---	Eliminated; replaced by AND
AND8	-	---	Eliminated; replaced by AND
OR_12	OR_12	---	---
OR_2	-	---	Eliminated; replaced by OR
-	OR	---	New; generic at the input side
OR_22	-	---	Eliminated; replaced by OR_W
-	OR_W	---	New; generic at the input side
OR_4	-	---	Eliminated; replaced by OR
OR_8	-	---	Eliminated; replaced by OR
NAN_2	-	---	Eliminated; replaced by NAND
-	NAND	I = 1	New; generic at the input side
NAN4	-	---	Eliminated; replaced by NAND
NAN8	-	---	Eliminated; replaced by NAND
NOR2	-	---	Eliminated; replaced by NOR
-	NOR	Q = 1	New; generic at the input side
NOR4	-	---	Eliminated; replaced by NOR
NOR8	-	---	Eliminated; replaced by NOR
XOR2	-	---	Eliminated; replaced by XOR
-	XOR	---	New; generic at the input side
XOR22	-	---	Eliminated; replaced by XOR_W
-	XOR_W	---	New; generic at the input side
NOT	NOT	Q = 1	---
NOT02	NOT_W	QS = 65535	---
MFP0F	MFP	---	---
PCL0F	PCL	---	---
PST0F	PST	---	---
PDE0F	PDE	---	---
PDF0F	PDF	---	---
PIN8	PIN8	---	---
ETE	ETE	---	---

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
FUI	FUI_W	---	---
UDI	UDI	---	---
CTR	CTR	---	---
NCM	NCM_I	QE = 1	X1, X2 as "INT" (previously "N2")
NCM0F	NCM	QE = 1	---
NSW	NSW_I	---	X1, X2, Y as "INT" (previously "N2")
NSW04	NSW_D	---	X1, X2, Y as "DINT" (previously "N4")
NSW0F	NSW	---	---
ANS	-	---	Eliminated; replaced by ANS_I
-	ANS_I	---	New; generic at the input side
ANS0F	-	---	Eliminated; replaced by ANS
-	ANS	---	New; generic at the input
BSW	-	---	Unchanged
MUX8	MUX8_I	---	X1...X8,CCI, Y as "INT" (previously "N2")
MUX8F	MUX8	---	---
DX_8	DX8_I	---	X, Y1...Y8 as "INT" (previously "N2")
DX_8F	DX8	---	---
CNM	CNM_I	---	X1, X2, Y as "INT" (previously "N2")
CNM04	CNM_D	---	X1, X2, Y as "DINT" (previously "N4")
CNM0F	CNM	---	---
RSS	RSS	QN = 1	---
DFR	DFR	---	---
DFRV	DFR_W	---	---
RSR	RSR	QN = 1	---
SAV	SAV_I	---	X, Y as "INT" (previously "N2")
SAV01	SAV_B	---	---
SAV04	SAV_D	---	X, Y as "DINT" (previously "N4")
SAV0F	SAV	---	---
-	SAV_TR	---	New; 32-bit quantities are saved in the NOVRAM of a technology module T400; Porting the P16-FB-SAVN with the main data type "REAL"
DAT0F	DAT	---	---
DLB0F	DLB	---	---
BBF0F	BF	---	---
SBF0F	BF_W	---	---
DTS0F	DTS	DT = 0.01ms	---
SHD	SH	---	---

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
LVM0F	-	---	Eliminated; replaced (partially) by LVM
LVM2F	LVM	---	---
DUMY	NOP1_I	---	X, Y as "INT" (previously "N2")
-	NOP8_I	---	New;
DUMY1	NOP1_B	---	---
-	NOP8_B	---	New;
DUMY4	NOP1_D	---	X, Y as "DINT" (previously "N4")
-	NOP8_D	---	New;
DUMYF	NOP1	---	---
-	NOP8	---	New;
THEN	-	---	Eliminated; replace (indirect) using the sequence group
END	-	---	Eliminated; replace (indirect) using the sequence group
PAS	PAS	---	---
PAC0F1	PAC	---	---
PAI	PAI	---	---

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-5 Changes in the logic blocks

4.1.5 Input/output blocks

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Input/output blocks			
-	AENC	---	New;
BII8	BII8	---	---
BIQ8	BIQ8	---	---
-	BIQT	---	New;
SBI	SBI	---	---
SBQ	SBQ	---	---
ADC0F	ADC	---	---
AFC0F	AFC	---	---
DAC0F	DAC	---	---
NAV0F	-	---	Eliminated; not replaced as only for EM11
NAV0F2	NAV	---	---
NAV0F4	NAVS	---	---
NAV0F5	-	---	Eliminated; not replaced (not included in the V4 standard library)
NAV0F6	-	---	Eliminated; not replaced (not included in the V4 standard library)
NDB	-	---	Eliminated; not replaced

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-6 Changes in the input/output blocks

The assignment of the input/output blocks to CPU- and peripheral modules is shown in the following table.

Input/output block	CPU- and peripheral modules						
	PM5	PM6	T400	IT41	IT42	EA12	EB11
AENC	x		x				
BII8	x	x	x	x	x		x
BIQ8				x	x		x
BIQT			x				
SBI	x	x	x	x	x		x
SBQ				x	x		x

Input/output block	CPU- and peripheral modules						
ADC			x	x	x		
AFC					x		
DAC			x	x	x	x	
NAV	x		x	x			
NAVS	x		x	x			

Table 4-7 Assignment of the input/output blocks to CPU- and peripheral modules

4.1.6 Communication blocks

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Communication blocks			
@MSC	@MSC	NOM = 15	---
MSI	MSI	---	---
MSI2	MSIPRI	---	---
MES	MER1	---	---
MES2	MER_I	---	X as "INT" (previously "N2")
MES4	MER_D	---	X as "DINT" (previously "N4")
MESF	MER	---	---
MESV2T	MER16	---	---
MESV4T	-	---	Eliminated; replaced by MER16
MESV2	MER0	---	---
MESV4	-	---	Eliminated; replaced by MER0
MED	MERF1	---	---
MED2	MERF_I	---	X as "INT" (previously "N2")
MED4	MERF_D	---	X as "DINT" (previously "N4")
MEDF	MERF	---	---
MEDV2T	MERF16	---	---
MEDV2	MERF0	---	---
MEDV4	-	---	Eliminated; replaced by MERF0
@CTV	-	---	Eliminated; replaced by CTV
CTV	CTV	---	Unchanged
@CRV	-	---	Eliminated; replaced by CRV
CRV	CRV	---	---
CCC4	CCC4	---	---
CDC4	CDC4	---	---
CTB1	-	---	Eliminated; replaced by NOP8_B
CTB2	-	---	Eliminated; replaced by NOP8_I

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
CTB4	-	---	Eliminated; replaced by NOP8_D
CTBF	-	---	Eliminated; replaced by NOP8
@TCI	@TCI	CHA = 200	---
@TRI	@TRI	---	---
TRCC2	TRCC_I	---	X as "INT" (previously "N2")
TRCC4	TRCC_D	---	X as "DINT" (previously "N4")
TRCCF	TRCC	---	---
@TCP	@TCP	CHA = 200	---
TRHI	TRHI	---	---
TRP1	TRP_B	---	---
TRP2	TRP_I	---	X as "INT" (previously "N2")
TRP4	TRP_D	---	X as "DINT" (previously "N4")
TRPF	TRP	---	---
@DIS0R	-	---	Eliminated; replaced by @DIS
@DIS0T	-	---	Eliminated; replaced by @DIS
-	@DIS	---	New;
DISA1	-	---	Eliminated; replaced by DISA_B
DISA2	-	---	Eliminated; replaced by DISA_I and DISA_W
DISA4	-	---	Eliminated; replaced by DISA_D
DISAF	-	---	Eliminated; replaced by DISA and DISA_T
-	DISA_I	---	New;
-	DISA_B	---	New;
-	DISA_D	---	New;
-	DISA	---	New;
-	DISA_T	---	New;
-	DISA_W	---	New;
DISS1	-	---	Eliminated; replaced by DISS_B
DISS2	-	---	Eliminated; replaced by DISS_I and DISS_W
DISS4	-	---	Eliminated; replaced by DISS_D
DISSF	-	---	Eliminated; replaced by DISS and DISS_T
-	DISS_I	---	New;
-	DISS_B	---	New;
-	DISS_D	---	New;
-	DISS	---	New;
-	DISS_T	---	New;
-	DISS_W	---	New;
DISA11	DISA1B	---	---

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
DISA18	-	---	Eliminated; not replaced
DISS11	DISS1B	---	---
DISS18	-	---	Eliminated; not replaced
@DPH	@DPH	UP = 1; PHL = 1;	XWS, YWS, SPS as "INT" (previously "N2"); XWL, YWL, SPL as "DINT" (previously "N4")
DPI	DPI	---	XS, YS as "INT" (previously "N2"); XL, YL as "DINT" (previously "N4")
SER	SER	LT = 242	---
RTCM	RTCM	XYR = 97 XMO = 1 XDA = 1	---
RTC003	RTCABS	---	---
RTC005	RTCREL	---	---
@NMC	@NMC	---	---
NRI	NRI	---	---
NTC	NTC	---	---
NTD	NTD	---	---
NSI	NSI	---	---
NSL	NSL	---	---
@CSL2A	@CSL2A	MAA = 1; BDR = 3	---
@SYL2A	@SYL2A	SEL = 1; CNX = 1	---
DIAL2A	DIAL2A	ST1 = 3; ST2 = 3	---
@CPN	@CPN	---	---
@CMM	@CMM	---	---
@CEP	@CEP	---	---
@CEP22	-	---	Eliminated; replaced by @CEP
@CS1	@CS1	---	---
@CS11	-	---	Eliminated; replaced by @CS1
@CS2	@CS2	---	---
@CS21	-	---	Eliminated; replaced by @CS2
@CSH11	@CSH11	---	---
@CSL2F	@CSL2F	MAA = 1; BDR = 3	---
@CSL2L	@CSL2L	MAA = 1; BDR = 3; AST = 1	---
@CSL2D	-	---	Eliminated; replaced by @CSL2A

STRUC V.4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
@CSD01	@CSD01	BDR = 9600; TWU = 64	---
@CSD02	@CSD02	BDR = 9600; TWU = 64	---
@CSD03	@CSD03	BDR = 9600	---
@CSD07	@CSD07	BDR = 9600	---
@CSU	@CSU	BDR = 9600;	---
-	@DRIVE	PCF=1 PTF=1 PEN=1	New;
-	PNAME		New;
-	PLIM	MIN=-1.0e38; MAX=1.0e38	New;
-	PLIM_I	MIN=-32768; MAX=32767	New;
-	PLIM_D	MIN=-2147483648; MAX=2147483647	New;
-	PLIM_T	MIN=0.0ms; MAX=1.0e38ms	New;
-	PTRANS	---	New;
-	CBCONF	---	New;
-	TFAW	---	New;
-	RFAW	---	New;
-	SYNCT4	---	New;
-	@PEER	BDR = 6	New;
-	@USS_S	BDR = 6; PAR = 1 PZD = 2 CNX = 10	New;
-	@USS_M	BDR = 6;	New;

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-8 Changes in the communication blocks

4.1.7 Conversion blocks

STRUC V. 4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Conversion blocks			
BSC	B_W	---	---
SBC	W_B	---	---
SBW	BY_W	---	---
SWB	W_BY	---	---
I2NF	I_R	---	---
NFI2	R_I	---	---
WDC	I_D	---	X as "INT (previously "N2"); Y as "DINT (previously ("N4")
DWC04	D_I	---	X as "DINT (previously "N4"); Y as "INT" (previously "N2")
DWR04	-	---	Eliminated; not replaced
DWS04	-	---	Eliminated; not replaced
N2NF	-	---	Eliminated; not replaced
N4NF	-	---	Eliminated; not replaced
NFN2	-	---	Eliminated; not replaced
NFN4	-	---	Eliminated; not replaced
CBR	SWB_W	---	---
CBR04	SWB_DW	---	---
CBRIF	SWBI	---	---
CBRQF	SWBO	---	---
BNR0F	BNR	STZ = 2; NF = 1;	---
I4NF	D_R	---	---
NFI4	R_D	---	---

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-9 Changes in the conversion blocks

4.1.8 Diagnostic blocks

STRUC V. 4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
Diagnostic blocks			
STG0F	STG	---	---
RFG0F	RFG	---	---
SQG0F	SQG	---	---
SQGBF	SQGB	---	---
USF	USF	---	---
ASI	ASI	---	---
SYF1	SYF1	---	---
SYF4	SYF4	---	---
PNO	PNO	Y = 1	---
SSD	SSD	---	---
PSL	PSL	---	---
-	DLED	LDN = 1	New;
-	EPE	---	New;

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-10 Changes in the diagnostic blocks

4.1.9 SIMOVERT D block

STRUC V. 4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
TRV	-	---	Eliminated; not replaced

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-11 Change in the SIMOVERT D block

4.1.10 COROS blocks

STRUC V. 4.x	CFC with D7-SYS	Pre-assignment *('---' = 0)	Comment
COROS blocks			
ARD	ARD	---	---
ARR	ARR	---	---
ARW	ARW	---	---
CHC	CHC	---	---
CI	CI	---	---
ERS1	ERS1	---	---
RS2	ERS2	---	X, SV, Y as "INT" (previously N2")
FI	FI	---	---
FM	FM	---	---
LI	LI	---	---
MM	MM	---	---
RIB	RIB	---	---
SER02	SER02	---	---
SI	SI	---	---
SI_02	SI_02	---	X, SV, Y as "INT" (previously "N2")
SI_F	SI_F	---	---
VC	VC	---	---
VI	VI	---	---
VM	VM	---	---
BM	BM	---	---
TCO	TCO	---	---
TRP	TRPCOR	---	---

* Corresponds to „0“ as pre-assignment of the various parameters of the individual function blocks.

Table 4-12 Changes in the COROS blocks

4.2 Adapting specific connection attributes

The following connection attributes are no longer available in D7-SYS:

- Minimum (MIN),
- Maximum (MAX),
- Format (FORM),
- Signal designator (NAME)
- and LOG texts (LOG0/LOG1)

Specific function blocks of the display utility and the equipment response utility are involved.

4.2.1 Display utility

For the display utility, the attributes involved, "MIN", "MAX", "FORM", " 'Signal designator' (name) " and "LOG0/1" are configured using new connections at the blocks involved.

D7-SYSdesignation	New connections
Process data blocks	
DISA_B	NAMe
DISA_I	NAMe
DISA_W	NAMe
DISA_D	NAMe
DISA	NAMe, FORmat
DISA_T	NAMe, FORmat
DISS_B	NAMe
DISS_I	NAMe, MIN, MAX
DISS_W	NAMe
DISS_D	NAMe, MIN, MAX
DISS	NAMe, MIN, MAX, FORmat
DISS_T	NAMe, MIN, MAX, FORmat
Binary value blocks	
DISA1B	NAMe LG0 (LOG0-Text)
DISS1B	LG1 (LOG1-Text)

Table 4-13 Display utility

4.2.2 Equipment response utility

For the equipment response utility, the associated attributes "MIN", "MAX" and " 'Signal designator' (name) " are configured using the new function blocks PLIM, PLIM_D, PLIM_I, PLIM_T and PNAME.

Adapting the DATX attributes

The DATX attribute is no longer included in D7-SYS. In order to be able to directly access a connection having a different sampling time using an input, instead of a DATX attribute, a pseudo comment „@DATX“ must be configured.

4.2.3 Changing the data types for function blocks

The comparison between the data types of STRUC V. 4.x and D7-SYS is provided in the following table:

STRUC V.4.x data type (abbreviation)	D7-SYS data type (abbreviation)	Designation
B1	BO	Bool
I2	I	Integer
I4	DI	Double-Integer
O2	I	The function blocks involved have an integer connection.
O4	DI	The function blocks involved have a double integer connection.
N2	I	The function blocks involved have an integer connection.
N4	DI	The function blocks involved have a double integer connection.
NF	R	Real
V1	BY	Byte
V2	W	Word
V4	DW	Double-Word
NS	S	String
TF	TS	SDTime
IK, NK, CR, MR, TR, RR	GV	Global

Table 4-14 Data type changes as result of the changeover

4.3 Hardware differences

This Chapter describes the hardware differences between STRUC V.4.x and D7-SYS

STRUC V.4.x	CFC with D7-SYS	Comment
Subracks		
SR4	SR12	
SR6	SR6	
SR12	SR12	
SR24	SR24	
-	SRD	Synonym for T400 master drive configuring
-	SRT400	
CPU modules		
-	PM5	
-	PM6	
PM16	PM5	
PG16	PM5/6 + ITDC	
PG26	PM5/6 + ITDC	
PS16	PM5/6 + ITDC	
PT20	PM5/6 + T41/42	For further information refer to the SIMADYN D "Hardware" Manual
PT20G	PM5/6 + IT41/42 + ITDC	For further information refer to the SIMADYN D "Hardware" Manual
PT20M	PM5/6 + IT41/42 + MM11/4	For further information refer to the SIMADYN D "Hardware" Manual
PM3	PM5/6	
PM4	PM5/6	
PT31	PM5/6 + IT41	
PT32	PM5/6 + IT41	
Expansion modules		
IT41	IT41	
IT42	IT42	
-	ITDC	
-	ITSL	

STRUC V.4.x	CFC with D7-SYS	Comment
Communication buffer modules		
MM11	MM11	
MM21	MM11	
MM3	MM3	
MM4	MM4	
Input/output modules		
EA12	EA12	
EB11	EB11	
EM11	IT41	
Technology modules		
T300	T400	
PT10	T400 in the SRT400	
DPM	BB_D	Configuring aid as synonym for T400 configuring
CS51	CB_D	Configuring help
DPZ	BB_D	
CSZ	CB_D	
Communication modules		
CS7	CS7	
CS11	CS12/13/14	
CS12	CS12	
CS13	CS13	
CS14	CS14	
CS21	CS22	
CS22	CS22	
CS41	-	
CSH11	CSH11	
CS61	-	
Special modules		
EP3	EP3	
EP22	EP3	
IS_1	IS_1	
IS_2	IS_2	
IS_3	IS_3	
Slot covers		
SR81	SR81	
SR82	SR82	
SR83	SR83	

STRUC V.4.x	CFC with D7-SYS	Comment
Program memory modules		
MS5	MS5	
-	MS51	
MS55	MS5	
MS41	MS5/MS51	
MS45	MS5/MS51	
MS300	-	
Communication modules		
SS4	SS4	
SS5	SS5	
SS51	SS52	
SS52	SS52	
Interface sub-modules		
SS1	SS1	
SS2	SS2	
SS31	SS31	

Table 4-15 Hardware changes due to the changeover to D7-SYS

4.4 Communications

The following communication possibilities are no longer available in SIMADYN D7-SYS.

STRUC V.4.x designation	Comment
DUST4	Replacement: SS52, PROFIBUS DP Replacement: SS5, SINEC L2 FDL
DUST5	Replacement: SS4, USS with VD1
DUST6 and ET100	Replacement: SS52, PROFIBUS DP and ET200
Indirect/direct communications	Replacement: Process data
Monitor handling	Replacement: Service
Equipment response and equipment response on T300	Replacement: Equipment response on T400
Communications to SIMOVIS	Not replaced
Redundant serial coupling	Not replaced
Selectable network	Not replaced
System trace	Not replaced

Table 4-16 Changes in the communication possibilities

4.5 Configuring

This Chapter describes the differences as far as the configuring is concerned between STRUC V.4.x and D7-SYS.

4.5.1 Configuring tools

The individual configuring tools which were available in STRUC Version 4.x are compared with the appropriate tools in D7-SYS in this Chapter.

Reference point	**Tool in STRUC V.4.x**	**Tool in D7-SYS**
Work station	PC with Intel CPU from 486 onwards, min. 20 Mbyte main memory CGM- or Postscript printer Internal prommer PP1I or external prommer PP1X	PC with Intel CPU from 486 onwards, min. 16 Mbyte main memory Any Windows 95/NT-compatible printer PCMCIA slot (generally included in notebooks, available as card for standard units)
Operating system platform	SCO Open Desktop V. 3.2x SCO Open Server Release 5	Microsoft Windows 95/NT
Installation	Installation program	Menu-prompted setup
Administering project data	Basic dialog	SIMATIC Manager
Configuring the hardware	Master program editor	HWConfig
Configuring the open-loop/ closed-loop control	Function package editor	CFC
Test/start up	FP editor in the IBS G mode	CFC in the test mode
List-oriented editors	STRUC L editors	For D7-SYS, exclusively configured using graphic tools.

Table 4-17 Comparison of the configuring tools

4.5.2 Object-oriented handling of the configuring tools

The STRUC V4.x configuring tools are always handled depending on the particular function, i. e. you select a function from the menu (e. g. "Delete block") and then the object to be processed (e. g. the block to be deleted).

Example of object-oriented handling

The configuring tools of SIMATIC STEP7 are, just like all Windows 95/NT applications, handled in an object-oriented fashion. You select one or several objects (e. g. blocks to be deleted), and then the action which you wish to execute via the menu (e. g. "**Edit > Delete block(s)**"). The individual tools offer diverse possibilities to select objects. The selection can either be made via

- menu bar
- context-sensitive pop-up menus
- keyboard commands (hotkeys).

4.5.3 Installation and de-installation

Installation

This section describes the installation and de-installation procedure, step by-step. The sequence is oriented to the "STRUC G installation instructions" to Version 4.x.

in STRUC V.4.x	in D7-SYS
Operating system adaptions	Eliminated
Login as "Superuser"	Not necessary, as the installation is possible without any special access authorization.
Installing a driver for a parallel/serial interface	Not necessary, the required drivers are installed with the automatic hardware identification of Windows 95/NT.
Installing a driver for a CD-ROM drive	Not necessary, required drivers are automatically installed with the automatic hardware identification of Windows 95/NT.
Installing a printer	Is realized using the "Printer assistant" from Windows 95/NT; for further information please refer to help under Windows 95/NT under the subject "Printer, setting-up".
Adapting the parameters of the operating system kernel	Not necessary. Ensure that your PC/PG has the minimum hardware requirements, and use the standard configuration which is set when installing Windows 95/NT.
Configuring a English keyboard	For information, please refer to the help for Windows 95/NT under the subject "Keyboard, layout".
Installing the STRUC G master	Eliminated

in STRUC V.4.x	in D7-SYS
Installing parallel to older versions	Not possible. Only one version of STEP7 (and the option packages for STEP7) can be installed on a PC.
Loading the data medium	Insert the software medium (CD-ROM or floppy disk No. 1) in the drive ...
init - machine initialization	... and start the "**Setup**" application (in directory "**disk1**" of the CD-ROM or in the root directory of the floppy disk). The "Setup" installation program guides you through the installation step-by-step. Please observe the product information supplied with the data medium.
print - configuring the printer	Not necessary, all (graphics-capable) printers are available, which you installed under Windows 95/NT, under STEP7 (refer above).
acl - setting access authorization	Not required;
lang - setting the language	Not necessary. You can change the language of the user interface from STEP7 in the SIMATIC Manager at any time (menu command **Extras > Settings, Register side "Language"**).
burn - programmer gets to know the operating system	Not necessary. To load memory modules offline in the CFC, all of the installed PCMCIA slots are available.
Installing software for the programmer	Not necessary. The required drivers are installed with the automatic hardware identification function of Windows 95/NT. Drivers for many commercially available PCMCIA cards are already included in the scope of supply of Windows 95/NT. Drivers for other devices can be obtained from the appropriate suppliers. The "PCMCIA assistant" of Windows 95/NT will help you install the necessary drivers for the PCMCIA slots. For further information, please use the help infos for Windows 95/NT under the subjects "Hardware, setting-up" and "PCMCIA, activating the support for".
Installing the user STRUC G	Not necessary. The installed configuring tools are available at this PC for all users.

Table 4-18 Comparison of the installation instructions

De-installation

in STRUC V.4.x	in D7-SYS
Not possible	This is necessary before installing a new product version. If you wish to install a new product version, without having deleted the old version, then you will be appropriately informed at setup. Please follow the instructions in the product information and the help info to Windows 95/NT under the subject "Software, removing from your computer", in order to de-install the SIMADYN D7-SYS software product.

Table 4-19 De-installation changes

4.6 Configuring, step by step

The following sections provide an overview for the essential working steps under STEP7 which you already know from configuring with STRUC G V.4.x. Please refer to the appropriate manuals for more detailed information on the individual working steps, as well as the online help of the configuring tool. The sequence is oriented to the Chapter "Brief instructions" of the "STRUC G User Manual", Version 4.x.

4.6.1 Administering the project data

This section describes the first steps with the configuring tools.

in STRUC V.4.x	in D7-SYS
Start STRUC G (basic dialog)	Start STEP 7 (SIMATIC Manager) In the Windows 95/NT desktop: Double click on the "SIMATIC Manager" icon on the Windows 95/NT desktop or call the program **Start > Simatic > Step 7 > SIMATIC Manager** via the Windows 95/NT task bar.
Create new project	Create a new project In the SIMATIC Manager: Select the menu command **Insert > Program > SIMADYN D program**.
Create new master program	Create a new SIMADYN D station In the SIMATIC Manager: In the project window, mark the symbol of the project and select the menu command **Insert > Station > SIMADYN D station.**
Select libraries	In the CFC: (refer to the Chapter "Configuring the open-loop/closed-loop control")

Table 4-20 Differences at the start of configuring

4.6.2 Configuring the hardware

in STRUC V.4.x	in D7-SYS
Start the MP editor	Start HWConfig In the SIMATIC Manager: Double click-on the SIMADYN D station, just created in the righthand section of the project window, and then on the "Hardware" symbol.
Create a subrack	In HWConfig: Double click in the hardware catalog on one of the SIMADYN D subracks.
Insert the modules	In HWConfig: Select the required slot in the subrack table. Double click in the hardware catalog on the module to be inserted.
Insert sub-modules	In HWConfig:

in STRUC V.4.x	in D7-SYS
	In the subrack table, select the module slot which is to accept the sub-module. In the hardware catalog double click on the sub-module to be inserted.
Define the basic sampling time of the CPU modules	In HWConfig: Double click on the CPU module. In the parameterizing dialog window which opens, select the register side "Basic clock cycle".
Define the sampling times of the CPU modules	In HWConfig: Double click on the CPU module. In the parameterizing dialog window which opens, select the register side "Cyclic tasks".
Define the function package names of CPU modules	Not required; new CFC charts are simply created in the SIMATIC Manager in the chart container of the particular CPU (refer below).
Define FP connections ($ signals)	Not required; $ signals for communications between CPUs in the subrack no longer have to be centrally defined. They can be simply used in CFC at the function block connections to be connected.
Define the interrupts from CPU modules	In HWConfig: Double click on the CPU module. In the parameterizing dialog window which opens, select the register side "Interrupt tasks".
Define dimensions (unit texts)	Not required; unit texts no longer have to be centrally defined. They can be simply assigned in CFC when parameterizing function block connections.
Reference MP	In HWConfig you can simultaneously process as many SIMADYN D stations as required. Double click on the SIMATIC Manager on all of the required stations. In HWConfig, you can copy the modules from one station to another.
Print-out master program	Print-out hardware configurations. In HWConfig: Select the menu command **Station > Print**. Comment: The print-out is in the form of a list. It includes, among other things a list of the Order Nos. of all of the configured modules and sub-modules.
Compile master program (in the basic dialog)	Check the hardware configuration for consistency In HWConfig: Select the menu command **Station > Check consistency.**
Exit MP editor	Save the hardware configuration In HWConfig: Select the menu item **Station > Save**. The individual configuring tools of STEP7 (SIMATIC Manager, HWConfig, CFC, ...) can all be simultaneously opened. Thus, you need not exit HWConfig if you wish to continue in the SIMATIC Manager or CFC.

Table 4-21 Differences in the hardware configuration

4.6.3 Configuring the open-loop/closed-loop control

in STRUC V.4.x	in D7-SYS
Create a new function package	Create new CFC charts in the chart container of a CPU In the SIMATIC Manager: After you have saved the hardware configuration, you will see, next to the "Hardware" object, symbols in the project window for the CPU modules in the station. Double click on a CPU, and then on the SIMADYN D program in it, and then all of the chart containers in it. Select the menu command **Insert > S7 software > CFC**.
Start the FP editor	Start the CFC editor In the SIMATIC Manager: Double click on the CFC chart just created.
	Import the libraries In the CFC: A newly created chart container already includes the function block types of the FBSLIB standard library. Additional libraries must be explicitly imported into the chart container. Select the menu command **Extras > Module types.**
Insert function blocks	In the CFC: Select the menu command **View > Catalog** to display the function block catalog of the CFC. Select the required function block and drag it with the lefthand mouse key depressed into the work area of a CFC chart.
Delete function blocks	In the CFC: Select the function block(s) to be deleted and then the menu command **Edit > Delete**.
Copy function blocks	In the CFC: Select the function block(s) to be copied and then the menu command **Edit > Copy**. Then select **Edit > Insert** and place the copied function blocks at the required position or select the function block(s) to be copied and drag them to the required position with the lefthand mouse key and Ctrl key depressed. You can now copy function blocks from one CFC chart to the next.
Shift function blocks	In the CFC: Select the function block(s) to be shifted and shift the mouse pointer with the mouse key depressed, to the required position. Comment: You can also shift function blocks from one CFC chart into another chart of the same CPU.

in STRUC V.4.x	**in D7-SYS**
Edit comments block	Enter free comments text In the CFC: Select the menu command **View > Catalog** to display the function block catalog of the CFC. Select the "**Text**" entry and, with the mouse key depressed, drag it into the work area of a CFC chart. Double click on the text field to enter text. With the shift key depressed, click on the text field to change its size.
Interconnect function blocks	In the CFC: Click on the function block output, which is to be the source for the interconnection. Then click on the input which is the destination of the connection. Comment: The CFC must be in the sheet view.
Connect the function blocks to the margin ($ signals, virtual connections, connections at connectors, types CR, IK, MR, NK, RR, TR)	Create interconnections to global operands ($ signals, virtual connections, connections at function block connections (I/O), data type GLOBAL) In the CFC: Select the function block connection to be connected. Select the menu command **Insert > Connection to operand.**
Parameterize function blocks	In the CFC: Double click on the function block connection. In the dialog window which opens, you can enter a value, comments text to the connection, scaling factor and units text or double click on the function block header. You can now parameterize all the connections (I/O) of this function block in the register side "**Connections**" of the dialog window which opens.
Define the sequence in which the function blocks are processed	In the CFC: Double click on the function block header. You can now see the position of the function block in the sequence in which it is executed in the register side "**Run-time properties**" of the dialog window which opens. You can now remove the function block and insert it at another position in the execution sequence, or select the menu command **Edit > Sequence**. You can now shift the function blocks to other positions in the execution sequence in the window which opens.
	Create a run-time group and edit its properties. In the CFC: Select the menu command **Edit > Sequence**. You can create new run-time groups or change the characteristics/properties of existing run-time groups in the window which opens.

in STRUC V.4.x	in D7-SYS
Print-out function package	Print-out the CFC chart; in the CFC: Select the menu command **Chart > Print** to print an individual chart. Select the menu command **Chart > Selective print** to print several charts of the chart container. In the SIMATIC Manager: Select the charts to be printed and select the menu command **File > Print**.
Change sheet	In the CFC: Select the menu command **Edit > Go to > Sheet** and select the required sheet.
Change sheet	Change between the overview and sheet view of the CFC: In the CFC: Select the menu command **View > Overview** or **View > Sheet view**.
Save function package	CFC charts do not have to be saved. Every change which you make in the CFC is immediately saved.

Table 4-22 Changes when configuring the open-loop and closed-loop control

4.6.4 Compiling and loading the user program

in STRUC V.4.x	in D7-SYS
Compile the master program (MP-COMP)	Check the hardware configuration for consistency. In the HWConfig: Select the menu command **Station > Check consistency**.
Compile the function packages (FP-COMP)	Not necessary as individual step (refer below)
Compile the processor program (PN-COMP)	Not necessary as individual step (refer below)
Compile the selected processor program (AUTOCOMP)	Compile the user program of a CPU In the CFC: Place the chart window of the CPU to be compiled in the foreground. Select the menu command **Chart > Compile**. All of the charts of this CPU are compiled and are then linked with the hardware configuration, which has been checked for consistency as well as the code libraries to form a runnable user program. In so doing, a map listing of the user program is generated. You will be able to identify the path names of the map listing from the compilation protocol.
Create the address book (OPTIONS address book)	In the CFC: Select the menu command **Extras > Settings > Compile** and select the "Create address book" option in the dialog window which opens. When compiling the user program (menu command **Chart > Compile**) an address book is automatically generated for this CPU. You will be able to identify the path names of the address book file from the compilation protocol.
Load the program module (PROG - selected PN)	Loading the user program offline In the CFC: Select the menu command **Target system > Load**. Select the "**Offline**" option in the dialog window which subsequently opens, and then depress "**Load**": The compiled user program, and if relevant, the SIMADYN D operating system are loaded into the memory module. This memory module is then inserted into the PCMCIA slot of your PC.
Download (PROG download)	Loading the user program online In the CFC: Select the **Target system > Load** menu command. In the dialog window which opens, select the "**Online**" option and then depress "**Load**": The compiled user program, and if relevant the SIMADYN D operating system are loaded into the CPU memory module via a communications link.

Table 4-23 Compiling and loading the user program

4.6.5 Test and start-up

Your software is tested and commissioned in Version 3.1x using the CFC editor which in this case, has a test mode.

in STRUC V.4.x	in D7-SYS
Start IBS G (start-up program)	Start the CFC editor; in the SIMATIC Manager: Double click on a CFC chart of the CPU to be tested.
Establish an online connection to the CPUs (IBS G online start)	Changeover into the CFC test mode; in CFC: In the creation mode, select the menu command **Test > Test mode**. Note: This step must be executed for each CPU which you wish to test.
Interrupt the online connection to the CPUs (IBS G online stop)	Changeover into the creation mode of the CFC; in the CFC: Select, in the test mode, the menu command **Test > Test mode**.
Display the connector values online	In the CFC test mode: Select the connections to be displayed or function blocks and select the menu command **Test > Log-on connections**. Select the **Test > Monitor** menu command to display the actual values of all these connections, logged-on with this CPU, online.
Create the interconnections online	In the CFC test mode: Click on the output of the function block which is to be the source for the interconnection. Then click on the input which is the destination of the connection.
Delete the interconnections online	In the CFC test mode: Click on the function block input, which is the end of the interconnection and then select the menu command **Edit > Delete**.
Insert the function blocks online	In the CFC test mode: Select the menu command **View > Catalog** to display the function block catalog of the CFC. Select the required function block and drag it, with the mouse key depressed, to the work area of a CFC chart.
Delete the function blocks online	In the CFC test mode: Remove all interconnections which go from the outputs to the function blocks to be deleted. Select the function block(s) to be deleted and select the menu command Edit > Delete.
Differentiation between temporary and permanent online changes (IBS G OPTIONS as well as changing the "permanent" option in the dialog window "change value").	All online changes are permanently stored in the CFC, i. e. they are saved in the CPU change memory. Even after a CPU has been reset, the executed CPU program and the CFC charts, which were changed online, coincide.
Display the error fields in the "Service IBS" tool	System diagnostics: Display the error fields of a CPU. In the CFC: Select the menu command Target system > Module status and then change to the register side "Error fields".

in STRUC V.4.x	in D7-SYS
Display the exception buffer in the "Service IBS" tool	System diagnostics: Display the exception buffer of a CPU. In the CFC: Select the menu command **Target system > Module status** and change to the register side "**Exception buffer**".
	System diagnostics: Display and change the operating status of a CPU. In the CFC: Select the menu command **Target system > Operating status**.

Table 4-24 Differences in the test- and start-up phase

Performance features which are not supported in D7-SYS

The following performance features of STRUC V4.x are not supported in D7-SYS:

- Editing function charts using list-type editors.
- Working with macros.
- Adapting function chart versions to new versions of the function block libraries.
- Functions to extract and compile comment texts in the function diagrams.
- Undo changes in function charts.
- Tabular displays in the CFC test mode.

4.7 V4.x terminology which is replaced by D7-SYS terminology

Terms, which were used in the SIMADYN D environment for Version 4.x are compared in this list, with D7-SYS.

The appropriate explanations can be taken from the glossary.

Terminology from Version 4.x	Comparable/new terms	Comment
Connector	Function block output Output	CAUTION, previously in SIMADYN D up to V4.x "Connector" was used which is now designated "connection" (I/O).
Interrupt task	Interrupt task	
EEPROM	Change memory	
PSW	User program	
Module	Module	
Board ID	Module name	
Rack	Subrack	
Rack	Subrack	
Output connector	Function block output Output	
Input connector	Function block input Input	
Initialization, run-up	INIT mode	
Cyclic operation	RUN mode	
Processor board, processor	CPU module	
Processor number	CPU number	
Daisy chain connector	Daisy chain jumper	
Connector type	Data type	
Dialog box	Dialog box	
Signal module	I/O module	
Dimensions	Units, units text	
Configuring mode	Create mode	
Message system reference	Name reference	
Promming, loading into the memory module	Offline loading	
Download	Online loading	Loading in the CPU module, loading via a communications link
Configuring, programming	Configuring	
Interrupt event	Process interrupt	
SIMADYN D program	Chart container	Contrary to an S7- or M7 program, a SIMADYN D program only has a chart container.
Basic dialog	SIMATIC Manager	
Scaling value	Scaling factor	
Memory-Card,	Memory module	
Memory sub-module	Memory module	

Terminology from Version 4.x	Comparable/new terms	Comment
System function package, @SIMD	System chart	
Task	Task	The sequence in which the user program is processed (executed) is defined in the tasks.
Generating, generating code	Compiling	
Connection	Interconnection	
Default value	Default	

Table 4-25 Modified terminology due to the changeover

5 Closed-loop thyristor current control

Section overview

5.1 Overview

Validity range

The documentation for the closed-loop thyristor current control is valid for Step 7 with D7-SYS ≥ version V5.2.0 in conjunction with the CFC program.

The closed-loop thyristor current control software can only run in conjunction with the ITDC expansion module.

WARNING

The warning information/instructions in the Instruction Manuals/Operating Instructions of the associated thyristor sets must be carefully observed.

Introduction

The closed-loop thyristor current control is a standard software package for closed-loop armature current and field current controls of single (1Q) or four-quadrant (4Q) DC drives.

The following functions are included in the standard software package CFC Chart “D7-SPTCC”

- Switch-over logic stage
- Closed-loop armature current control
- Closed-loop field current control
- Gating unit

For a 6-pulse, line-commutated drive converter in a B6C or, for two 6-pulse rectifiers in a circulating-current free, anti-parallel, fully-controlled bridge circuit (B6)A(B6)C.

This standard software package exchanges ITDC signals with the 6QG2x/6QG3x SITOR sets via the SITOR interface -X7 of the expansion module.

These standard software packages should be copied into the user project and supplemented by the application-specific system data and connections to the user program.

The gating unit comprises line supply synchronization, actual value sensing and firing pulse generation and requires a clockwise rotating field.

5.1.1 Hardware configuration

The ITDC converter gating is inserted on a PM5 or PM6 processor and screwed into place. The modules have a local expansion bus (LE bus) via which signals and data are transferred.

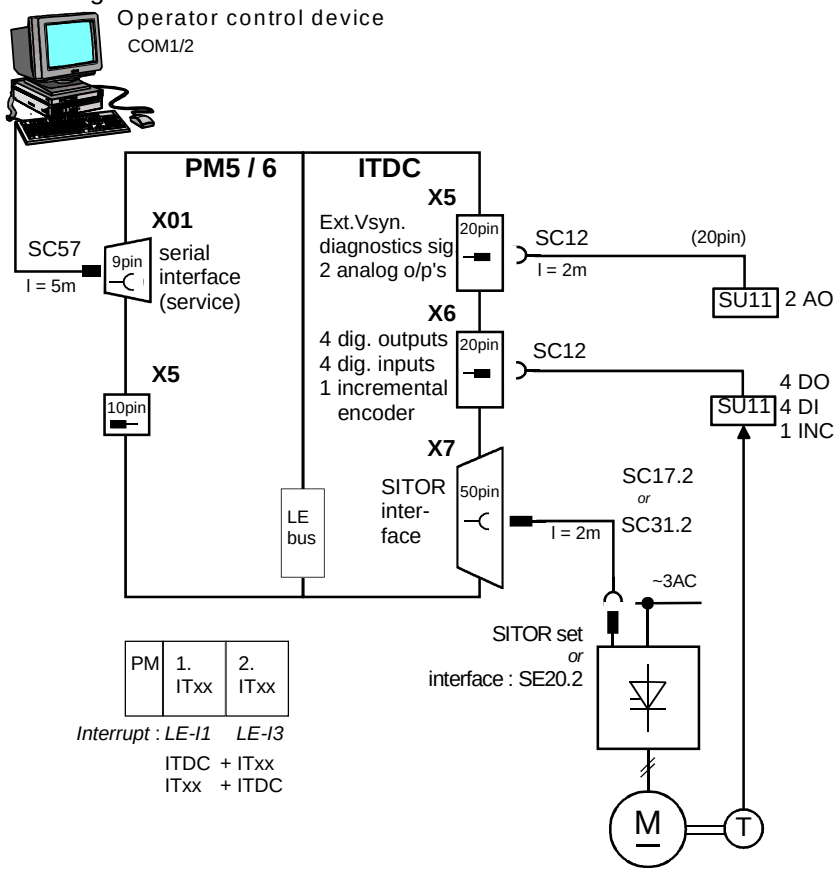


Fig. 5-1 Hardware configuration

NOTE 2 ITDC modules cannot be used on a processor module. However, combinations with other expansion modules is permitted (e.g. IT41)

The interface: SE20.2 implements the mechanical conversion and the electrical isolation of the standard SITOR interface from the ITDC to a 6QG5x SITOR cabinet or another drive converter.

SITOR sets 6QG2x and 6QG3x differ in the way that the current actual value is sensed, the conditioning of the zero crossover signals and the phase-to-phase voltages.

If a 6QG2x or 6QG3x SITOR set is used with an optional field device module (excitation option), then the FB FCS is required.

The gating unit has been released for operation with 50 Hz and 60 Hz line supplies (e.g. for PM5); however, it also has automatic frequency adaptation in the range from 10 to 530 Hz.

HW configuration

The interrupt, depending on the slot on the PM5/6 should be selected in the "HW Config" software section.
The user should make the following settings.

- Interrupt tasks I1: LE bus interrupt L1 (ITDC in the 1st PM slot) or
  LE bus interrupt L3 (ITDC in the 2nd PM slot)
- Equivalent sampling time **3.3 ms** for 50 [Hz] line frequency
  2.7 ms for 60 [Hz] line frequency

The following settings are made in the standard software package.

- Name: D01_P1 Processor 1 at slot 01
- Sampling time T0: 2.0 ms
- Name: D02_I1 ITDC module
  Properties, ITDC: Addresses:
  Digital inputs 1 D02_Bin
  Speed sensing 1 D02_IncEnc
  HW of the closed-loop thyristor current control D02_TCCONTR

5.1.2 Software configuration

The software for the standard closed-loop thyristor current control comprises the set from the converter-specific function blocks (FB).

The FBs are programmed in a standard function chart (CFC) for normal applications of a DC drive.

The closed-loop current control should be integrated in the plant/system software. Generally, there is a higher-level closed-loop and open-loop speed control.

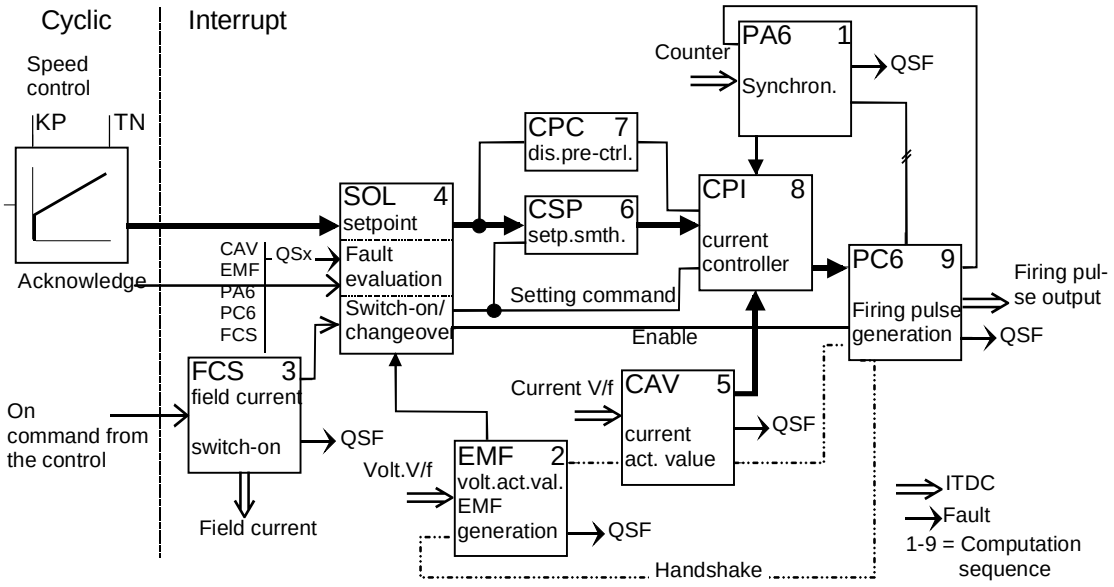


Fig. 5-2 Overview of the software configuration

Only the most important connections are shown in the diagram.

The FBs should be programmed in a defined sequence.

FBs EMF, CAV and PC6 have a special internal handshake mechanism to acknowledge computation of the FBs.

Run sequence, function blocks

1. PA6 (firing angle actual generation, 6 pulse)
   - User-specific FBs for e.g. higher-level speed control loop in this interrupt sampling time.
2. EMF (voltage actual value sensing)
3. FCS (field current setpoint output), if the option is required.
4. SOL (switch-over logic stage)
5. CAV (current actual value sensing)
6. CSP (current setpoint calculation)
7. CPC (current pre-control in the discontinuous range)
8. CPI (current controller)
9. PC6 (firing angle controller)

Comment

FB-PA6 should always be configured at the start of the interrupt-controlled run sequence and FB-PC6 as the last block.
Other blocks can also be configured between these blocks depending on the processor utilization.

All of the converter-specific function blocks should be configured, in accordance with the run sequence specified above, in an interrupt task I1 with alarm source LE1 or LE3.

FB–FCS can also be computed in a cyclic task.

The FB–FCS can be removed from the standard software package if the field current setpoint is not to be entered via SIMADYN D (for SITOR sets 6QG2x, 6QG3x without field device option).

The gating unit computation is started by interrupts in synchronism with the firing pulse. In steady-state operation (constant firing angle in 50[Hz] line supplies), the interrupts are every 3.3 ms.
When converting time-dependent quantities, this time data is required to define the interrupts (equivalent sampling time in the I1=3.3 ms for 50[Hz] line supplies or 2.7 ms for 60[Hz] line supplies).

The FB–CPC for pre-control in the discontinuous range can be replaced by a polygon characteristic with a characteristic which has been specifically plotted.

5.2 Function description

All of the converter-specific function blocks are described in this Section.

Parameter defaults

The system characteristic quantities are pre-assigned "0" (Default) for example (e.g. rated voltages, rated currents and armature quantities).

All of the other parameters are pre-assigned non-critical values (e.g. low controller gains, high integral action times).

A list of the parameters to be set is provided in Section 5.3.2.

Init connections

The blocks have an initialization mode which is executed once after each successful reset / restart. The values at several connections (Initialization connections) are only read-in in the initialization mode;
changes at one of these initialization connections (Init) are therefore only effective after a reset

Configuring errors

Each function block checks the entries for plausibility when specific quantities are configured and when conflicts arise, it outputs a fault ID at fault word QSF.

All of the fault words are collected in the switch-over logic stage FB SOL and are evaluated. The closed-loop thyristor current control cannot be switched-in if there is a configuring error (refer to Section “SOL, switch-over logic stage”).

5.2.1 PA6, synchronization

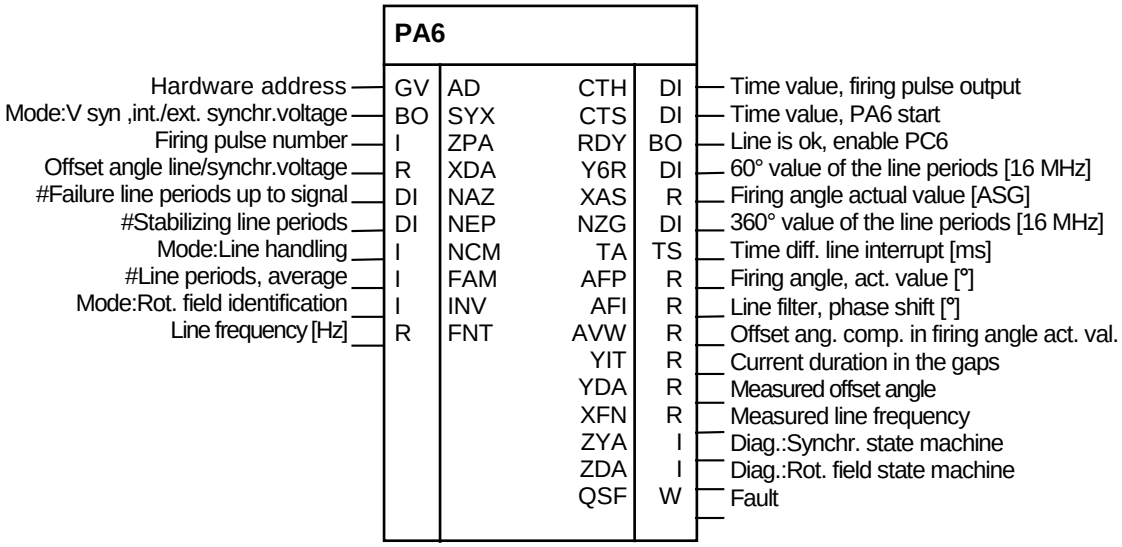


Fig. 5-3 PA6 represented in the CFC

Function

The FB–PA6 is used to continuously synchronize the firing pulses to the line supply for a 6-pulse line-commutated converter.
The actual value for the firing pulse position is generated and transferred to the firing pulse controller FB–PC6 in order to evaluate the correct position of the firing pulses. The firing angle actual value is determined taking into account the input filter on the ITDC and the offset angle.

The ITDC generates the interrupt to start FB-PA6 in synchronism to the firing pulses via the local expansion bus (LE) depending on the internal counter states.

Program sections of the gating unit which are always executed.

- A line supply analysis, which checks the availability of the synchronizing voltage and which executes plausibility tests.
- Synchronizing the firing pulses to the synchronizing voltage.
- Determining the offset angle and other line supply quantities.

Synchronization to the line supply (single-phase synchronization) is realized using a synchronizing voltage derived from the electronics power supply of the SITOR set (standard) or with the external synchronization ITDC X5 : 5 \ 6.

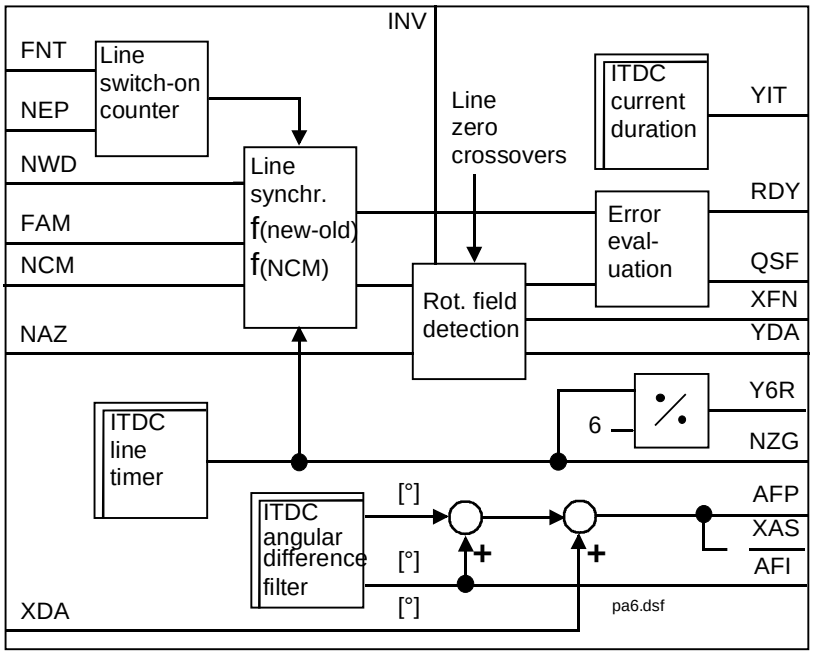


Fig. 5-4 Block diagram of PA6

5.2.1.1 Offset angle

The synchronizing module, which is required for analog gating units is replaced here by entering an offset angle at input PA6.XDA. Using this offset angle, the phase shift between the 6QG2x/6QG3x SITOR set power connection V_{L1} and the single-phase synchronizing voltage derived from the electronics power supply line is compensated.

The offset angle PA6.XDA corrects the phase shift between the natural firing instant of semiconductor device 1 (α=0°) and the zero crossover of the filtered synchronizing voltage (filter on the ITDC). The filter phase shift is a function of the frequency.

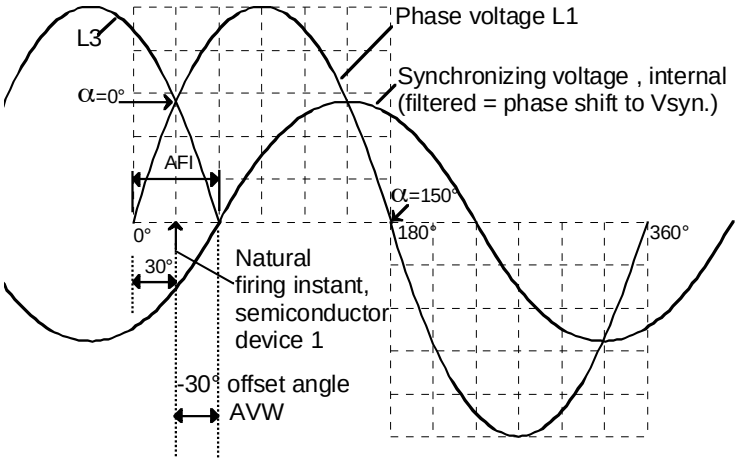


Fig. 5-5 Schematic representation of the offset angle in the 50[Hz] line supply

The angle 30[°] is specified as a result of the three-phase system.
The FB automatically corrects the existing offset –30[°]. The remaining deviation should be entered at connection XDA.

e.g. XDA=0.0 ⇒ AVW = -30 [°]
XDA=10.0 ⇒ AVW = -20 [°]

Comment The connections of the power section and electronics section of the SITOR set must have the same phase position and the clockwise rotating in order to ensure perfect functioning of the offset angle determination. (e.g. if the phases are interchanged at the electronics power supply, this then incorrectly indicates an incorrect offset angle).

The offset angle between line supply voltage L1 and the filtered synchronizing voltage, which is to be determined when commissioning the system, should be entered at input PA6.XDA in degrees (refer to the Section, Determining the offset angle).

5.2.1.2 Line supply analysis / rotating field detection

The following functions are processed in this program section:

1. The filtered, internal synchronizing voltage (V_{SYN}) is monitored
2. The line supply is checked for a clockwise rotating field
3. The actual offset angle is determined
4. The period duration is checked for stability and that the rough limits are maintained

The scope of the monitoring calculations to be executed is parameterized via connection PA6.INV.

a) If INV=0, the line supply is permanently checked for a clockwise rotating field and the offset angle is determined.

b) If INV=1, a check is made once when starting.

c) If INV=2, there is no monitoring.

Line supply analysis sequence

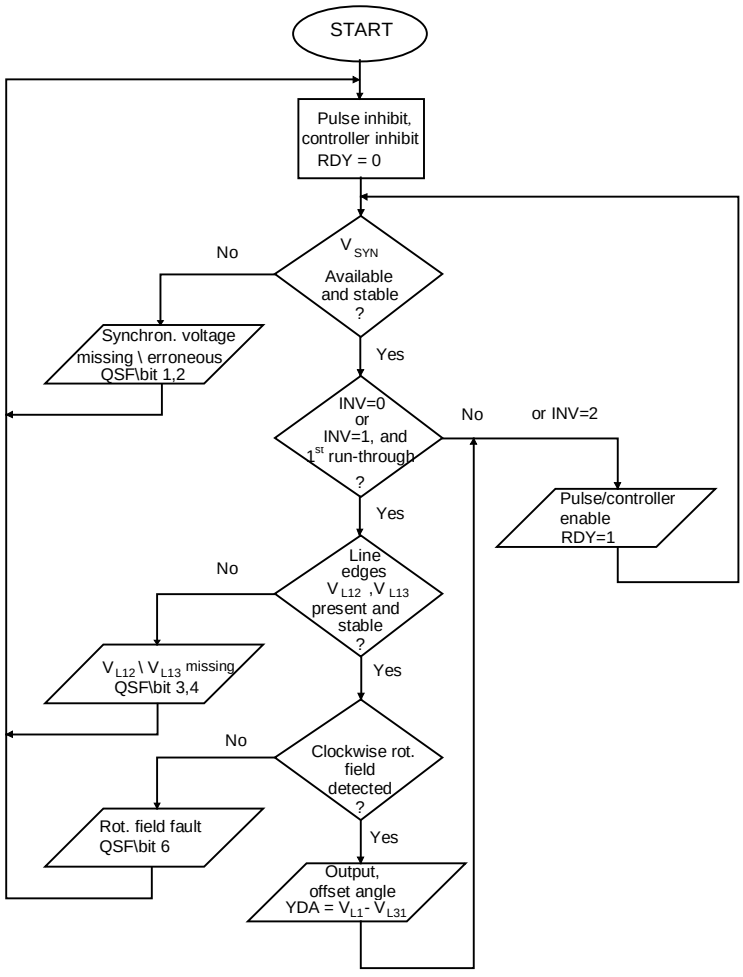


Fig. 5-6 Line supply analysis sequence

Comment

After the line supply is switched-in, it is checked, PA6.NEP. If an attempt is made to enable the closed-loop thyristor current control (SOL.ION=1) before this check has been completed, the bits in the fault ID are set at output PA6.QSF. The closed-loop thyristor current control does not go into operation. The firing angle controller and therefore the pulses remain inhibited until a stable line supply is recognized.

Fault signals inhibit closed-loop thyristor current control operation if the line supply analysis was unsuccessful (refer to Fig. 5-4).

Rotating field detection

The closed-loop thyristor current control always requires a clockwise rotating field!

If there is a counter-clockwise rotating field, a fault signal is output and the closed-loop thyristor current control cannot be switched-in.

The clockwise rotating field is determined from the phase shift of the zero crossovers from L1-L2 (V_{L12}) and L1-L3 (V_{L13}) from the Sitor set.

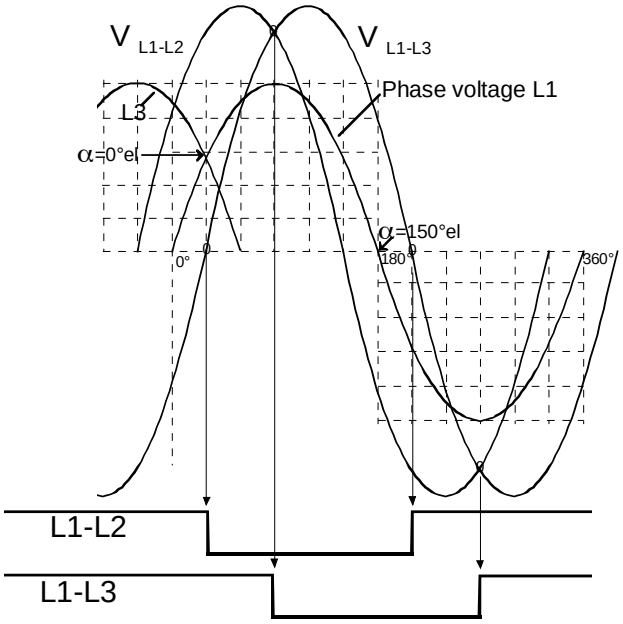


Fig. 5-7 Zero crossovers of the clockwise rotating field

When determining the phase position between the filtered synchronizing voltage and the zero crossovers of V_{L12} and V_{L13}, the actual offset angle is obtained and is output at PA6.YDA in degrees.

$$PA6.YDA = V_{SYN} - V_{L13} \neq PA6.XDA$$

When making the check, several line supply periods are evaluated. Output PA6.YDA is a monitoring connection for the commissioning phase.

If the external synchronizing voltage source (ITDC-X5:5/6) (mode:PA6.SYX=1) is used, the signals of the zero crossovers of phase-to-phase voltages V_{L12}/V_{L13} are not available so that the rotating field detection should be suppressed (PA6.INV=2).

6QG2

For the 6QG3x SITOR sets, the zero crossover signals of phase-to-phase voltages V_{L12} and V_{L13} are smoothed and are therefore phase shifted. This is not the case for 6QG2x types. The calculated offset angle should then be appropriately interpreted.

Line voltage check

The synchronizing voltage is cyclically monitored and from this value the period duration and line frequency determined.

A check is made as to whether the change in its period duration between two consecutive measurements is less than 10 %.

For non-stable line supplies, different line supply handling methods can be enabled by making the appropriate selection at the PA6.NCM connector.
For example, in the operating mode PA6.NCM=2, an average value of the period duration is generated over a parameterizable number of measured values of the period duration. The number of measured values used is specified at connection PA6.FAM (refer to the Table).
If larger deviations occur more frequently, then the "Synchronizing voltage erroneous" fault message is output.

All of the frequency-dependent quantities are calculated from the new average value of the period duration.

The gating unit calculates an internal offset angle which defines the position of α=0° with respect to the line supply. The frequency-dependent phase shift of the synchronizing voltage PA6.AFI, filtered through an RC filter and the offset angle between the line supply and synchronizing voltage PA6.XDA is included in this quantity.

Line supply quantities

The line supply frequency is emulated using a 16MHz counter (21 bit) [16MHz] in the line supply value (50Hz $\hat{=}$ 320000) and is output at PA6.NZG. The value for 60° of the periods is calculated from this value for 360°, and is output at PA6.Y6R.

The determined line supply frequency [Hz] is output at PA6.XFN.
If the line supply value is not smoothed (PA6.NCM=0), the line supply frequency value actual periods can be monitored so that the line supply frequency stability can be evaluated.

Pulse synchronization

The actual phase position of the output pulses is compared with a reference position (setpoint position), and from this a correction quantity is determined for the pulse position.

Frequency adaptation

FB–PA6 operates with the pre-set frequency PA6.FNT until the line supply is connected to the Sitor set.
The pre-synchronization, which starts when the line supply is detected, over NEP periods, harmonizes the interrupt frequency to the continuously measured line supply frequency (XFN).
If the deviation is <10% of the line supply periods for PA6.NEP times consecutively, the firing angle actual value (PA6.XAS) is enabled for the closed-loop control (FB-PC6) (PA6.RDY).
The signal is output as a function of PA6.NEP, but at the earliest after two line supply periods.

Current conduction duration

The current conduction duration PA6.YIT in the discontinuous range is determined from the zero current signal from the Sitor.
Value 1 designates the limit of the non-discontinuous range.

5.2.1.3 Synchronization and pulse generation

The firing pulses for the thyristors for the specified firing angle are generated by the firing angle controller FB–PC6.

The firing angle to be set is available at the firing angle controller input PC6.WAS (= CPI.Y, output of the current controller) in the ASG format and at the control input PA6.AQL in degrees.

The gating unit synchronizes the phase position of the pulses to the line supply once every line supply period. Differences which occur are corrected in the following periods.
Connections PA6.NCM, .FAM are especially used when the drive is operated from weak line supplies.
FAM should be set to 0 for operation from “stable” line supplies.

The switch-over logic changes-over from closed-loop controlled operation to open-loop control SOL.ISE. and also selects a torque direction.

I/O PA6

PA6.	Significance	Value\connection
AD	Hardware address	
SYX	Mode: Synchronizing voltage source (normally, phase L1 is used) SYX=0: Internally via the SITOR interface (ITDC-X7:18,34) SYX=1: Externally via connector (ITDC-X5:5)	(Initialization connection/ default: 0)
ZPA	Firing pulse number No. of the active main pulse for the active torque direction.	PC6.ZPA → PA6.ZPA { 1…6 }
XDA	Offset angle of the specified angle corrects the phase shift between the natural firing instant of semiconductor device 1 and the zero crossover of the filtered synchronizing voltage (ITDC) e.g. XDA=0.0 ⇒ AVW = -30 [°] XDA=10.0 ⇒ AVW = -20 [°] Offset angle and natural firing instant (α=0°):	(Default: 0.0) { -180°…+180° }
NAZ	Number of failed line supply periods of the synchronizing voltage until a signal is output Condition: 0 ≤ PA6.NAZ ≤ 3050, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 8)
NEP	Number of line supply periods until the system can be considered to have stabilized and can be switched-on Condition: 0 ≤ PA6.NEP ≤ 5000, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 5)
NCM	Mode : Line supply handling (also refer to FAM connector) Correction of the counter value of the line supply value (period duration and phase) before the result is transferred to FB-PC6. 0 = the line supply value is not handled 1 = refer to NCM=4 2 = the average value is generated from the last (max.8) line supply values, the number of which is defined at FAM 3= line supply value fluctuation are corrected using the PLL method (P controller). The phase difference is only taken into account with 1/FAM. 4 = line supply value fluctuations are corrected using the PLL method (PI controller). The phase difference is only weighted with 1/FAM and the last average with (FAM-1)/FAM. (NCM > 0 is used for weak line supplies or if the synchronizing voltage is polluted. For single synchronizing voltage disturbances, the best suitable setting is NCM=4 with FAM=20…40)	(Default: 0) { 0…4 , >4= 0 } FAM { ≥1…<8 } FAM { ≥1…≤1000 } FAM { ≥1…≤1000 }
FAM	For NCM=1: Refer to 4 For NCM=2: Number of saved line supply periods to generate the average value For NCM=3: Factor to reduce a measured phase difference For NCM=4: Factor to reduce a measured phase step	(Default: 0) { ≥1…<8 } { ≥1…≤1000 } { ≥1…≤1000 }

PA6.	Significance	Value\connection
INV	Rotating field detection mode INV=0 continuous monitoring, INV=1 the rotating field is defined once when starting INV=2 no monitoring	(Initialization connection/ default: 0)
FNT	Line supply frequency [Hz] for start of synchronization after the line supply voltage is switched-in Condition: 6 ≤ PA6.FNT ≤ 600, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 50)
———		
CTH	Firing pulse output, time value (this value changes in each cycle)	PA6.CTH → PC6.CTH (Default: 0)
CTS	Time value at the start of FB-PA6 (the value changes in each cycle)	PA6.CTS → PC6.CTS (Default: 0)
RDY	Enables the firing angle controller FB-PC6, internal interrupt frequency is harmonized to the line supply frequency	PA6.RDY → PC6.EN (Default: 0)
Y6R	Counter value ≙ 60° ≙ 1/6 of the line supply periods [16 MHz] NZG / 6	PA6.Y6R → PC6.X6R (Default: 0)
XAS	Firing angle actual value [ASG]	PA6.XAS → PC6.XAS (Default: 0.0)
NZG	Counter value ≙ line frequency (360°) [16 MHz] (dependent on NCM)	(Default: 0) {50Hz = 320000} {60Hz = 384000}
TA	Time difference between the actual and last firing pulse [ms]	(Default: 0 ms)
AFP	Firing angle actual value [°]	(Default: 0.0)
AFI	Phase shift angle of the line supply filter ITDC-HW [°] $AFI = \arctan(f / 50 * \tan 60°)$ (e.g. f = 50Hz ,AFI = 60°)	(Default: 0.0)
AVW	Offset angular component in the firing angle actual value (refer to XDA) $AVW = XDA + 30° - AFI$	(Default: 0.0)
YIT	Current conduction duration in the discontinuous range (YIT <1 ≙ discontinuous current, =1 ≙ continuous current)	PA6.YIT → CPI.XIT (Default: 0.0) { >0…1<}
YDA	Offset angle, This is calculated from the zero crossovers of the synchronizing voltage and the phase-to-phase line supply voltage. YDA should be equal to XDA.	(Default: 0.0)
XFN	Measured line supply frequency [Hz] = f (NZG)	(Default: 0.0)
ZYA	Diagnostics: Status "Synchronous state machine"	(Default: 0)
ZDA	Diagnostics: Status "Rotating field state machine"	(Default: 0.0)
QSF	Fault	PA6.QSF → SOL.QSA (Default: 16#0000)

Table 5-1 I/O PA6

5.2.2 EMF, voltage - actual value sensing

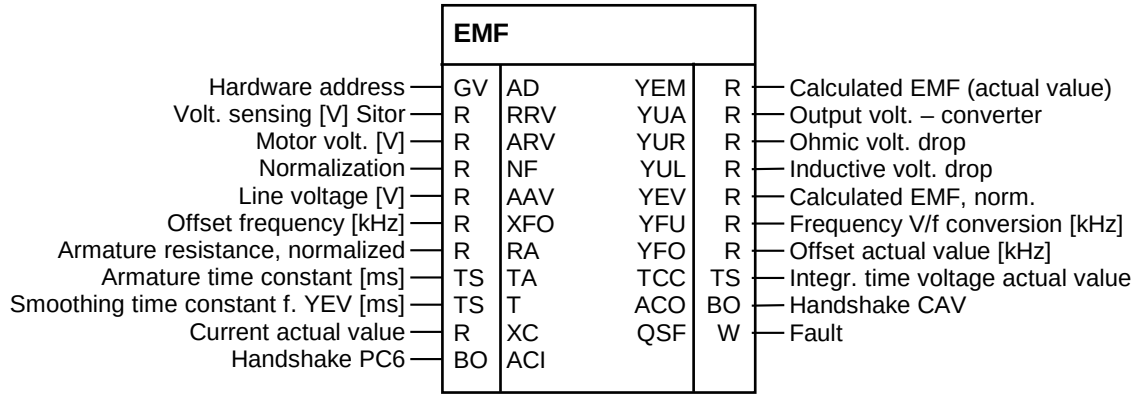


Fig. 5-8 EMF representation in the CFC

Function

Using the function block FB EMF (Electro Motive Force), the actual output voltage V_d is determined and output at EMF.YUA.
The output voltage EMF.YUA is normalized using the system parameters (EMF.RRV,.ARV,.NF) or is output as an absolute value.

The rated system voltage (e.g. rated motor voltage) should be specified at input EMF.ARV; this is referred to the determined voltage values.

The induced voltage (EMF) of the motor is calculated taking into account the ohmic and inductive voltage drop, dependent on current actual value CAV.YC and is output at EMF.YEM.

The “Typical sensing voltage” of the SITOR set should be entered at input EMF.RRV. SITOR sets 6QG2x/6QG3x are equipped as standard so that the V/f converter frequency is increased by 30 kHz at the “Typical voltage” (e.g. 6QG2\3 = 1000V).

The power section supply voltage should be entered at input EMF.AAV.

This is calculated from the no-load amplitude $V_{L13} \cdot \frac{3\sqrt{2}}{\pi}$.

Comments

ARV must be > 0.675*AAV, otherwise the “Configuring error” error bit is set at output QSF.

$$ARV > \frac{3}{\pi\sqrt{2}} \cdot AAV$$

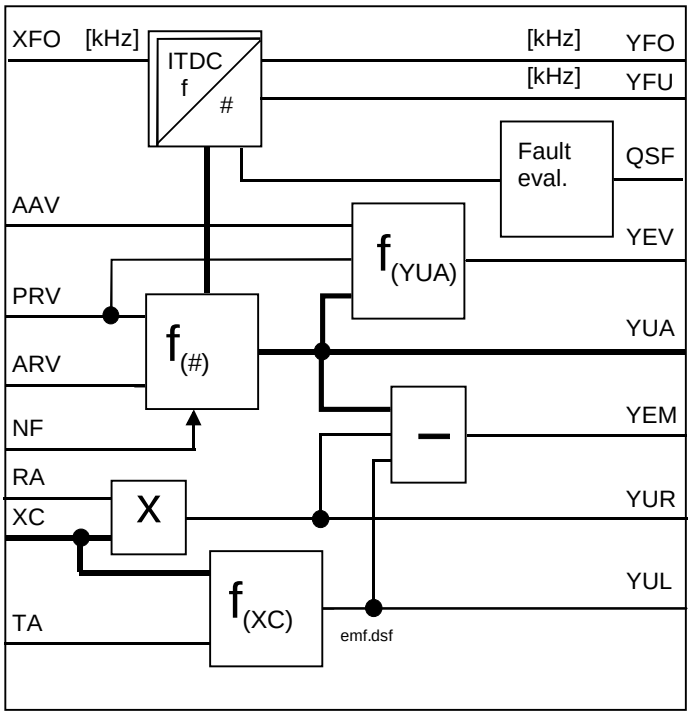


Fig. 5-9 EMF block diagram

Normalization

For EMF.NF = 1, the normalized values {0 …1} are displayed at outputs ENF.YEM, .YUA, .YUR, .YUL.
If NF is set to ARV, absolute values $\hat{=}$ [V] are displayed. When the value is changed-over, this has an effect on the settings of the control parameters!

Sensing the terminal voltage V_d

The output voltage V_d of the drive converter is converted into a frequency using a voltage-frequency converter and is transferred via the SITOR interface.

$$f_U = 60[\text{kHz}] + 30[\text{kHz}] \cdot \frac{V_{Sitor}}{RRV} \quad \text{Range: } 30 \leftarrow 60 \rightarrow 90 \text{ [kHz]}$$

$$-1*, V = 0 \text{ ,} +1* V_{rated}$$

The number of pulse edges of this signal are converted into a value, integrating over the time period between two firing pulses.

Calculating the drive converter output voltage from the frequency:

$$\text{EMF.YUA} = \frac{RRC * NF}{ARC} * \left(\frac{f_U - 60[\text{kHz}] - XFO}{30[\text{kHz}]} \right)$$

Calculating the induced voltage of the motor *EMF* from the output voltage and the current actual value:

$$V_{EMF} = V_d - \left(R_A * I_A \right) - \left(L_A * \frac{di}{dt} \right) \quad \text{is converted into}$$

$$\text{EMF.YEM} = \text{YUA} - \text{YUR} - \text{YUL}$$

With the ohmic voltage drop:

$$\mathrm{YUR} = R_{\sum} * \mathrm{I}_{\mathrm{armature}} = RA * XC$$,whereby RA should be calculated with the determined armature resistance:

$$\mathrm{RA} = R_{armature}\left[\ \right] * \frac{\mathrm{NF}\ \ (\mathrm{EMF})}{\mathrm{ARV}\,(\mathrm{EMF})} * \frac{\mathrm{ARC}\ (\mathrm{CAV})}{\mathrm{NF}\ \ \ (\mathrm{CAV})}$$

With the inductive voltage drop:

$$\mathrm{EMF.YUL} = \mathrm{L}\frac{\mathrm{di}}{\mathrm{dt}} = \frac{\mathrm{RA}}{\mathrm{TA}} * \left(\mathrm{XC_n} - \mathrm{XC_{n-1}}\right)$$

Comment The inductive voltage drop is only approximately calculated using this formula and is therefore not so precise that this value can be used for other calculations.

The *EMF* value is normalized to the no-load line supply amplitude

$$V_{L13} * \frac{3\sqrt{2}}{\pi} \mathrel{\hat{=}} AAV * \frac{3\sqrt{2}}{\pi}$$ and output.

$$\mathrm{EMF.YEV} = \frac{\pi}{3\sqrt{2}} * \frac{\mathrm{RRV}}{\mathrm{AAV}} * \mathrm{YEM}$$

Comment The EMF is determined with a deadtime by sensing the terminal voltage as the average value between two firing pulses.
Thus, current actual value oscillations can occur for an EMF angle pre-control at the current controller.
This can be avoided if a greater value than the actual armature time constant is configured at input EMF.TA.

Calibration frequency of the V/f converter

The center frequency (60[kHz]) of the V/f converter in the Sitor-converter has an offset.
The offset frequency for V_d=0 V is available at connection EMF.YFO.

EMF.YFO = YFI - 60[kHz] - XFO

NOTE Connection EMF.XFO is an initialization connection and is only valid after a restart \ reset.
EMF.XFO should be determined after replacing the SITOR-converter and when commissioning the system.

Instructions are provided in the Section: Voltage sensing calibration.

I/O for EMF

EMF.	Significance	Value\connection
AD	Hardware address	
RRV	Sitor rated voltage of the sensing [V]. (e.g. Sitor = 1000[V] PT = 30[kHz]) Condition: RRV ≥ ARV, otherwise, QSF\bit 14 = 1	(Initialization connection/ default: 0.0)
ARV	Rated system / motor voltage [V] Condition: RRV ≥ ARV ≠ 0, otherwise, QSF\bit 14 = 1	(Initialization connection/ default: 0.0)
NF	Normalization of the voltage actual value at YUA NF= 1 (YUA = normalized value), NF= ARV (YUA , YEM = absolute value)	(Initialization connection/ default: 1.0)

EMF.	Significance	Value\connection
AAV	Line supply voltage [V]. Condition: $AAV \geq \cdot ARV \frac{\sqrt{2} * \pi}{3}$, otherwise, QSF\bit14= 1	(Default: 0.0)
XFO	Offset frequency of the V/f converter [kHz] Measurement for a drive converter output voltage = 0[V] ! Calibration/adjustment: XFO = **-** YFO ! Condition: -6 kHz ≤XFO≤ 6 kHz, otherwise, QSF\bit 14 = 1	(Initialization connection/ default: 0.0)
RA	Normalized armature resistance (this should be calculated from the determined value)	(Default: 0.0)
TA	Armature time constant [ms]	(Default: 0 ms)
T	Smoothing time for YEV value (with T=0, smoothing is disabled)	(Default: 20 ms)
XC	Current actual value (with sign) to calculate the voltage drop of armature quantities	CAV.YC → EMF.XC
ACI	Handshake from the PC6 block	PC6.ACO → EMF.ACI
——		
YEM	Calculated EMF actual value $YEM = YUA - YUR - YUL$ (this value is too inaccurate for other calculations as the value calculated for YUL is only approximate!)	(Default: 0.0)
YUA	Drive converter output voltage	(Default: 0.0)
YUR	Ohmic voltage drop across the DC motor $YUR = R * I_{armature} = RA * XC$	(Default: 0.0)
YUL	Inductive voltage drop across the DC motor $YUL = L\frac{di}{dt} = \frac{RA}{TA} * \left(XC_n - XC_{n-1}\right)$	(Default: 0.0)
YEV	EMF value normalized to the no-load line supply amplitude $YEV = \frac{\pi}{3\sqrt{2}} * \frac{RRV}{AAV} * YEM$ (smoothed with time T)	EMF.YEV → SOL.XEV (Default: 0.0)
YFU	Frequency of the voltage actual value [kHz] (of the V/f conversion) without correction	(Default: 0.0)
YFO	Offset actual value [kHz] $YFO = YFI - 60[kHz] - XFO$	(Default: 0.0)
TCC	Measuring time, voltage measurement	(Default: 0 ms)
ACO	Handshake for CAV block	EMF.ACO → CAV.ACI (Default: 0)
QSF	Fault	EMF.QSF → SOL.QSM (Default: 16#0000)

Table 5-2 EMF I/O

5.2.3 SOL, switch-over logic

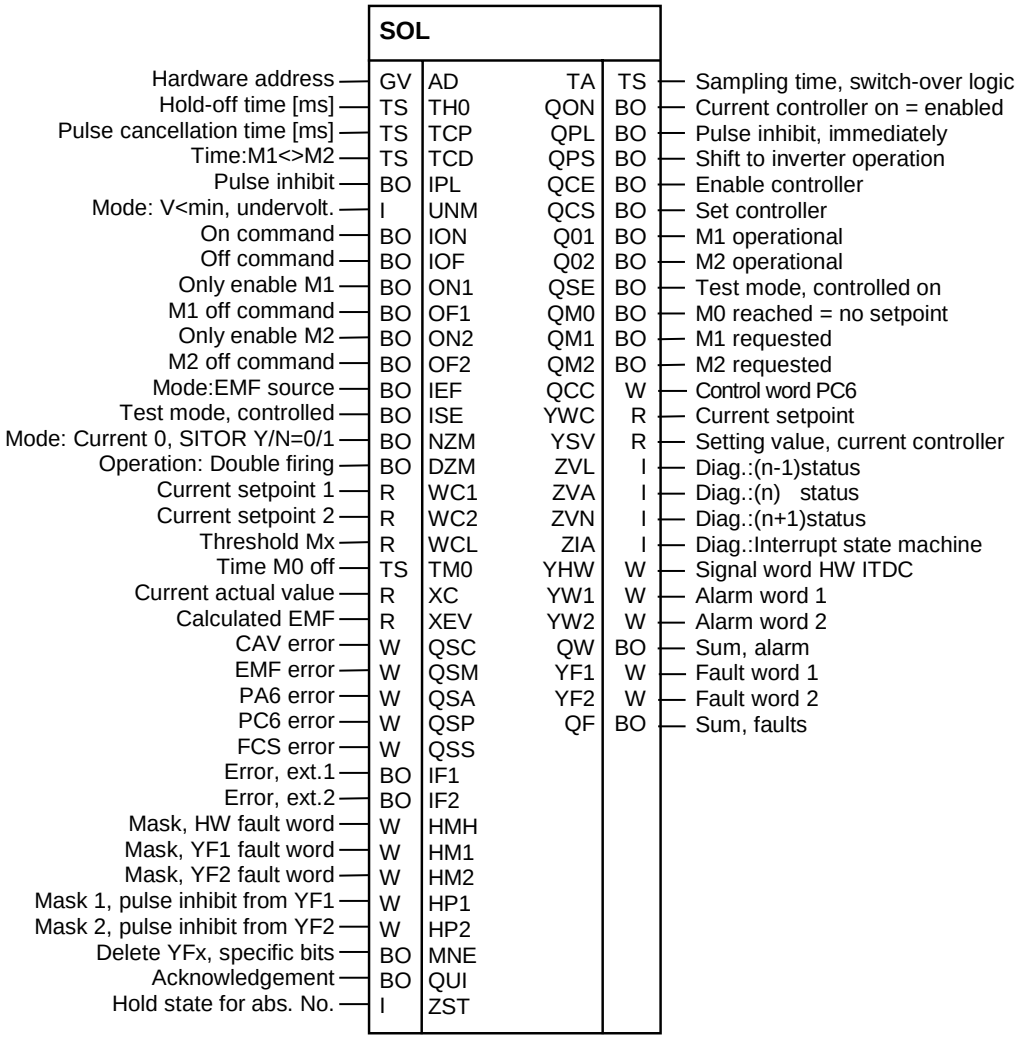


Fig. 5-10 SOL represented in the CFC

Function

The switch-over logic stage FB–SOL (Switch Over Logic) controls the sequence when switching-in and switching-out the closed-loop thyristor current control for:

- 4Q drives with drive converters in a circulating current-free anti-parallel circuit configuration comprising two fully-controlled three-phase bridge circuits
- 1Q drives with drive converter in a fully-controlled three-phase bridge circuit configuration.

4Q drive

Additional tasks are executed for four-quadrant drives (4Q).

- A torque direction is selected, and
- The changeover sequence controlled
  (shift to inverter operation, pulse inhibit, set controller...).

The torque direction is derived from the sign of the complete current setpoint (SOL.WC1 + .WC2) from a higher-level control. The following inter-relationship exists:

- Positive setpoint Torque direction M1
- Negative setpoint Torque direction M2

If a torque direction is not requested, i.e. the setpoint SOL.WC1+ SOL.WC2 < SOL.WCL, the "virtual torque direction M0" is reached and output SOL.QM0 is set.
The outputs QMx are only controlled from the setpoint.

1Q drive

For 1Q drives, torque direction M2 must be inhibited using a permanent off command SOL.OF2=1.

The switch-over logic stage calculates, from the calculated *EMF* from FB–EMF, a pre-control angle with which the current controller is pre-assigned for torque direction reversal. The value is used with the selection: Permanent intervention for each calculation.

The switch-over logic stage executes the following commands for switch-off or changeover:

- Shift to inverter operation (current is reduced) (SOL.QPI).
- The system waits until the zero current signal is received from the SITOR set (SOL.NZM), as soon as the absolute value of the current actual value (SOL.XC) falls below 3%
- The pulses are deleted and the hold-off time SOL.THO started
- The new torque direction is switched-in after the hold-off time SOL.THO has expired and the pulse cancellation time SOL.TCP.

The no-current interval when the torque reverses is determined by the I=0 signal and the delay times for the thyristors are between approx. 6.6 and 10 ms (this depends on the motor inductance).

The closed-loop thyristor current control is only enabled with

- the on command from the switch-over logic stage at input SOL.ION,
- the current setpoint SOL.WC1+WC2 > the torque threshold SOL.WCL, and
- there is no off command or fault condition.

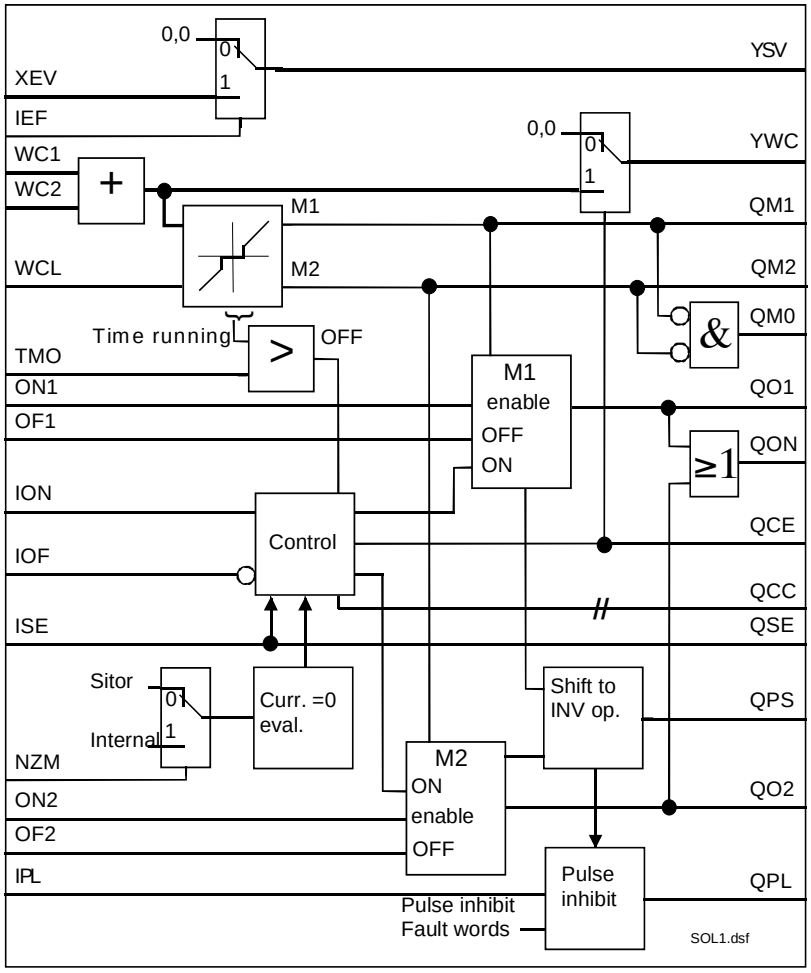


Fig. 5-11 Function diagram SOL control

Priorities of the switch-on commands

The inputs SOL.ION, .IOF have a higher priority than the other command inputs.

The switch-off commands for the torque direction SOL.OF1 \ .OF2 have a higher priority than the enable signals SOL.ON1 \ ON2 and always result in the appropriate torque direction being switched-out (disabled).

Switching combinations which are not plausible are either not executed, or result in the closed-loop thyristor current control being switched-out.

Comment

If the current actual value only decreases very slowly (e.g. closed-loop field controls), then it can occur that the “current=zero” signal of the SITOR set oscillates between binary values “0” and “1”. These changeover operations can be suppressed by extending the pulse cancellation time (SOL.TCP). The torque direction is only changed-over if the "holding current" is actually fallen below. SOL.TCP = 2 [ms] corresponds to the standard closed-loop thyristor current control operation for armature supply.

Test mode

The controlled test mode is selected with input SOL.ISE = 1. The FB-PC6 firing angle controller immediately executes firing angle PC6.AQL. The torque direction is derived from the sign of the current setpoint if a torque direction (SOL.ON1 , .ON2) was not forced.

Changing-over the torque direction

For the torque changeover, the switch-over logic stage sets the current controller (CPI.SV) to the voltage actual value of the *EMF*, refer to the no-load amplitude, using the signal SOL.QCS. The *EMF* can also be set, for the current controller as EMF pre-control angle (CPI.SVC=1), into the "continuous tracking" mode.

NOTE **To enable the pulses, a jumper ITDC -X5:7 \ 10 must be inserted. An "open-circuit" input is interpreted as "external hardware pulse inhibit" and causes the pulses to be immediately inhibited!**

I/O

SOL.	Significance	Value\connection
AD	Hardware address	
TH0	Thyristor hold-off time [ms] Condition: 0.5 ms ≤ TH0 ≤ 131 ms, otherwise, YW2\bit10=1	(Initialization connection/ default: 10 ms)
TCP	Thyristor pulse suppression time [ms] Condition: 0.0 ms ≤ TH0 ≤ 20000 ms, otherwise, YW2\bit10=1	(Initialization connection/ default: 2 ms)
TCD	Monitoring time for torque change M1 ⇔ M2 (inverse > (TCP + THO + TCD) ⇒ fault)	(Default: 50 ms)
IPL	Pulse inhibit = 1 is immediately effective! (this is the same as the hardware pulse inhibit ITDC–X5:10.) (At high currents and speed this can result in inverter commutation faults.)	(Default: 0)
UNM	Mode: Handling the undervoltage condition (Sitor) UNM=0: Undervoltage signal as alarm (YW1\bit 6) UNM=1: Transition into the status: Pulse inhibit UNM=2: Transition into the status: Pulse inhibit + total pulse inhibit (HW-ITDC)	(Default: 2)
ION	On command for the closed-loop thyristor current control, only if IOF = 0. ION is only level controlled! A transition from off ⇒ operation is only realized if the sum of the setpoints WC1+WC2 ≥ WCL.	(Default: 0)
IOF	Off command for the closed-loop thyristor current control IOF has priority over all of the other control inputs.	(Default: 0)
ON1	Enable, only torque direction M1, for OF1 = 0 & OF2 = 0	(Default: 0)
OF1	Off command, torque direction M1 For QON = 1, only negative setpoints are executed.	(Default: 0)
ON2	Only enables torque direction M2, for OF2 = 0 & OF1 = 0	(Default: 0)
OF2	Off command, torque direction M2 For QON = 1, only positive setpoints are executed.	(Default: 0)

SOL.	Significance	Value\connection
IEF	Mode: Use calculated EMF value (FB EMF present) Use the value at XEV for output at YSV	(Default: 1)
ISE	Changes over to the open-loop controlled test mode. The input is only effective for ION=0. Changes at firing angle controller PC6: PC6.AQL=150 [°] (firing angle setpoint in the open-loop controlled mode) The setpoints WC1/2 are not relevant during test operation (ISE=1), only the sign! Alternatively, the torque direction to be controlled can be switched-in (forced) using inputs ON1 and ON2	(Default: 0)
NZM	Zero current signal from the SITOR set, Y/N=0/1 (if NZM=1, no signal is received ⇒ time monitoring TCD sets a hardware fault)	(Default: 0)
DZM	Operating signal, double firing from the firing angle control PC6	PC6.DZM → SOL.DZM
WC1	Current setpoint 1 WC1 + WC2 = YWC	(Default: 0.0)
WC2	Current setpoint 2	(Default: 0.0)
WCL	Switch-on threshold for the torque direction (absolute value)	(Default: 0.01)
TM0	Monitoring time for torque direction M0 $\left(\lvert WC1 + WC2\rvert \leq WCL\right) \& \left(t_{act} \rangle TM0\right) \Rightarrow QM0 = 1$	(Default: 2000ms)
XC	Current actual value (with sign)	CAV.YC → SOL.XC
XEV	Calculated EMF value (referred to Vdi) for torque reversal and continuous tracking from FB-CPI)	EMF.YEV → SOL.XEV
QSC	Fault word from CAV	CAV.QSF → SOL.QSC
QSM	Fault word from EMF	EMF.QSF → SOL.QSM
QSA	Fault word from PA6	PA6.QSF → SOL.QSA
QSP	Fault word from PC6	PC6.QSF → SOL.QSP
QSS	Fault word from FCS , if FCS available, (optional for a 6QG3x SITOR set with option: Excitation)	FCS.QSF → SOL.QSS , otherwise = 0.
IF1	Fault, external 1 (appears in YW1\bit 9)	(Default: 0)
IF2	Fault, external 2 (appears in YW1\bit 12)	(Default: 0)
HMH	Enables the bits for hardware signaling word YHW and therefore the connection to YW1	(Default: 16#FFFF)
HM1	Enables the bits for fault word YF1	(Default: 16#FFFF)
HM2	Enables the bits for fault word YF2	(Default: 16#FFFF)
HP1	Enables the bits from YF1 for immediate pulse inhibit WARNING: "Inverter commutation faults" possible!	(Default: 16#0020)
HP2	Enables the bits from YF2 for immediate pulse inhibit WARNING: "Inverter commutation faults" possible!	(Default: 16#0040)
MNE	Group inhibit, fault words YF1 and YHW deletes defined bits (refer to the Table under: ∅ = deleted bits)	(Default: 067E)
QUI	Acknowledges faults YF1 and YF2 The acknowledgment is only realized with ION=0!	

SOL.	Significance	Value\connection
ZST	Diag.: Stop in the status of the specified number (ZVA) (The pre-set value (Default value) can only be modified by trained personnel!)	(Default: 100)
TA	Processing time, switch-over logic stage	(Default: 0 ms)
QON	Closed-loop current control operational (only enabled if there are no faults and after a switch-on command and setpoints WC1+WC2 > WCL > 0.0)	(Default: 0)
QPL	Pulse inhibit (the status is displayed at connector ITDC-X5:15 = 0)	(Default: 0)
QPS	Shift to inverter operation is executed (The firing angle PC6.AWS becomes active.)	(Default: 0)
QCE	Enables the current controller	SOL.QCE → CSP.EN (Default: 0)
QCS	Sets the current controller FB-CPI, set or track	SOL.QCS → CPI.S SOL.QCS → CSP.EN (Default: 0)
Q01	Torque direction M1 operational (setpoint is switched-through to YWC)	SOL.Q01 → CAV.IM1 (Default: 0)
Q02	Torque direction M2 operational (setpoint is switched-through to YWC)	SOL.Q02 → CAV.IM2 (Default: 0)
QSE	Test mode is switched-in	(Default: 0)
QM0	M0 requested, current setpoint < WCL = neither M1 nor M2 requested	(Default: 0)
QM1	M1 requested	(Default: 0)
QM2	M2 requested	(Default: 0)
QCC	Control word for FB-PC6	SOL.QCC → PC6.ICC (Default: 16#0000)
YWC	Current setpoint	SOL.YWC → CSP.WC (Default: 0.0)
YSV	Setting value, current controller even when tracking is switched-in	SOL.YSV → CPI.SV (Default: 0.0)
ZVL	Diag.:(n-1) status	(Default: 0)
ZVA	Diag.:(n) status , control state machine	(Default: 0)
ZVN	Diag.:(n+1) status	(Default: 0)
ZIA	Diag.:Status, interrupt state machine	(Default: 0)
YHW	Signaling word hardware ITDC (masked by HMH)	(Default: 16#0000)
YW1	Alarm word 1	(Default: 16#0000)
YW2	Alarm word 2	(Default: 16#0000)
QW	Sum, alarm 1 bit in YW1 or YW2 = 1	(Default: 0)
YF1	Fault word 1 (masked using HM1)	(Default: 16#0000)
YF2	Fault word 2 (masked using HM2)	(Default: 16#0000)
QF	Sum, fault signal 1 bit in YF1 or YF2 = 1	(Default: 0)

Table 5-3 I/O SOL

5.2.3.1 Fault evaluation and protection

Function

All of the faults are concentrated in the switch-over logic stage where they can be evaluated.
The faults of the FBs (PA6, EMF, SOL, CAV, PC6, FCS) and two user-specific, external faults (SOL.IF1 \ IF2) and faults from the ITDC hardware are combined to two alarm words YW1 and YW2.

Using the masks HM1, HM2, the bits of alarm words YW1 and YW2 are switched-through into the words for faults YF1 and YF2.
Each bit initiates the “Shift to inverter operation” SOL.OPS=1 and results in the closed-loop current control being switched-out.
The faults should be acknowledged after the cause has been removed (QUI=1).

Using the selection masks SOL.HP1, .HP2,
the user decides whether the pulses should be immediately inhibited SOL.OPL=1.
If this function is enabled, under certain circumstances it can result in “Inverter commutation faults”!

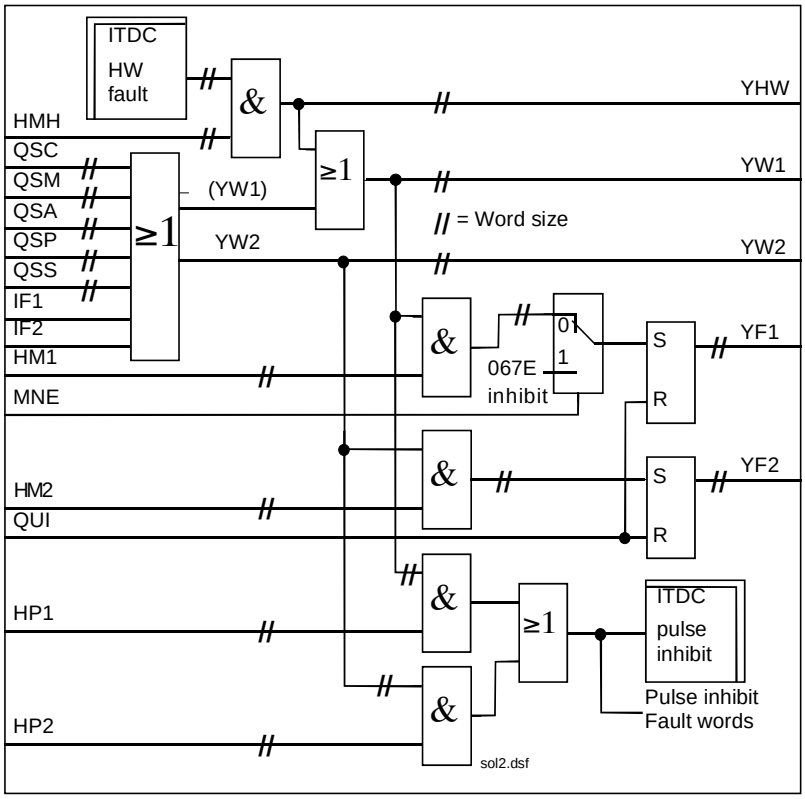


Fig. 5-12 Function chart SOL - fault evaluation

External faults

The user can disable the closed-loop thyristor current control with fault message at inputs SOL.IF1, .IF2.

Acknowledging fault messages

The system can be switched-in again after a fault has occurred after

- Removing the fault
- Acknowledging the fault (signal edge at connection SOL.QUI = 0 → 1)
- Switch-on command (signal transition at connection SOL.ION = 0 → 1)

All of the faults which are present are displayed at outputs SOL.YW1 and YW2; however, they are not saved. Using these outputs, it can be checked whether a fault has been removed.
The faults are only removed from fault words SOL.YF1, .YF2 after acknowledgment and if they have been removed.

Undervoltage

An undervoltage condition, detected by the SITOR set electronics can be handled as configured at input SOL.UNM.

The selection results in different responses to this message:

- UNM=0: Message: Undervoltage as alarm (SOL.YW1\bit 6)
- UNM=1: Transition into the status: Pulse inhibit SW
- UNM=2: Transition into the status: Pulse inhibit SW + total pulse inhibit (HW-ITDC)

Temperature monitoring

The “Temperature monitoring” signal is derived from the fan monitoring of the SITOR set and must result in a trip in order to avoid destroying the thyristors as a result of overtemperature.

When the fan runs-up, the SITOR electronics suppresses the monitoring signal for approx. 10 s. This is the reason that the fan should be powered-up together with the SITOR set electronics power supply.

Hardware faults

The faults, detected by the ITDC hardware are enabled with the SOL.HMH mask, and entered into alarm word SOL.YW1. These masked bits are output in word SOL.YHW.

Significance of fault bits ITDC HMH → YHW

YHW		Fault message → remedy
Bit 1		Logical 0
Bit 2	∅	Fuse monitoring (Sitor) → check whether a fuse has failed
Bit 3	∅	Temperature monitoring (Sitor) → check for overtemperature
Bit 4	∅	Undervoltage (Sitor) → check the line supply values and connector SOL.UNM
Bit 5	∅	External pulse inhibit if a voltage is not available at the input → ITDC-X5:10 > 15 V $\hat{=}$ pulse enable
Bit 6	∅	Logical 0 $\hat{=}$
Bit 7	∅	Hardware Watchdog ITDC Causes: Defective module, → replace the module Task overflow in the PMx → modify the configured software
Bit 8		Total pulse inhibit (display: ITDC-X5:15) Cause: Voltage missing, SW pulse inhibit, HW-ITDC fault → remove the fault statuses
Bit 9-16		Logical 0
∅ = suppressed with MNE=1		

Table 5-4 HW faults from the ITDC

Group inhibit, fault word YF1/YF2

If the group inhibit fault word is set (SOL.MNE=1), this permanently deletes the defined bits in fault words SOL.YF1\2.

Fault words YW1 ,YW2 YF1 , YF2

An alarm message is transformed from YW1 or YW2 into fault message YF1 or YF2 by setting bits 1-16 at SOL.HM1 or SOL.HM2.

The closed-loop thyristor current control is switched-out by a fault message in fault word YF1 or YF2.

Significance of the fault bits YW1, with HM1 → YF1

YW1→YF1	Fault message → remedy	Source
Bit 1	Synchronizing voltage not present / failed → check the synchronizing voltage connection (hardware)	PA6
Bit 2 ∅	Erroneous synchronizing voltage Frequency step > 10% / periods → check the synchronizing voltage (hardware)	PA6
Bit 3 ∅	Zero crossovers UL1-2 missing (Sitor) only, if the signal was present once. → check the line supply connection and initialization connection PA6.INV	PA6
Bit 4 ∅	Zero crossovers UL1-3 missing (Sitor) only, if the signal was present once. → check the line supply connection and initialization connection PA6.INV	PA6
Bit 5 ∅	Rotating field error = no clockwise rotating field of Vsyn., or both zero crossovers missing. (dependent on the mode: INV) → check the line supply connection and initialization connection PA6.INV	PA6
Bit 6 ∅	Undervoltage (Sitor). (dependent on the mode: UNM) → check the line supply values and connector SOL.UNM	SOL
Bit 7 ∅	Logical 0	
Bit 8	Pulse inhibit, software (.IPL = 1) + hardware command: Total pulse inhibit	SOL
Bit 9	Fault, external 1 (SOL.IF1= 1)	SOL
Bit 10 ∅	Fuse monitoring (Sitor) → check for fuse failure	SOL
Bit 11 ∅	Temperature monitoring (Sitor) → check for overtemperature	SOL
Bit 12	Fault, external 2 (SOL.IF2 = 1)	SOL
Bit 13	External pulse inhibit for voltage missing at the input + hardware command: Total pulse inhibit → ITDC-X5:10 > 15 V $\hat{=}$ enable the pulses	SOL
Bit 14	Excitation current fault (optional for SITOR set 6QG3x with excitation option) Cause: FCS.FC > 5% and field current actual value < 3% FCS.ARC → check the field control/connection	FCS
Bit 15	Hardware Watchdog ITDC + hardware command: Total pulse inhibit Causes: Defective module, → replace the module Task overflow in the PMx → change the application software	SOL
Bit 16	Hardware command: Total pulse inhibit (ITDC-X5:15) → remove the fault statuses	SOL

Table 5-5 Fault list SOL.YW1 .YF1

Significance of fault bits YW2, with HM2 → YF2

YW2→YF2	Fault message → remedy	Source
Bit 1	Hardware fault of the current actual value sensing (Sitor) ITDC: Current actual value has not been latched (saved). Cause: V/f conversion frequency not present → check the current actual value sensing (60 kHz) or ITDC	CAV
Bit 2	Overcurrent M1 → check the system values, connector CAV.CX1 and initialization connections CAV: RRC, ARC, NF, XFO, AL1	CAV
Bit 3	Overcurrent M2 → check the system values, connector CAV.CX2 and initialization connections CAV: RRC, ARC, NF, XFO, AL2	CAV
Bit 4	CAV configuring error → check the initialization connections, CAV: RRC, ARC, AL1, AL2, IAV, XF2, NF, XFO	CAV
Bit 5	Hardware fault: Voltage actual value sensing (Sitor) ITDC: Voltage actual value has not been latched (saved). Cause: V/f conversion frequency not present → check the voltage actual value sensing (60kHz) or ITDC	EMF
Bit 6	EMF configuring error → check the initialization connections EMF: RRV, ARV, AAV, XFO	EMF
Bit 7	Pulse position error (PC6) Cause: Erroneous pulse position → check the line supply values and connectors PC6: DIL, DIZ	PC6
Bit 8	Configuring error → AAV voltage specified too high (1.35*AAV > 2*ARU)	
Bit 9	Fault, zero current signal for M1 ⇔ M2 (NZM=0, Sitor) or Iact >3% → check the zero current signal from the SITOR interface (only with NZM=0)	SOL
Bit 10	SOL configuring error → check the initialization connections SOL: TH0, TCP	SOL
Bit 11	SOL block, internal status fault → check the ITDC hardware	SOL
Bit 12	FCS configuring error → check the initialization connections FCS: RRC, ARC and FC	FCS
Bit 13	PA6 configuring error → check the initialization connections PA6: NAZ, NEP, NWD, INV, FNT	PA6
Bit 14	PC6 configuring error → check the initialization connections PC6: LDU, LDL, AWS, DAG, DAW	PC6
Bit15-16	Logical 0	

Table 5-6 Fault list SOL.YW2 .YF2

5.2.4 CAV, current actual value sensing

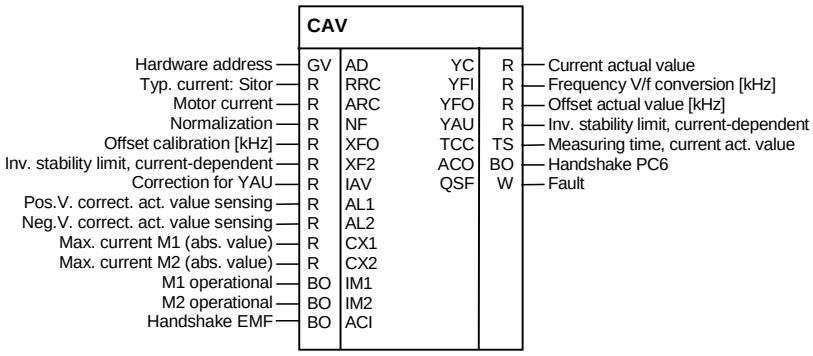


Fig. 5-13 CAV represented in the CFC

Function

Using the function block FB–CAV (Current Actual Value), the current actual value is determined and output at CAV.YC.

The current actual value is either converted into a voltage at a shunt or using AC current converters in the drive converter and then converted into a frequency. This measured frequency is transferred to the ITDC where it is measured in the hardware.

The mapping range of the current actual value is
±10[V] = 2* rated current, corresponding to ±30[kHz].
The frequency at zero current is 60[kHz].

The average current actual value is determined from the number of pulse edges of the frequency and the time between two firing pulses.

The “Typical DC current” of the drive converter should be entered at input CAV.RRC.
The SITOR sets 6QG2x/6QG3x are equipped as standard, so that the frequency of the V/f converter is increased by 15 kHz at the typical DC current. At the test socket: Iact is output as 5V.

The rated system/motor current [A] should be specified at input CAV.ARC. All of the current-dependent thyristor current control quantities refer to this value.

Limits

If the current actual value exceeds the limits set at inputs CX1 or CX2, then an "Overcurrent Mx" fault message is output which causes a trip at the FB SOL (standard), or, depending on what has been configured, only an alarm is generated.

Gain error

If the V/f conversion manifests a gain error, this can be corrected, within limits using the data at CAV.AL1 /AL2.
The absolute value at CAV.AL1 acts on positive values and the input CAV.AL2, correspondingly for negative values. The thus corrected actual value is provided at CAV.YC.

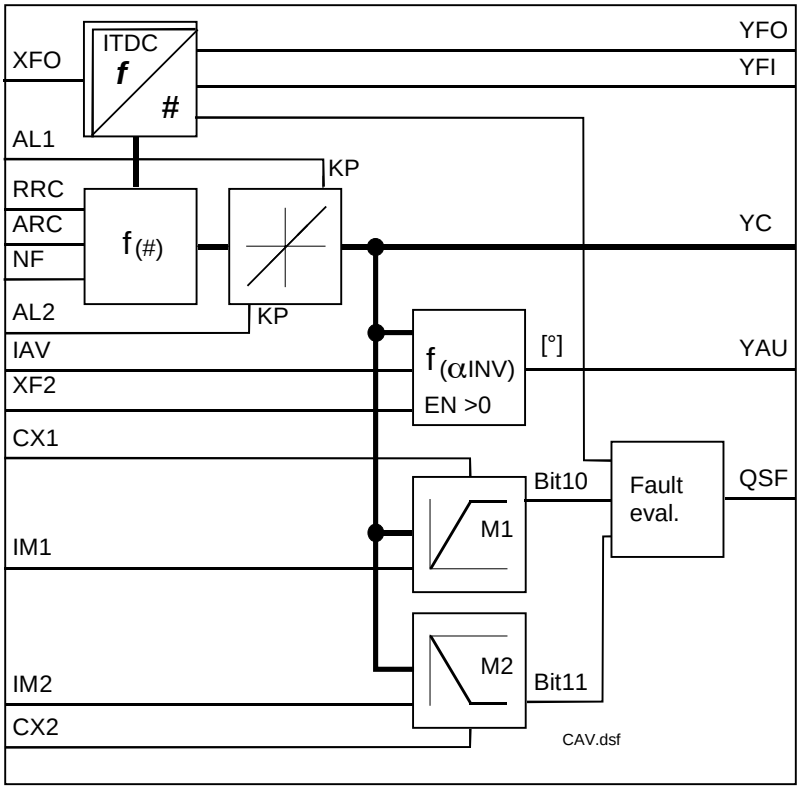


Fig. 5-14 Function chart CAV

Normalization

The normalized current actual value {0 …1} is displayed at output CAV.YC with the value CAV.NF = 1.
If NF is set to ARV, the absolute value $\hat{=}$ [A] is displayed. If the value is changed-over, this has an effect on the setting of the controller parameters!

Calculating the drive converter output current:

with $f_I = 60[kHz] + 15[kHz] \cdot \frac{I_{Sitor}}{ARC}$

Frequency range: $30 \leftarrow 45 \leftarrow 60 \rightarrow 75 \rightarrow 90$ [kHz]

$-2* \quad -1* \quad I = 0 \quad 1* \quad 2* I_{rated}$

The current actual value YC is calculated as follows:

$$YC = \frac{RRC * NF}{ARC} \cdot \left(\frac{f_I - 60[kHz] - XFO}{15[kHz]} \right)$$

Output YC is signed.

Calibration frequency of the V/f converter. The center frequency (60[kHz]) of the V/f converter in the Sitor converter has an offset.
The offset frequency for I_A= 0 [A] is available at connection CAV.YFO.

YFO = YFI - 60[kHz] - XFO

When the closed-loop thyristor current control is switched-out (I=0), the frequency at YFO corresponds to the offset error of the V/f converter in the Sitor.
The output only indicates values up to 10% of the system current.

NOTE

Connection CAV.XFO is an initialization connection and is only valid after a restart \ reset.
CAV.XFO should be determined when commissioning the system and after the SITOR-converter has been replaced.

Instructions are provided in the Section "Current sensing ".

Negative inverter limit characteristic

The inverter stability limit is normally permanently specified at FB PC6 with a value. If the maximum output voltage is to be used, then the limit must be adjusted as a function of the current, as the overlap angle increases as a result of the extended commutation. This means that the inverter stability limit must be reduced in order to avoid “Inverter commutation faults”. A current-dependent inverter stability limit YAU can be calculated for these special applications.

$$YAU = 180° - \left(90° - \arcsin\left(1 - \frac{YC}{ARC} * \frac{XF2}{IAV} \right) \right) \quad \text{, with XF2} > 0$$

The variations of CAV.XF2 are shown in the diagram.

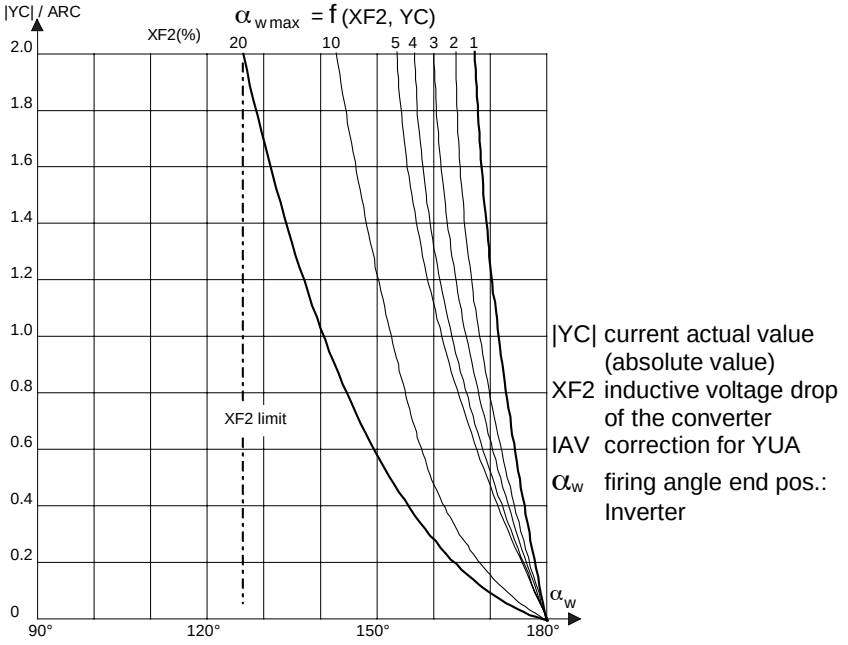


Fig. 5-15 Dynamic inverter stability limit

The data {≥0.7…1.3≤} at connection CAV.IAV results in an additional correction of the dynamic stability limit.
The bandwidth of the correction of CAV.IAV decreases with CAV.XF2 ⇒ 0.

Line supply changes can be taken into account here.

Comment

The inverter stability limit calculation is disabled with XF2=0.0.
If the function is required, the connections must be established to FB–CPI.CLU and FB–PC6.AWS.

I/O

CAV.	Significance	Value\connection
AD	Hardware address	
RRC	Rated DC current of the SITOR set [A] Condition: RRC ≥ ARC, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
ARC	Rated system/motor current [A] Condition: RRC ≥ ARC ≠ 0, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
NF	Normalization of the current actual value at YC NF= 1 (YC = normalized value), NF= ARC (YC = absolute value) Condition: NF > 0, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 1.0)
XFO	Offset calibration of the V/f conversion frequency [kHz] calibration: XF0 = - YFO! Value measured at I=0 A! Condition: -6 kHz ≤ XFO ≤ 6 kHz, otherwise, QSF\bit12=1 (max. 10% of the rated frequency)	(Initialization connection/ default: 0.0) {≥-6.0…+6.0≤}
XF2	Current-dependent inverter stability limit [1] XF2 corresponds to the “inductive voltage drop” of the converter. XF2=0 % ⇒ stability limit calculation disabled. This intervention is not required for standard applications. Condition: 0.0 ≤ XF2 ≤ 0.2, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0) {≥0.0…0.2≤}
IAV	Correction for the stability limit [1] Line supply changes can be taken into account here. The bandwidth always decreases with CAV.XF2 ⇒ 0. Line supply changes can be taken into account here. Condition: 0.7 ≤ IAV ≤ 1.3, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 1.0) {≥0.7…1.3≤}
AL1	Positive correction of the gain, current actual value sensing Condition: -0.1 ≤ AL1 ≤ 0.1, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
AL2	Negative correction of the gain, current actual value sensing Condition: -0.1 ≤ AL2 ≤ 0.1, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
CX1	Max. current for torque direction M1 (absolute value) (observe the normalization!)	(Default: 0.1)
CX2	Max. current for torque direction M2 (absolute value) (observe the normalization!)	(Default: 0.1)
IM1	Torque direction M1 operational ⇒ “+” = CX1 is used.	SOL.Q01 → CAV.IM1
IM2	Torque direction M2 operational ⇒ “-“ = CX2 is used.	SOL.Q02 → CAV.IM2
ACI	Handshake from the EMF block	EMF.ACO → CAV.ACI
——		
YC	Current actual value (with sign)	CAV.YC → CPI.XC → SOL.XC → EMF.XC (Default: 0.0)

CAV.	Significance	Value\connection
YFI	Frequency [kHz] of the V/f conversion of the current actual value (uncorrected value)	(Default: 0.0)
YFO	Offset actual value [kHz] YFO = YFI - 60[kHz] - XFO When the closed-loop thyristor current control is switched-out (I=0), the frequency at YFO corresponds to the offset error of the V/f converter in the Sitor. The output only indicates values up to 10% of the system current.	(Default: 0.0)
YAU	Limit of the current-dependent inverter stability limit [°] is used, in conjunction: Interdependencies: Value > 0, if XF2 > 0	(Default: 0.0) CAV.YAU → CPI.CLU → PC6.AWS
TCC	Internal measuring time of the current actual value conversion [ms]	(Default: 0 ms)
ACO	Handshake for PC6 block	CAV.ACO → PC6.ACI (Default: 0)
QSF	Fault	CAV.QSF → SOL.QSC (Default: 16#0000)

Table 5-7 I/O CAV

5.2.5 CSP, current setpoint calculation

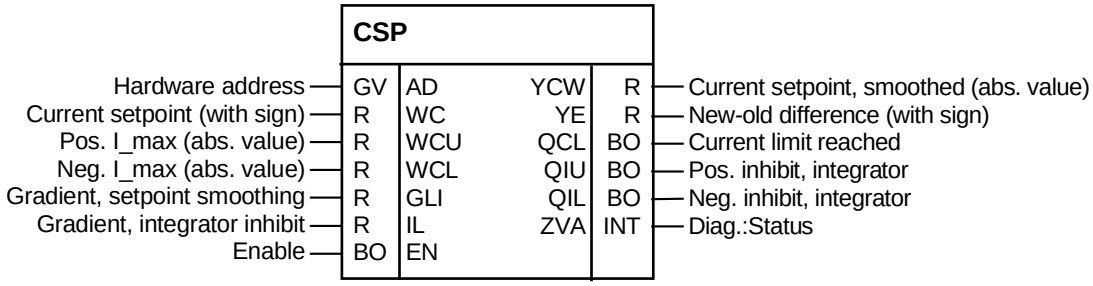


Fig. 5-16 CSP represented in the CFC

Setpoint smoothing

The current setpoint (SOL.YWC) is limited to the absolute value of the current limits CSP.WCU and CSP.WCL.
To smooth the setpoint, the difference between setpoint CSP.WC and the CSP.YCW current setpoint, output in the previous cycle, is formed and is output at CSP.YE.

The difference, compared with parameter GLI, decides the change of output YCW
If the difference > GLI, then the value of GLI is output.
If the difference < GLI, but, > GLI/2, this is limited to GLI/2.
If the difference <GLI/2, this is transferred without any correction.
The result is added to output YCW with the correct sign.
The absolute value of the smoothed and limited current setpoint is output at CSP.YCW.

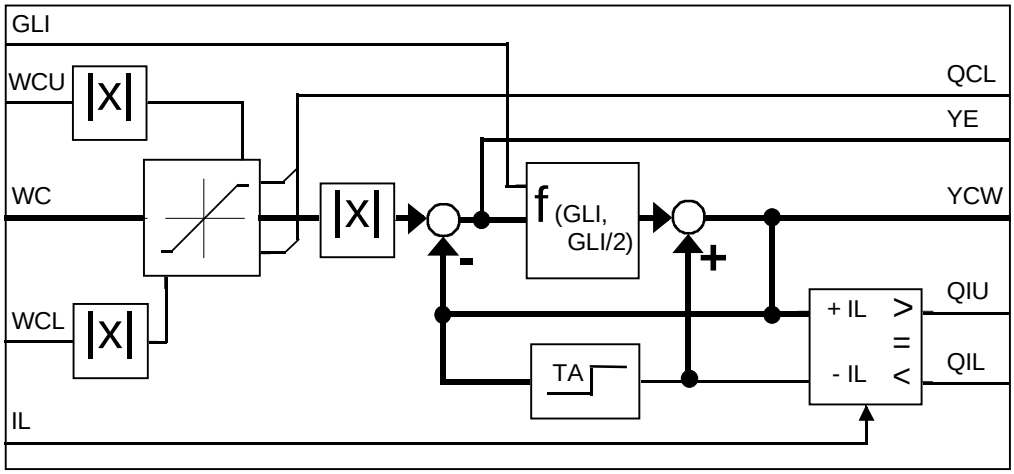


Fig. 5-17 Function chart CSP

If the difference > +IL or < -IL, the integrator component of the current signal is inhibited in the particular direction with signals QIU or QIL.

Setpoint smoothing with setpoint step WC

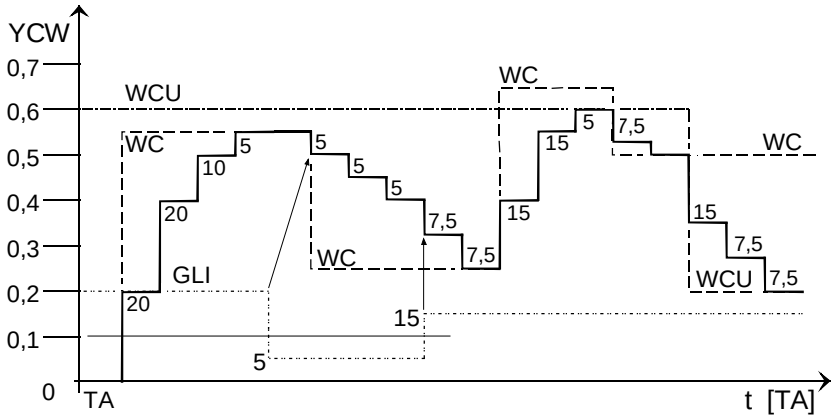


Fig. 5-18 Setpoint smoothing with steps in the setpoint

I/O

CSP.	Significance	Value\connection
AD	Hardware address	
WC	Current setpoint (with sign)	SOL.YWC → CSP.WC (Default: 0.0)
WCU	Positive current limit (absolute value)	(Default: 1.0)
WCL	Negative current limit (absolute value)	(Default: 1.0)

CSP.	Significance	Value\connection
GLI	Gradient for the setpoint smoothing The actual value from WC is used for the calculation.	(Default: 0.6)
IL	Gradient for the integrator inhibit	(Default: 0.6)
EN	Enable	SOL.QCS → CSP.EN (Default: 1)
——		
YCW	Smoothed current setpoint (absolute value)	CSP.YCW → CPI.WC CSP.YCW → CPC.WC
YE	Difference: WC – YCW (with sign)	
QCL	Pos. or neg. current limit reached	
QIU	Integrator inhibit of the CPI, positive values	CSP.QIU → CPI.ILU
QIL	Integrator inhibit of the CPI, negative values	CSP.QIL → CPI.ILL
ZVA	Diagnostics: Status	

Table 5-8 I/O CSP

5.2.6 CPC, current pre-control

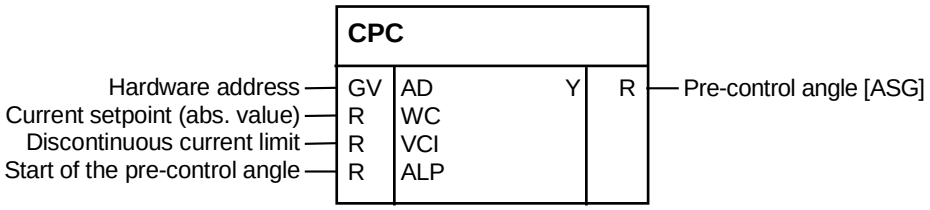


Fig. 5-19 CSP represented in the CFC

Function

The function block FB CPC (Current Pre-Control) calculates a pre-control angle for the discontinuous current range from the current setpoint.

The control loop has a different behavior in the discontinuous range than outside this range. In the discontinuous range, characteristic Vd / Id no longer has a linear relationship. The current controller is optimized for the continuous current range. This means that either the controller has to be adapted, or the firing angle must be pre-controlled corresponding to the current setpoint.

The FB calculates a pre-control angle according to the following formula:

$$Y = \mathrm{ALP}\left(\frac{1-\frac{2}{\pi}*\arcsin\left(1-\frac{WC}{4*VCI*NFI}\right)}{1-\frac{2}{\pi}*\arcsin\left(1-\frac{1}{4}\right)}-1\right)$$

NFI = internal current normalization FB – CAV

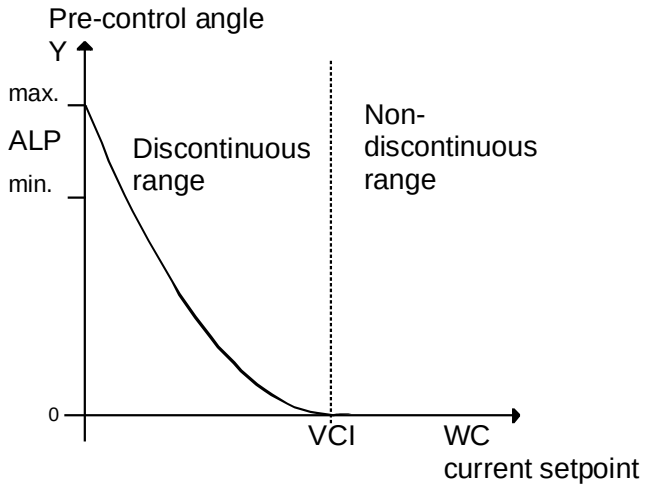


Fig. 5-20 Characteristic of the current pre-control

Note

The output CPC.Y must go to zero at the discontinuous limit (PA6.YIT<1), as otherwise the pre-control and the controller would oppose each other. This could result in current spikes. The value at CPC.VCI must correspond to the current setpoint at the end of the discontinuous range.

I/O

	Significance	Value\connection
AD	Hardware address	
WC	Current setpoint (absolute value)	CSP.YCW → CPC.WC
VCI	Current setpoint at the discontinuous limit, normalized to the motor current CAV.ARC (The discontinuous limit should be determined using PA6.YIT.) This function is switched-out with the value = 0.	(Default: 0.1) {0 < VCI < discontinuous limit}
ALP	Pre-control angle in the discontinuous range [°], start when the current starts to flow	(Default: 25.0) {≥25°…30°≤}
Y	Pre-control angle in the discontinuous range [ASG]	CPC.Y → CPI.CPC

Table 5-9 I/O CPC

5.2.7 CPI, current controller

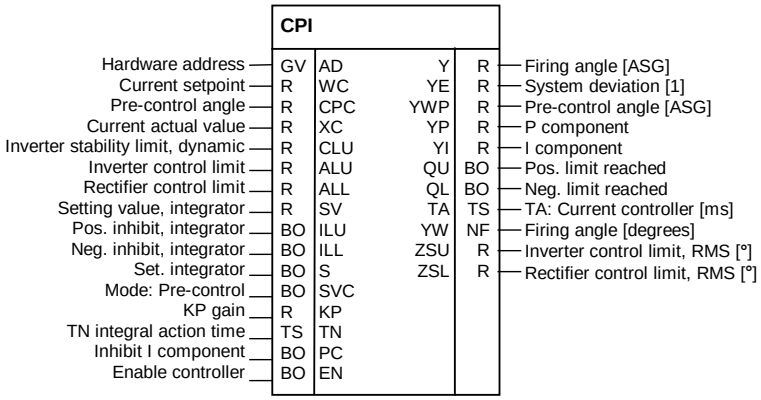


Fig. 5-21 Representation of CPI in the CFC

Function

The function block FB CPI (Current PI Controller) implements a PI controller with a pre-control and setting input.
The current controller only uses the absolute value of the current setpoint.
The I component of the controller can be permanently disabled using CPI.PC=1.

For large setpoint changes, the integrator can be briefly held using CPI.ILL or CPI.ILU. This prevents the integrator integrating out of control. The inputs only limit the values in “their direction”.

The firing angle limits are entered at CPI.ALL and CPI.ALU as well as at a higher-level at the firing angle controller PC6.LDU and PC6.LDL.

Comment

Internally, the integrator is not limited by the control limits CPI.ALU or CPI.ALL. The integrator value runs up to the format limit (R=+-3,4e38)!

Set I component

The controller integrator is loaded with the value at input CPI.SV as long as the input CPI.S is set to 1.
When the torque direction reverses, the integrator is set by the switch-over logic stage (SOL.QCS) with the calculated *EMF* actual value and output at CPI.YI.

The controller integral component is still limited to this EMF angle CPI.SVC=1.

For analog control systems, this limit replaces the usual pulse inhibit or wobbling at low current actual values.

Pre-control angle

The *EMF* actual value, conditioned and normalized by FB SOL is available at setting input CPI.SV. The integrator is set during changeover with the control command from SOL.QCS at input CPI.S.

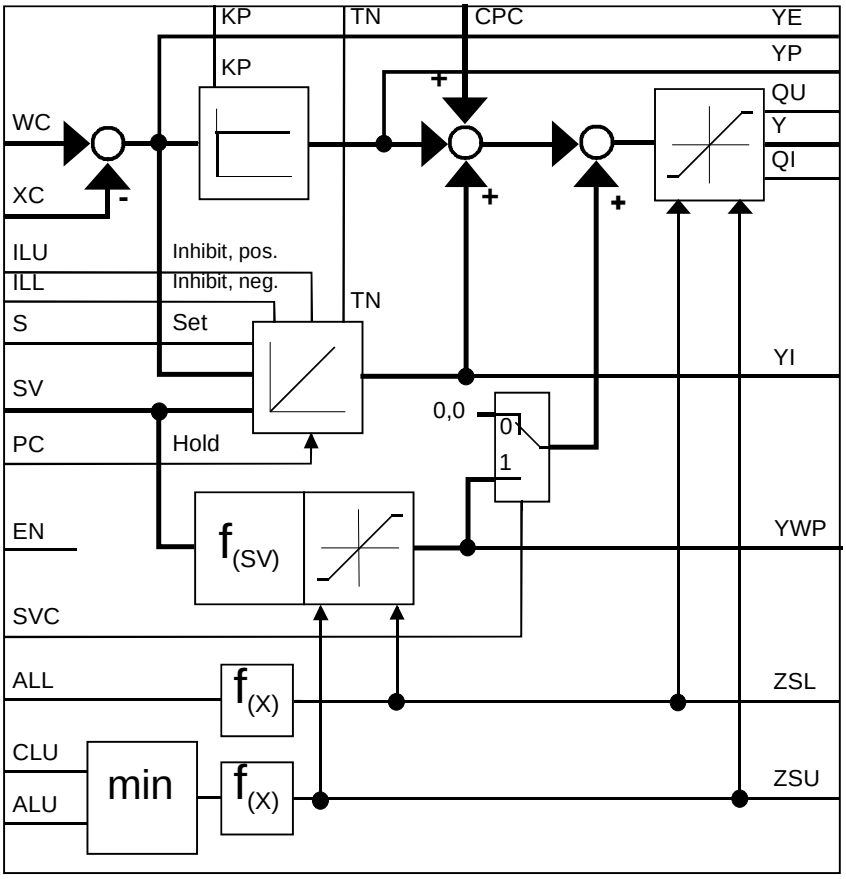


Fig. 5-22 Function chart CPI

EN = enable controller			X = irrelevant
	S = setting the integrator with the setting value		
		SVC = pre-control mode	
0	X	X	Controller inhibit Outputs Y,YE,YWP,YP,YI are set to 0
1	0	0	Normal function Y = YP + YI
1	0	1	With continuous tracking (correction) Y = YP + YWP , YI = 0
1	1	0	Setting mode Y = YP + YI , YI = SV
1	1	1	Setting mode with continuous tracking Y = YP + YI + YWP , YI = SV

Table 5-10 Behavior of the control inputs

Tracking

When selecting the mode “Pre-control and continuous tracking” CPI.SVC=1, the current controller converts this actual value into a pre-control angle CPI.YWP = “EMF angle” and this is added to controller output CPI.Y.

The pre-control angle CPI.YWP is limited to the effective limits CPI.ZSU and ZSL.

$$YWP = f_{(SV)} = \frac{2}{\pi} * \arcsin(SV) \Rightarrow -1 \leq SV \geq 1$$

$$= +1 \qquad \Rightarrow \text{if } SV > +1$$

$$= -1 \qquad \Rightarrow \text{if } SV < -1$$

The actual value of the EMF sensing FB EMF must be calibrated as precisely as possible. The EMF has a deadtime.
The continuous tracking is only possible with separate sensing due to the average value generation of the current sensing in the Sitor.

Dynamic inverter control limit

Input CPI.CLU allows the current-dependent limiting of the inverter control limit to be additionally influenced.

The function of the dynamic inverter stability limit is programmed in FB CAV and requires the connection (CAV.YAU → CPI.CLU)

The lower value of CPI.ALU and CPI.CLU acts as limiting for the inverter control limit and is the dynamic effective control limit, output at CPI.ZSU.

I/O

CPI.	Significance	Value\connection
AD	Hardware address	
WC	Current setpoint (absolute value)	CSP.YCW → CPI.WC
CPC	Pre-control angle in the discontinuous range	CPC.Y → CPI.CPC (Default: -0.333333 = 30[ASG])
XC	Current actual value (with sign)	CAV.YC → CPI.XC
CLU	Limit of the current-dependent inverter stability limit [°], if this function is not required, CLU=ALU should be set to 150 [°].	CAV.YAU → CPI.CLU (Default: 150.0)
ALU	Inverter control limit of the firing angle [°] the minimum of CLU and ALU is used	(Initialization connection/ default: 150.0)
ALL	Rectifier control limit of the firing angle [°]	(Initialization connection/ default: 30.0)
SV	Setting value for torque reversal or continuous tracking (only active for S = 1) (SV corresponds to the torque reversal of the motor EMF)	SOL.YSV → CPI.SV {>-1…+1<}
ILU	Integrator inhibit, positive direction	CSP.QIU → CPI.ILU (Default: 0)
ILL	Integrator inhibit, negative direction	CSP.QIL → CPI.ILL (Default: 0)
S	Sets the integrator with the value SV	SOL.QCS → CPI.S
SVC	Mode: Pre-control of the CPI	(Default: 0)
KP	Proportional gain [1]	(Default: 0.01)
TN	Integral action time [ms]	(Default: 10000 ms)
PC	Inhibits integrator component (with PC=1 ⇒ integrator is deleted)	(Default: 0)
EN	Controller enable (with EN=0, all Yxx are immediately set to zero)	SOL.QCE → CPI.EN
———		
Y	Firing angle [ASG]	CPI.Y → PC6.WAS (Default: 0.0)
YE	System deviation YE = WC – XC	(Default: 0.0)
YWP	Pre-control angle [ASG]	(Default: 0.0)
YP	P component	(Default: 0.0)
YI	I component	(Default: 0.0)
QU	Controller at its positive limit (M1)	(Default: 0)
QL	Controller at its negative limit (M2)	(Default: 0)
TA	Sampling time: Current controller (configured)	(Default: 0 ms)
YW	Firing angle [°] (same as Y, only in another format)	(Default: 0.0)
ZSU	Inverter control limit, effective [°] (internally used limit f (ALU,CLU) is displayed)	(Default: 0.0)
ZSL	Rectifier control limit, effective [°] (ALL limit is displayed)	(Default: 0.0)

Table 5-11 I/O CPI

5.2.8 PC6, firing angle controller

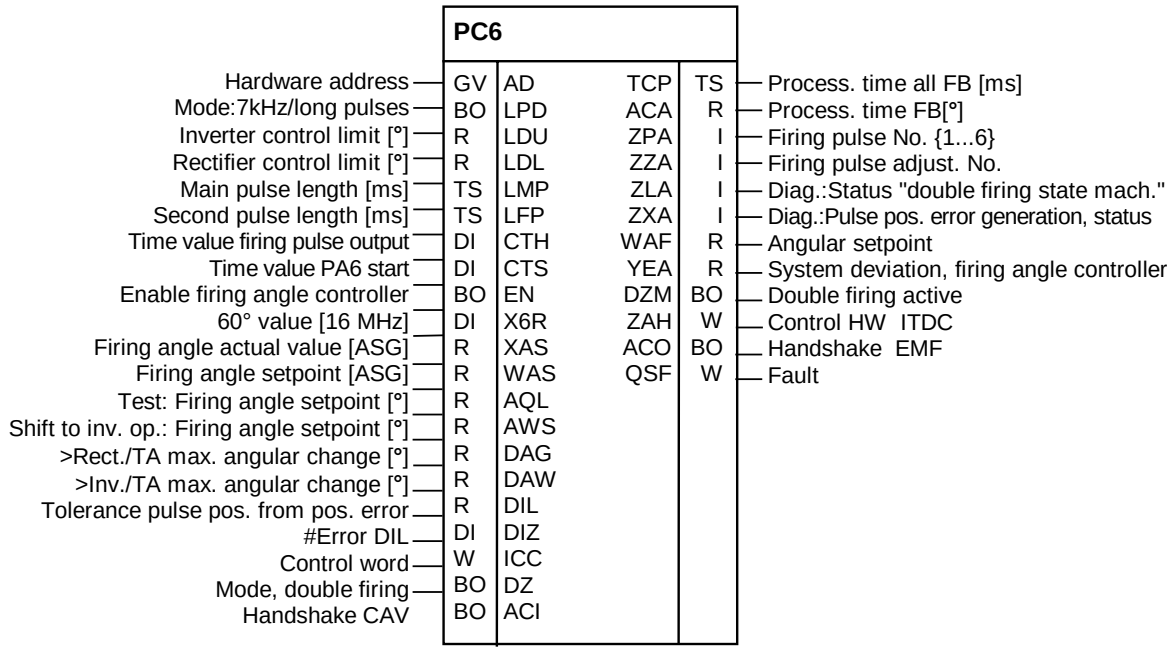


Fig. 5-23 PC6 represented in the CFC

Function

The PC6 function block (Pulse Controller 6-pulse) is used to implement a "Dead-beat" controller and the firing pulse generation for a 6-pulse line-commutated converter for a fully-controlled bridge B6C or two fully-controlled bridges in a circulating-current free, anti-parallel circuit configuration B6(A)B6(C).

Various firing angle setpoints are used, depending on the operating mode, entered from the switch-over logic stage.

- Closed-loop controlled operation (SOL.ISE = 0)
- Shift to inverter operation (SOL.QPI = 1)
- Open-loop controlled operation (SOL.ISE = 1 $\hat{=}$ test operation)

The firing pulses for the thyristors of the SITOR set are generated on the ITDC according to the specifications of FB PC6.
The firing pulses are output as 7[kHz] pulse chains (standard) or as long pulses.

FB PC6 is always calculated as the last block in an interrupt task in synchronism with the firing pulses.

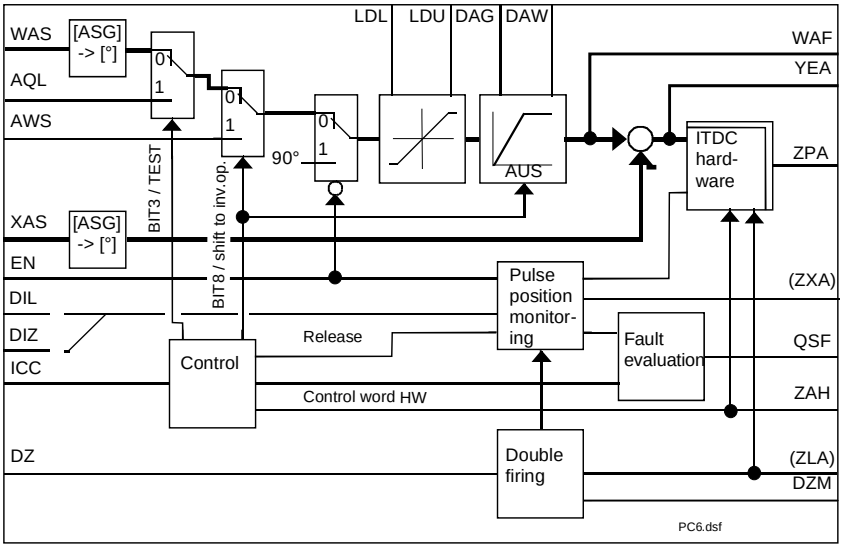


Fig. 5-24 Function diagram of PC6

It is possible to evaluate the accuracy of the gating unit by monitoring the pulse positions (this can be parameterized).

Firing angle setpoint

The firing angle setpoint is switched-over from the switch-over logic stage (command word SOL.QCC → PC6.ICC).
Corresponding to the selected mode, the inputs
PC6.WAS (closed-loop controlled operation)
PC6.AQL (test operation, open-loop controlled)
PC6.AWS (shift to inverter operation)
are used as manipulated variable to generate the firing pulses.

In the “Closed-loop/open-loop controlled operation” modes, the firing angle setpoints are fed through a ramp-function generator.
Separate change time constants are entered in the form of gradients for the two directions. The gradients PC6.DAG specify the max. angular change / sampling cycle ([°] / [TA]) in the direction of rectifier operation, PC6.DAW the max. angular change / sampling cycle towards inverter operation.

The ramp-function generator is de-activated in the “Shift to inverter operation” mode.

Control limits for the rectifier and inverter

The absolute limiting of the control limits are always active using parameters
PC6.LDU (inverter control limit) and
PC6.LDL (rectifier control limit)!

The limits, configured at current controller FB CPI.ALU, .ALL only act, if they have lower values than those at the absolute limits at FB PC6.

Pulse position monitoring

During operation the pulse position monitoring checks the difference between the firing angle setpoint and the actual value.
If the absolute value of the deviation exceeds the limit [°], entered at input PC6.DIL, the counter is incremented at each calculation. If the counter status reaches the value at PC6.DIZ, the difference was too high and directly initiates a hardware pulse inhibit and a fault message.

Synchronizing

A line supply frequency change is mapped in the internal counter values on the ITDC and is immediately taken into account, after transfer, in the firing angle actual value PC6.XAS and in the 60° value of the line supply periods PC6.X6R (refer to the Section: Synchronization and pulse generation).

The counter status "60° of the line supply periods" is used to shift the firing pulses.

Pulse waveform

The firing pulse waveform should be selected using input PC6.LPD and internally changes-over the ITDC. The “7 kHz pulse chain” waveform (PC6.LDP = 0) is selected as default, as the thyristor gating in the Sitor sets is only designed for pulse chains. If long pulses are output to a Sitor, this destroys the gating!
Long pulses should only be set for special thyristor gating circuits.

The length of the main pulse should be parameterized at input PC6.LMP (1.1 [ms]) and the second pulse at input PC6.LFP (1.1 [ms]). The pulse length may not exceed 45[°el], and must be adapted to the line frequency. We recommend that the length data are kept the same..

Double firing

Operation: Double firing results in a special status of the closed-loop thyristor current control and is selected using the command PC6.DZ = 1. For fault-free operation, output PC6.DZM should be set to 1. When activated at SOL.DZM, the output voltage goes to zero and a free-wheeling branch is therefore enabled. The first firing pulse following the enable is continuously output with the associated firing pulse of the same phase. This means that the DC circuit is de-coupled from the line supply (refer to Section: Definitions).

Note

The double firing command is directly executed. It can be switched-in at any time in rectifier operation; this is not possible in inverter operation. The command can be withdrawn at any time.

After the double firing has been de-activated, the firing pulses are generated again in synchronism with the line supply.
The current controller and therefore the firing angle setpoint are tracked (corrected) by the switch-over logic stage during double firing operation.

Enable

If the controller or pulses have not been enabled (EN=0), the setpoint (WAF) is pre-assigned the constant firing angle of 90°.

I/O

PC6.	Significance	Value\connection
AD	Hardware address	
LDP	Selects the firing pulse waveform: LDP = 0: 7kHz pulse chains, LDP = 1: Long pulses 7kHz is required for all Sitor converters.	(Initialization connection/ default: 0)
LDU	Absolute inverter (INV) control limit [°] Condition: 90 ≤ PC6.LDU ≤ 180, otherwise, QSF\bit 9 =1 (180° is a theoretical value. The free-wheeling, pulse cancellation time and the overlapping due to the commutation must be taken into account.)	(Initialization connection/ default: 150)
LDL	Absolute rectifier (RECT.) control limit [°] Condition: 0 ≤ PC6.LDL ≤ 90, otherwise, QSF\bit 9 = 1 (The limit should lie symmetrically around 90° to the inverter control limit.)	(Initialization connection/ default: 30)
LMP	Main pulse length [ms] Conversion into degrees according the line frequency f: LMP [°] = LMP [ms] * f [Hz] * 10^{-3} * 360[°] ⇒ LMP ≥ 0.05ms If the configured value is lower, LMP is limited to 50 µs.	(Default: 1.1ms) { < 45[°] el. }
LFP	Second pulse length [ms] We recommend that the value = LMP should be kept. (handled according to connection LMP)	(Default: 1.1ms) { < 45[°] el. }
CTH	Firing pulse output, time value (the value changes in each cycle)	PA6.CTH → PC6.CTH
CTS	Time value at the start of FB-PA6 (the value changes in each cycle)	PA6.CTS → PC6.CTS
EN	Firing angle controller enable is realized, if Vsyn. and line supply = ok	PA6.RDY → PC6.EN
X6R	Numerical value ≙ 60° of the line supply period [16 MHz] (50 Hz ≙ 320000[1])	PA6.Y6R → PC6.X6R { 2^{21} }
XAS	Firing angle actual value [ASG]	PA6.XAS → PC6.XAS {-1...0...+1}
WAS	Firing angle setpoint [ASG]	CPI.Y → PC6.WAS
AQL	Test operation: Firing angle setpoint [°] Input limited with LDL ≤ AQL ≤ LDU The transferred firing angle is directly executed! Enter small changes in order to avoid overcurrents.	(Default: 150)
AWS	Shift to INV operation: Firing angle setpoint [°] This angle becomes setpoint with signal SOL.QPI. The current controller is disabled. Condition: 90 ≤ AWS ≤ 180, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 150)
DAG	Max. angular change/sampling cycle in the direction of rectifier operation Condition: 0 ≤ PC6.DAG ≤ 180, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 60)
DAW	Max. angular change/sampling cycle in the direction of inverter operation Condition: 0 ≤ PC6.DAW ≤ 180, otherwise, QSF\bit 9 = 1	(Initialization connection/ default: 150)

PC6.	Significance	Value\connection
DIL	Pulse position tolerance [°] Limit for the setpoint-actual value difference of the firing angle.	(Default: 1.0)
DIZ	Number of permissible continuous limit violations, DIL	(Default: 3)
ICC	Control word (assignment, refer below)	SOL.QCC → PC6.ICC
DZ	Operation: Double firing For DZ=1, a firing pulse pair of a phase is constantly output in the constellation 1-4, 2-5, 3-6 or 4-1, 5-2, 6-3.	(Default: 0)
ACI	Handshake from the CAV block	CAV.ACO → PC6.ACI
———		
TCP	Processing time of all FBs [ms]	(Default: 0 ms)
ACA	Processing time in [°] (incl. 100 μs safety tolerance)	(Default: 0.0)
ZPA	Number of the firing pulse	PC6.ZPA → PA6.ZPA (Default: 0)
ZZA	Diag.: Firing pulse adjustment number (indicates the change of the number, only for changes > 60°.)	(Default: 0) {-3...0...+4}
ZLA	Diag.: Status "Double firing state machine"	(Default: 0)
ZXA	Diag.: Status "Pulse position fault generation"	(Default: 0)
WAF	Firing angle setpoint α [°] (max. changes/TA are limited by DAG or DAW.)	(Default: 0.0)
YEA	System deviation, firing angle controller	(Default: 0.0)
DZM	Operation: Double firing active	PC6.DZM → SOL.DZM (Default: 0)
ZAH	Control word, hardware (assignment, refer below)	(Default: 16#0000)
ACO	Handshake for EMF block	PC6.ACO → EMF.ACI (Default: 0)
QSF	Fault word	PC6.QSF → SOL.QSP (Default: 16#0000)

Fig. 5-25 I/O PC6

Control word, hardware (ZAH)

Displays the control of the hardware register on the ITDC module

ZAH	Signal/message
Bit 1	Torque direction M1 enabled
Bit 2	Torque direction M2 enabled
Bit 3	Second pulses enabled
Bit 4	Operation: Double firing enabled
Bit 5	Pulse inhibit for undervoltage (refer to selection, SOL.UNM)
Bit 6	Pulse chains activated
Bit 7	Logical 0
Bit 8	Int./ext. synchronizing voltage (0/1), (relay changeover of the inputs)
Bit 9-16	Logical 0

Table 5-12 Control word, hardware (ZAH)

5.2.9 FCS, field current setpoint output

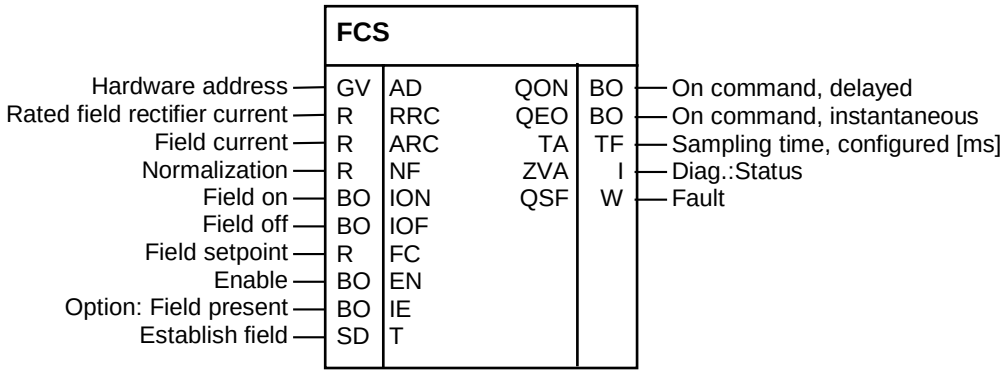


Fig. 5-26 FCS represented in CFC

Function

The function block FB FCS (Field Current Setpoint) is used to enter the field current setpoint for the excitation option and implements the sequence control to switch-in and switch-out the motor excitation and the closed-loop current control as well as a fault logic.

The switch-over logic stage to the system software is moved from FB SOL to FB FCS in order to take into account field built-up in the control.

The optional field device for the Sitor set is a single-phase "half-controlled" rectifier (B2HKFU) and requires a field current setpoint PC6.FC ≥ 0. Negative values are set to zero and result in a configuring error.

If a configuring error is detected, the outputs FCS.QON \ .QEO and the field current setpoint are set to zero.

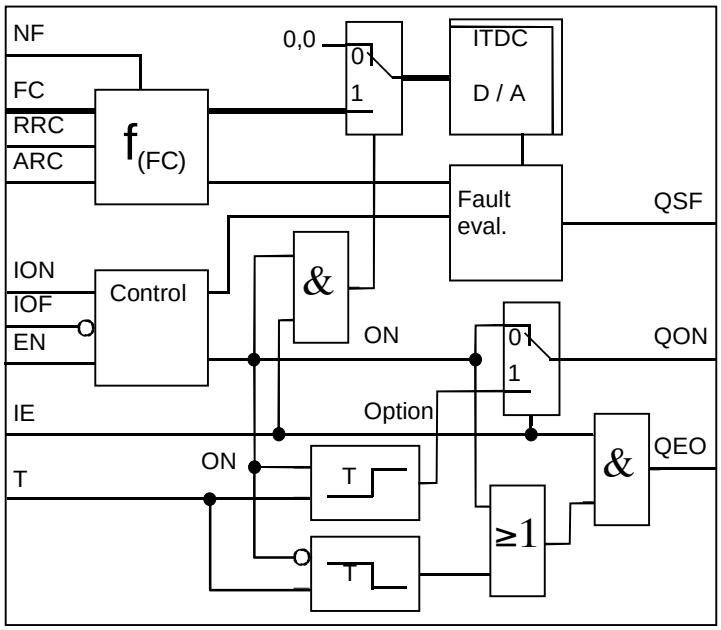


Fig. 5-27 Function chart FCS

Switching-in and switching-out the excitation

The behavior of the control is switched-over with the selection “Option: Field device” (FCS.IE = 1).
The delay time FCS.T runs when switching-in and switching-out.

- FCS.EN generally enables the function block.
  As soon as the input is reset, the excitation is reduced and the outputs QON, QEO and the excitation current fault (FCS.QSF) are set to 0.

- FCS.ION “Switch-in command” (FCS.ION=1, .IOF=0, .IE=1)
  Outputs the field current setpoint FCS.FC at the D/A converter and therefore switches-in the field. At the same time, output QEO is set. After time FCS.T has expired, after the field has been established, the switch-over logic stage FB SOL is switched-in with FCS.QON.
  The evaluation of the fault signal “Field current < 3%” is also activated with a delay of this time. If the signal is still present, then there is a fault in the motor excitation and operation is inhibited.

- FCS.IOF “Switch-out” (IOF=1)
  With IOF=1, the switch-in command is withdrawn at FCS.QON and the field and output FCS.QEO are switched-out, delayed by the time.

Diagram FCS

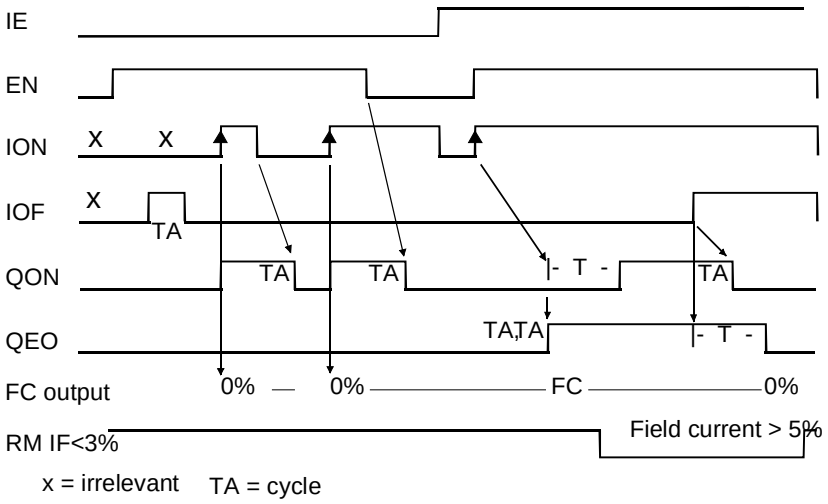


Fig. 5-28 Diagram, FCS control

The setpoint available at input FCS.FC is written to the analog output on the ITDC. The output voltage Va of the D/A converter is obtained according to the following algorithm:

$$V_a = 10[\,\mathrm{V}\,] * \frac{\mathrm{FC} * ARC}{NF * RRC}$$, D/A converter resolution (12 bit) = $\frac{\mathrm{RRC}}{4096}$

FCS.IE = 0 can be used during the commissioning phase to switch-out the field current setpoint.

NOTE

When configuring the FCS block, analog output 2 is switched-over from ITDC-X5 to the Sitor interface.
Channel 2 is no longer available for additional configuring purposes!

I/O

FCS.	Significance	Value\connection
AD	Hardware address	
RRC	Rated field current - rectifier [A] Condition: RRC ≥ ARC ≠ 0, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
ARC	Rated field excitation current of the DC motor [A] Condition: RRC ≥ ARC ≠ 0, otherwise, QSF\bit 12 = 1	(Initialization connection/ default: 0.0)
NF	Normalization factor to interpret the setpoint NF= 1 (FC=1 [1] $\hat{=}$ rated excitation current =ARC) NF=ARC (FC=ARC [A] $\hat{=}$ rated excitation current =ARC)	(Initialization connection/ default: 1.0)
ION	On command, field current a positive edges switches through the field setpoint, if IE and EN = 1 and IOF = 0	(Default: 0)
IOF	Switches-out the field setpoint output after time T and resets QON	(Default: 0)
FC	Field current setpoint is output at analog output 2 Observe the normalization! Condition: FC ≥ 0, otherwise, QSF\bit 12 = 1	(Default: 0)
EN	Enables inputs ION, IOF With EN=1 and IE=1, the current setpoint input is enabled. With EN=0, the field is reduced, as for ION=1	(Default: 0)
IE	Option: Field present If IE = 0, setpoint = 0 [V] is permanently output. A switch-on command ION=1 ⇒ QON=1, instantaneously	(Default: 0)
T	Delay time when switching-in and when switching-out, if the option IE=1 is acknowledged. QON is output, delayed by time T. This means that the switch-over logic stage is only switched-in when the field has been established. QEO is only reset after time T when switching-out. Condition: 0 ≤ T ≤ 100000 ms, otherwise, QSF\bit 12 = 1.	(Initialization connection/ default: 1500 ms)
———		
QON	Outputs the on command ION=1, for IE=1, QON is set, delayed by time T QON is reset 1 cycle after the switch-out command (ION=0 or IOF=1).	FCS.QON → SOL.ION (Default: 0)
QEO	Setpoint output checkback signal (only for IE=1) The output is only reset after time T has expired.	(Default: 0)
TA	Diagnostics: Configured sampling time	(Default: 0 ms)
ZVA	Diagnostics: Status "Field state machine"	(Default: 0)
QSF	Fault	FCS.QSF → SOL.QSS (Default: 16#0000)

Fig. 5-29 I/O FCS

5.3 Commissioning

WARNING

Only start the commissioning phase if effective measures have been made to ensure that the plant or drive is safely and reliably stopped, both electrically and mechanically, and cannot be started.

Ensure that all of the safety and EMERGENCY OFF monitoring functions are connected and are fully effective so that the drive can be safely shut down at any time.

Measuring equipment required

For commissioning, measuring equipment and a PC with system software S7 + CFC + D7Sys and the configured software are required.

- A two-channel storage oscilloscope with probes 1:10 or 1:100 are used for the measurements.
- A clip-on ammeter to check the field current and to plot the armature current if the current actual value in the Sitor converter is not available at the test socket.
- An oscilloscope can be used instead of a rotating field detector.

5.3.1 Preparatory work

WARNINGS

- The pulses are only enabled with a voltage > 15 V at pin ITDC-X5:10. The voltage at pin ITDC-X5: 7 can be used for this purpose. An open-circuit input at pin 10 is interpreted as "External pulse inhibit" and causes the pulses to be shutdown immediately on the hardware side.
- Before powering-up for the first time, the electronics and power connections of the Sitor drive converter must be checked to ensure that the rotating fields are all clockwise.
- The electronics and power connections must have the same phase relationships to one another.

Note

During the current controller optimization phase, the excitation must be switched-out and the rotor must be firmly locked so that it cannot rotate!

Comment

A circuit to enter step sequences has to be programmed for test purposes during the commissioning phase. This reduces the stressing on the stationary motor commutator during the current optimization routine.

The D/A converter on the ITDC should be configured to display internal values on an oscilloscope.

To optimize the current controller, the setpoint of the higher-level speed controller should be de-coupled using a switch, or the connection should be deleted.

5.3.2 Entering the characteristic system quantities

The characteristic system quantities have been entered when configuring the system and have to be checked when commissioning the system.

After the initialization parameter changes have been entered, the processors should be reset with a restart at the subrack or using the CFC online function (Target system\operating status - restart).

System parameters

Connec-tion	Significance	Value	Value change	Type
EMF.RRV	Rated Sitor voltage of the sensing [V]. Condition: RRV ≥ ARV, > QSF\bit 14 = 1	0.0		Init
EMF.ARV	Rated system / motor voltage [V] Condition: RRV ≥ ARV ≠ 0, > QSF\bit 14 = 1	0.0		Init
EMF.NF	Normalization of the voltage actual value at YUA	1.0		Init
EMF.AAV	Line supply voltage [V]. Condition: AAV ≤ · ARV $\frac{\sqrt{2} * \pi}{3}$, >QSF\bit 14 = 1	(0.0)		
EMF.XFO	Offset frequency of the V/f converter [kHz] Condition: -6 kHz ≤XFO≤ 6 kHz, > QSF\bit 14 = 1	0.0		Init
EMF.RA	Normalized armature resistance	0.0		
EMF.TA	Armature time constant [ms]	0 ms		
EMF.T	Smoothing time for YEV value (the smoothing is disabled with T=0)	20 ms		
CAV.RRC	Rated SITOR set DC current [A] Condition: RRC ≥ ARC , > QSF\bit 12 = 1	0.0		Init
CAV.ARC	Rated system / motor current [A] Condition: RRC ≥ ARC ≠ 0 , > QSF\bit 12 = 1	0.0		Init
CAV.NF	Normalization of the current actual value at YC Condition: NF > 0 ,	1.0		Init
CAV.XFO	Offset adjustment [kHz] {≥-6.0…+6.0≤}	0.0		Init
PA6.XDA	Offset angle { -180°…+180° }	0.0		
PA6.NAZ	No. of failed line supply periods Condition: 0 ≤ NAZ ≤ 3050, > QSF\bit 9 = 1	8		Init
PA6.FNT	Line supply frequency [Hz] for start of synchronization Condition: 6 ≤ FNT ≤ 600, > QSF\bit 9 = 1	50		Init
CPI.KP	Proportional gain [1]	0.01		
CPI.TN	Integral action time [ms]	10000 ms		
FCS.RRC	Rated current of the field current rectifier [A] Condition: RRC ≥ ARC ≠ 0, > QSF\bit 12 = 1	0.0		Init

Connec-tion	Significance	Value	Value change	Type
FCS.ARC	Rated DC motor field current [A] Condition: RRC ≥ ARC ≠ 0, > QSF\bit 12 = 1	0.0		Init
FCS.NF	Normalization factor to interpret the setpoint	1.0		Init
FCS.T	Delay when switching-in and switching-out Condition: 0 ≤ T ≤ 100000 ms, > QSF\bit 12 = 1.	1500 ms		Init
SOL.WCL	Switch-in threshold for the torque direction (absolute value)	0.01		
SOL.TH0	Thyristor hold-off time [ms] Condition: 0.5 ms ≤ TH0 ≤ 131 ms, > YW2\bit 10 =1	10 ms		Init
SOL.TCP	Thyristor pulse suppression time [ms] Condition: 0.0 ms ≤ TH0 ≤ 20000 ms , > YW2\bit10 =1	20 ms		Init
SOL.TCD	Monitoring time, torque change M1 ⇔ M2	1000 ms		
SOL.TM0	Monitoring time, torque direction M0	2000ms		
PC6.LMP	Main pulse length [ms] { < 45[°] el. }	1.1ms		
PC6.LFP	Second pulse length [ms] { < 45[°] el. }	1.1ms		
PC6.AQL	Test operation: Firing angle setpoint [°]	150		
PC6.AWS	Shift to INV. op.: Firing angle setpoint [°] Condition: 90 ≤ AWS ≤ 180, > QSF\bit 9 = 1	150		
PC6.DAG	Max. angular change/TA in the direction of rectifier op. Condition: 0 ≤ DAG ≤ 180, > QSF\bit 9 = 1	60		
PC6.DAW	Max. angular change/TA in the direction of inverter op. Condition: 0 ≤ DAW ≤ 180, > QSF\bit 9 = 1	150		
CPC.VCI	Current setpoint at the discontinuous limit, {0 < VCI < discontinuous limit}	0.1		
CPC.ALP	Pre-control angle in the discontinuous range [°], {≥25°…30°≤} starts when current starts to flow	25.0		
CSP.GLI	Gradient for setpoint smoothing	0.6		
CSP.IL	Gradient for integrator inhibit	0.6		

Limit values

Connec-tion	Significance	Value	Value change	Type
CAV.CX1	Max. current for torque direction M1 (abs. value)	0.1		
CAV.CX2	Max. current for torque direction M2 (abs. value)	0.1		
CPI.CLU	Limit of the current-dependent inverter stability limit [°]	150.0		
CPI.ALU	Inverter control limit of the firing angle [°]	150.0		Init
CPI.ALL	Rectifier control limit of the firing angle [°]	30.0		Init
PA6.NAZ	No. of failed line supply periods Condition: 0 ≤ NAZ ≤ 3050, > QSF\bit 9 = 1	8		Init
PA6.NEP	No. of line supply periods Condition: 0 ≤ NEP ≤ 5000, > QSF\bit 9 = 1	5		Init

Connec-tion	Significance	Value	Value change	Type
PC6.LDU	Absolute inverter (INV) control limit [°] Condition: 90 ≤ LDU ≤ 180, > QSF\bit 9 = 1	150		Init
PC6.LDL	Absolute rectifier (RECT) control limit [°] Condition: 0 ≤LDL ≤ 90, > QSF\bit 9 = 1	30		Init
PC6.DIL	Tolerance of the pulse position [°]	1.0		
PC6.DIZ	No. of permissible limit violations DIL	3		
CSP.WCU	Positive current limit (absolute value)	1.0		
CSP.WCL	Negative current limit (absolute value)	1.0		

Selection, parameters

Connec-tion	Significance	Value	Value change.	Type
PA6.SYX	Mode: Synchronizing voltage source	0		Init
PA6.NCM	Mode: Line supply handling { 0…4 , >4= 0 }	0		
PA6.FAM	For NCM=1: Refer to 4 For NCM=2: Average value generation { ≥1…<8 } For NCM=3: Decrease phase difference { ≥1…≤1000 } For NCM=4: Decrease phase step { ≥1…≤1000 }	0		
PA6.INV	Mode for rotating field detection	0		Init
PA6.FNT	Line supply frequency [Hz] for the start of synchronization Condition: 6 ≤ FNT ≤ 600, > QSF\bit 9 = 1	50		Init
SOL.UNM	Mode: Handling an undervoltage condition (Sitor)	2		
SOL.IEF	Mode: Use calculated EMF value (FB EMF present)	1		
SOL.NZM	Zero current signal from the SITOR set Y/N=0/1	0		
SOL.OF2	Off command, torque direction M2	0		
SOL.HMH	Enables the bits for the hardware signaling word YHW	16#FFFF		
SOL.HM1	Enables the bits for fault word YF1	16#FFFF		
SOL.HM2	Enables the bits for fault word YF2	16#FFFF		
SOL.HP1	Enables the bits from YF1 for immediate pulse inhibit	16#0020		
SOL.HP2	Enables the bits from YF2 for immediate pulse inhibit	16#0040		
CPI.SVC	Mode: Pre-control of the CPI	0		
PC6.LDP	Selects the firing pulse waveform: LDP = 0: 7kHz pulse chain, LDP = 1: long pulses.	0		Init

Options

Connec-tion	Significance	Value	Value change	Type
CAV.XF2	Current-dependent inverter stability limit [1] {≥0.0…0.2≤} Condition: 0.0 ≤ XF2 ≤ 0.2, > QSF\bit 12 = 1	0.0		Init
CAV.IAV	Correction for the inverter stability limit [1] {≥0.7…1.3≤} Condition: 0.7 ≤ IAV ≤ 1.3, > QSF\bit 12 = 1	1.0		Init
CAV.AL1	Positive correction of the current actual value sensing Condition: -0.1 ≤ AL1 ≤ 0.1, > QSF\bit 12 = 1	0.0		Init
CAV.AL2	Negative correction of the current actual value sensing Condition: -0.1 ≤ AL2 ≤ 0.1, > QSF\bit 12 = 1	0.0		Init
CPI.PC	Inhibit integrator component	0		
PC6.DZ	Mode: Double firing	0		
FCS.IE	Option: Field present	0		

5.3.3 Current sensing calibration

The following commissioning steps may only be carried-out when the system is stationary and the closed-loop control is disabled:

Procedure

Adjust (calibrate) the V/f converter frequency for the current actual value sensing:

- The closed-loop current control remains switched-out.
  → SOL.ION=0 or SOL.IOF=1
- The offset frequency [kHz] should be read at CAV.YFO = calibration value for CAV.XFO.
- The calibration value should be entered at CAV.XFO with the inverse polarity.
- The value becomes effective (Initialization mode) after a restart.
  The output CAV.YC must have a value which is approximately zero.

Note

The circuit for sensing and frequency conversion has an offset and drifts with temperature and time. This means that the offset must be checked again when the system is in a warm operational condition and after a longer operating time.

Correcting gain errors (optional)

In the software there is an option at FB CAV to correct a gain error of the current actual value sensing.
This adapts the normalization of the actual value.
The value for the correction in the software should be determined using a separate check of the sensing in the drive converter and is only required in special cases.
For a SITOR set (e.g. 6QG32x), a check always incurs some time.
The inputs CAV.AL1, .AL2 should be kept at the default value.

5.3.4 Voltage sensing calibration

The following commissioning steps may only be carried-out when the system is stationary and the closed-loop control is disabled.

Procedure

Calibrating the V/f converter frequency for the actual value sensing of the output voltage.

The closed-loop current control remains switched-out
→ SOL.ION=0 or SOL.IOF=1

- The offset frequency [kHz] should be read at EMF.YFO = calibration value for EMF.XFO.
- The calibration value should be entered with the inverse polarity at EMF.XFO = **-** EMF.YFO.
- The value becomes effective (Initialization mode) after a restart.
  The output EMF.YUA must have a value which is approximately zero.

5.3.5 Determining the offset angle

The offset angle should be determined if there is a clockwise rotating field at the electronics and power supply for the Sitor converter.

The offset angle to be specified corrects the phase shift between the natural firing instant of semiconductor device 1 and the zero crossover of the filtered synchronizing voltage on the ITDC.

Procedure

- The power to the drive converter should be disconnected.
  Open the armature circuit (!).
- Connect the phase voltage L1 (!) from the power connection AK1 of the SITOR set to channel 1 of the oscilloscope via the 1:100 probe
  Summed pulses at channel 2 (ITDC -X5:12)
  Connect the oscilloscope ground to the SIMADYN D ground
  (only use the ground from ITDC -X5: 14!)
- Enter firing angle PC6.AQL=150 [°],
  (this is normally set with the default value)
- Before the switch-on command, changeover to controlled test operation with SOL.ISE = 1
- Power-up the drive converter power supplies
- Enter a switch-on command from the higher-level control (SOL.ION=1) and either enter the current setpoint (SOL.WC1/2) > SOL.WCL > 0.0 or set with the on command for torque direction M1 (SOL.ON1).
- With a firing angle of 150°, the firing pulse from semiconductor device 1 must coincide with the zero crossover of voltage $V_{L1\text{-}MP}$.
  If this is not the case, the pulse position must be corrected using

parameter PA6.XDA.
e.g. PA6.XDA= 0.0 [°] ⇒ PA6.AVW = -30 [°]
PA6.XDA= +10.0 [°] ⇒ PA6.AVW = -20 [°]
Value range PA6.XDA {-180 [°] …+180 [°] }.

Pulse position for a correctly set offset angle

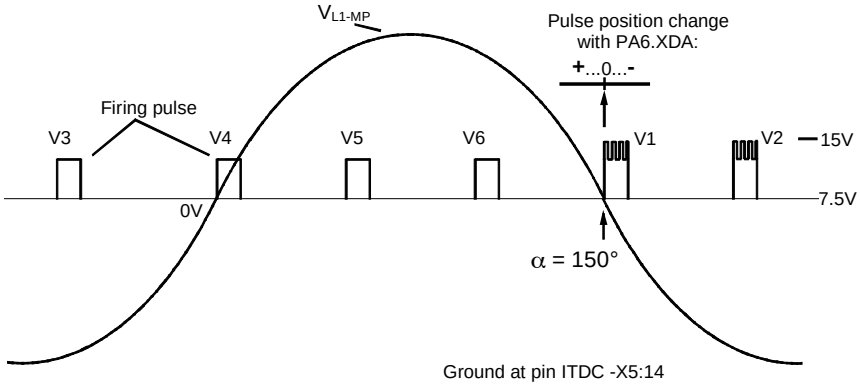


Fig. 5-30 Pulse position for a correctly set offset angle

- The correct firing pulse position must be checked after each correction and if required should be further changed. The position must be precise!
- Switch-off command (SOL.ION = 0) or (SOL.ON1 = 0)
- Switch-off the power to the Sitor set
- Remove the measuring cables for phase voltage L1 (!) and pulses.

5.3.6 Determining the armature time constant TA

The armature time constant TA is determined, in the open-loop controlled test mode using a “Current step” outside the discontinuous range.

The current actual value of the armature circuit should be plotted.

The SITOR set provides the current as voltage signal (I_{rated} = -10V) at test socket I_{act} (–A1: bottom right, M right-4th socket from the bottom) or at terminal–X15 :1 (:3 is ground).

The current can be connected to an oscilloscope channel using a clip-on ammeter or the internal value via the configured analog output.

Procedure

- The armature circuit should be closed again.
- The motor rotor should be mechanically locked, as the remanence field still generates a torque in the motor.
- Open the field circuit and inhibit the excitation! (FCS.IE=0).

Determining the discontinuous limit

- The discontinuous current limit should be determined.
  The test mode should be set-up and the firing angle α should be slowly reduced at PC6.AQL in the direction of rectifier operation. Depending on the system constellation, the current should exit the discontinuous range for a firing angle in the vicinity of 90° (PA6.YIT ≥1).
  Document this firing angle as α_1 and the associated current actual value (CAV.YC).

- To determine the upper current value, the firing angle α should be entered with a short step. The angle should be very carefully (!) decreased, as even small changes can result in significant current changes. The firing angle for the step amplitude of the current should be documented as α_2.

- Change the firing angle as a step function from angle α_1 to α_2 and trigger the oscilloscope when the current actual value changes.

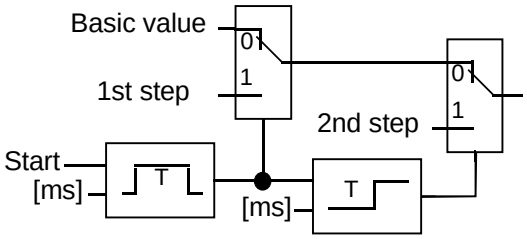


Fig. 5-31 Example: Circuit for the step combination

- The armature time constant should be determined from the current actual value characteristic (refer to the Fig. “Determining the armature time constant”).

Determining the armature time constant

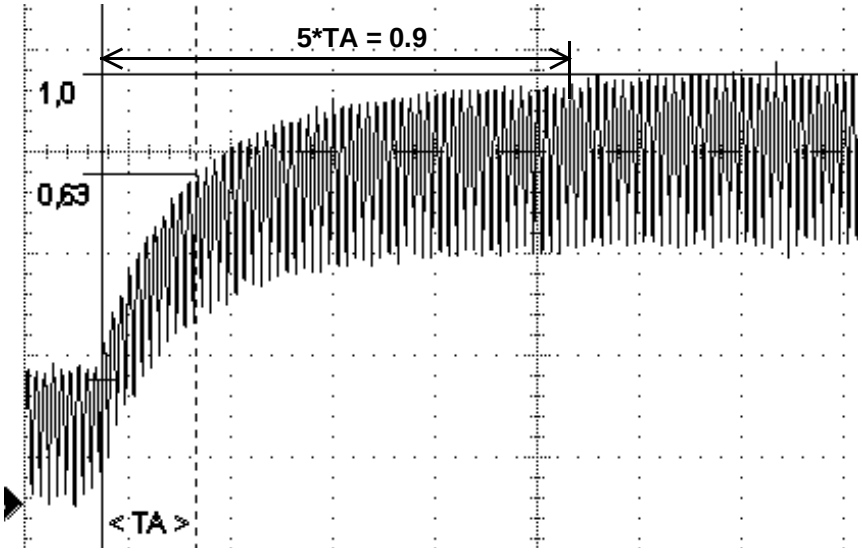


Fig. 5-32 Determining the armature time constant (schematic)

- Enter the determined value at input EMF.TA.

If the plant/system configuration has been entirely completed: → establish the original configured condition.

5.3.7 Optimizing the current controller

The controller parameters are determined with the field excitation switched-out (!) and the rotor mechanically locked.

The current controller FB CPI should be optimized with steps, reference input variable (command variable) = current setpoint. The controller is a PI controller. The gain CPI.KP and the integral action time CPI.TN should be separately set. The I component should first be switched-out (CPI.PC = 1), so that the integral action time CPI.TN is disabled.

- The current at the discontinuous limit, previously determined, should be entered at CPC.VCI. The current step to the discontinuous limit should in this case not result in an increased current.

The basic proportional gain setting, CPI.KP=0.01 for non-discontinuous operation is a non-critical value.

The current setpoints SOL.WC1 + SOL.WC2 are transferred as sums to the current controller (SOL.YWC → CPI.WC).

- CPI.TN=10000.0 integral action time [ms]
- The armature circuit should be closed again.
- To switch-in the closed-loop current control, the current setpoint SOL.YWC should be 0.0.
  Enable signal to the switch-over logic stage SOL.ION= 0→1

Controller optimization in the non-discontinuous range

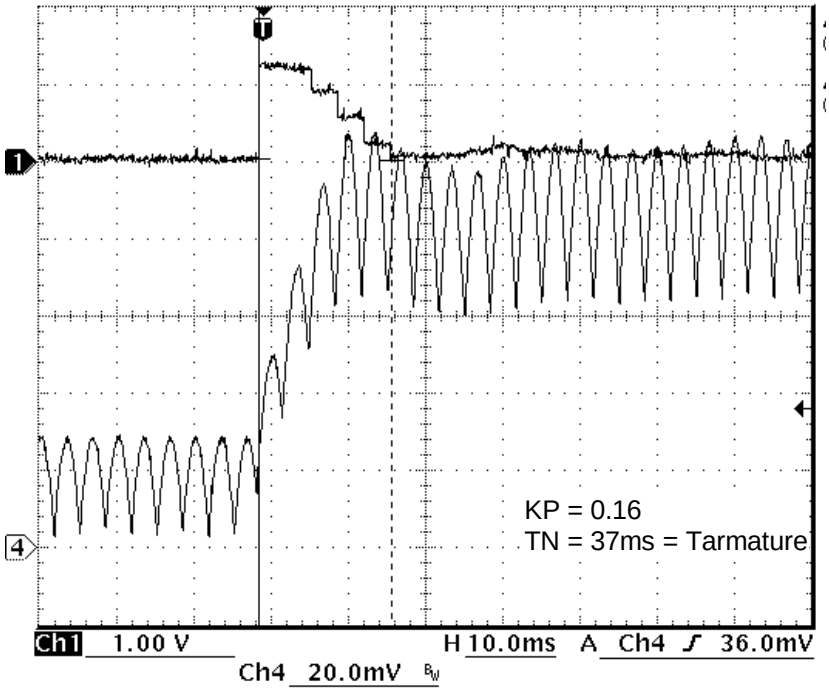
The step function circuit used previously can also be used here.

- The 1st step WC_1 of the current setpoint (e.g. connection SOL.WC1) must be slightly above the discontinuous current limit (CPI.XIT=1). The value which has already been determined, can be used.
- In the steady-state (stabilized) status, the 2nd step should be switched to setpoint WC_2. This should result in a significantly higher current with respect to the setting for WC_1. The length of the step must be adapted to the system situation. The step should be used to trigger the oscilloscope and trace the current actual value.
- The proportional gain CPI.KP should be empirically determined for the "optimum" transition. The user must decide which setting is optimum for the system. The plots shown below are for several typical settings.
- After the gain has been determined, the integral component is re-activated (CPI.PC=0). The armature time constant value is set at input CPI.TN and the setting should be checked using the current characteristic, with the same step function as was previously used.

Comment

The technique generally used in analog technology can be used to optimize the system.

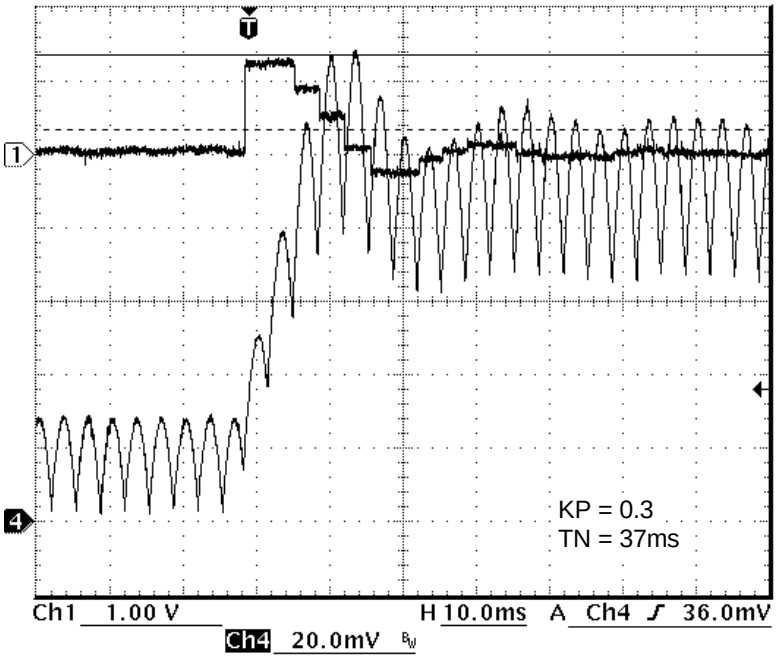
Transient response, current actual value, no overshoot



CH1 : System deviation via D/A converter
CH4 : Current act. value measured with a clip-on ammeter

Fig. 5-33 Transient response, current actual value, no overshoot (schematic)

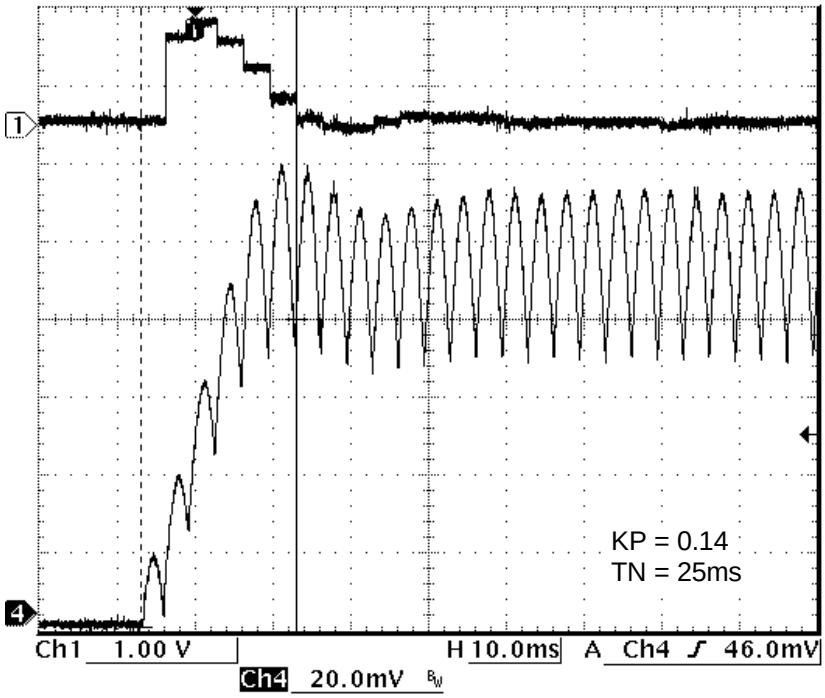
Transient response, current actual value, with overshoot



CH1 : System deviation via D/A converter
CH4 : Current act. value measured with a clip-on ammeter

Fig. 5-34 Transient response, current actual value, high overshoot (schematic)

Transient response, current actual value, step from zero



CH1 : System deviation via D/A converter
CH4 : Current act. value measured with a clip-on ammeter

Fig. 5-35 Transient response, current actual value, low overshoot (schematic)

5.3.8 Field supply

The SITOR field device is a half-controlled, single-phase rectifier (B2HKFU), where the power module and the control are one mechanical and electrical unit. The field device is permanently installed in the SITOR set, e.g. 6QG32x with the "Field device" option.

Current actual value sensing

The current actual value is sensed using a shunt on the DC current side. The current actual value is available at the SITOR electronics module -A1 at test socket "I_E_{act}" (-10V = I_E_{rated}).

The current actual value is adjusted to the rated current in the plant. Potentiometer R402 can be used to adapt the internal amplifier stage (electronics module -A2).

Current setpoint input

There are three ways of entering the current setpoint:

- The setpoint for the field excitation current is transferred to the field electronics A2 via the SITOR interface ITDC-X7 via the electronics module -A1 with ribbon cable.
  Switch
- Via potentiometer R212 on board -A1. In this case, switch -S217 must be changed-over to setting 2/3 (this switch is soldered!).

- External via terminal X102:3. In this case, switch -A1-S217 should be opened from setting 1/3 (factory setting), as otherwise the voltages would be connected.

NOTE

When entering the current setpoint from SIMADYN D, switch -S217 (SITOR set) must be in the 1/3 setting (factory setting).

Setting the field current

In order to operate the field controller from SIMADYN D using FB FCS, input FCS.IE should be set to "1".

The parameters for the field current controller on the electronics board are set by the manufacturer and are therefore permanent.

- The current, specified on the motor rating plate for the field excitation should be set using the setpoint at FCS.FC.
  A clip-on ammeter is the safest way to check that the field current is actually flowing.

- The time to establish the field should be specified with an additional safety margin at FCS.T. The closed-loop armature current control is only switched-in after the field has been established and this time has expired.

5.4 Special features/issues

5.4.1 Operation from 60 [Hz] line supplies

Several parameters must be re-determined for operation on line supplies with a frequency of 60 [Hz].

Calculation rule

The equivalent sampling time should be specified in the "HW Config" software according to the following equation.

$$Equivalent\ sampling\ time = \frac{1}{f * pulse\ No.}$$

This data is required to convert the time-dependent quantities in interrupt task I1 (3.3[ms] at 50 [Hz], 2.7 [ms] at 60[Hz]).

The gating unit uses input PA6.FNT as reference value for the automatic frequency adaptation. A value of 60 should be entered at the input for a 60 [Hz] line supply.

5.4.2 Operation with unstable line supplies

The normal public utility is generally stable regarding frequency and voltage, even under load conditions.
However, this stability can be restricted when operating the drive converter from line supplies with a lower fault rating, especially on local networks (island networks).

In order to be able to operate the gating unit on unstable line supplies or with “polluted” synchronizing voltages, several functions are available in the software at FB PA6 for the line supply monitoring and at FB EMF.

Generally, with unstable line supplies a low-frequency oscillation is superimposed on the line frequency. This can cause the gating unit to oscillate and, under extreme situations, can also result in the closed-loop thyristor current control being switched-out with "pulse position error".
Furthermore, the synchronizing voltage can have sporadic phase steps, especially when large loads are either powered-up or powered-down on the factory network. Using special software processing, these effects can either be reduced or even completely eliminated

Various methods can be selected at PA6.NCM for handling the line supply.

PA6.NCM = 0: There is no line supply handling. The zero crossovers of the synchronizing voltage, sensed using the hardware circuit, are used, without any software correction to determine of the firing pulses. This setting should only be used for "clean" synchronizing voltages.

PA6.NCM = 1: As for NCM = 4 (for reasons of compatibility)

PA6.NCM = 2: The line supply period is converted into an internal line supply value. From the last (max. 8) line supply values, the number of which is defined at PA6.FAM, the average value is generated and transferred to the synchronizing function. The average value is continuously generated {1 ≤ PA6.FAM ≤ 8}.
This means that changes in the line supply value appear smooth for the internal monitoring. This allows low frequency fluctuations to be suppressed using an n x duration of the line supply periods (e.g. a 12.5 Hz fluctuation does not appear in the frequency-dependent quantities when using an average value generated over 4 values).

PA6.NCM = 3: Period and therefore line supply value fluctuations are corrected using the PLL method (P controller). The phase difference is only taken into account with 1/FAM. {1 ≤ PA6.FAM ≤ 1000}.

PA6.NCM = 4: Period and therefore line supply value fluctuations are corrected using the PLL method (PI controller). The phase difference is weighted only with 1/FAM and the last average with (FAM-1)/FAM. NCM=4 with FAM=20…40 is most suitable for single, one-off faults of the synchronizing voltage.

- The average value generation of the line supply period must be adapted to the line frequency fluctuation by making a suitable entry at PA6.FAM.

- Trace several periods of the non-averaged line supply frequency (connection PA6.XFN, actual frequency)

  Determine the factor n: $$n = \frac{\text{Period duration of the fluctuation}}{\text{Line supply period duration}}$$

NOTE

If the line supply values are smoothed, this reduces the probability that the system oscillates, but it can also mean that the gating unit becomes slower (dynamic response) when synchronizing for real (e.g. load-related) frequency dips and then shuts-down with a pulse position error.

Line supply voltage fluctuations

Separate sensing is required for more significant fluctuations of the line supply voltage at the power feed.
The normalized signal is connected to connection EMF.AAV and corrects the gating unit firing angle.

5.4.3 Communications utility, time synchronization

All of the time functions (FB RTC…) cannot be used when using the closed-loop thyristor current control in conjunction with the ITDC expansion module.

In order that the time-critical closed-loop current control is not interrupted by "external" interrupts (clock interrupts), then these interrupts are suppressed by programming FBs on the processor. This means that the time utility is no longer available!

5.5 Interfaces to the power electronics

The PM5/6 processor module and the ITDC expansion module with the standard software are designed for three-phase bridges B6C or an anti-parallel circuit configuration comprising two three-phase bridge circuits B6(A)B6(C) with thyristors.

The connection between ITDC and the SITOR thyristor sets 6QG2x, 6QG3x is standardized. All of the signals are transferred via a 50-core cable with sub-D connector. There is no potential isolation between the SD and drive converter.

- There is a SITOR interface -X7 on the ITDC expansion module.

An SE20.2 interface module has been developed to connect the ITDC to a 6QC5x SITOR thyristor cabinet unit. The reason is that the cabinet system does not have a SITOR interface. SITOR cabinet units 6QC5 are connected to the ITDC expansion module via the SE20.2 interface module.

- If the power sections are mounted some distance away or are connected in parallel, then adapter modules must be used.

5.5.1 SITOR set

The permanently configured "SITOR interface" -X2 of 6QG2x/6QG3x SITOR sets are provided on the electronics module -A1.
The monitoring signals and actual values which are processed by SIMADYN D are conditioned there.
The "SITOR interface" includes the following signals:

- < synchronizing voltage [V]
- < zero crossover signals V_{L12} and V_{L13} for rotating field detection
- > control pulses for torque directions 1 and 2
- < current actual value [kHz]
- < current actual value [V]
- < output voltage [kHz]
- < zero current signal
- < temperature monitoring
- < undervoltage monitoring
- < fuse monitoring

More detailed information about the assignment of the interfaces specified above is provided in the "Hardware" Manual in the Section " ITDC expansion module".

A clockwise rotating field with the same phase sequence must be connected at the power connections and the power supply for the electronics module -A1. The zero crossovers of voltages V_{L12} and V_{L13} are retrieved from the power section supply.
The synchronizing voltage is taken from the electronics section at the secondary of the supply transformer.

If the synchronizing voltage from the SITOR set cannot be used, for example because the power supply of the SITOR set electronics does not have the same phase sequence as the power connections, then an external synchronizing voltage can be entered via connector ITDC-X5: 5/6 (15[V_{RMS}] , range 10-20[V_{RMS}], internal resistance 20[kΩ])

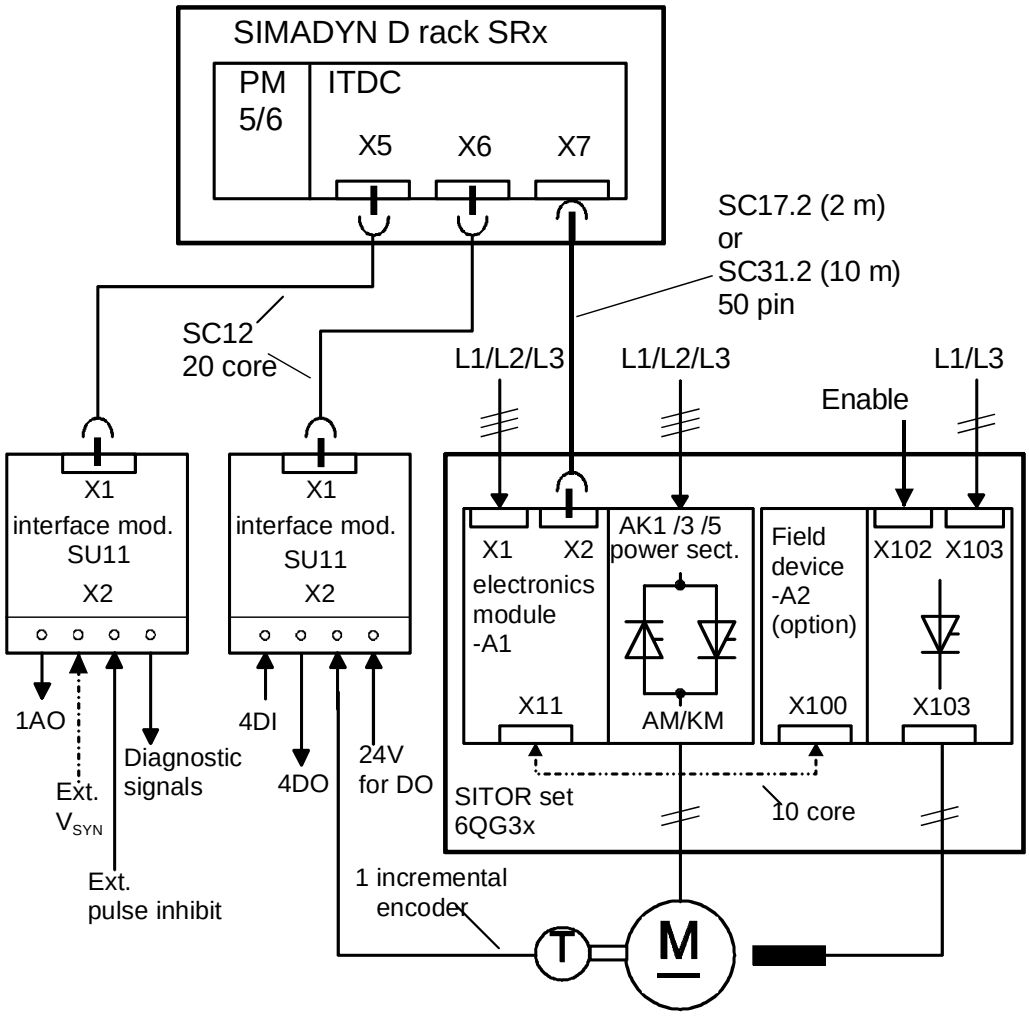


Fig. 5-36 Connection diagram SIMADYN D – SITOR set

The direct connection between the SITOR set 6QG2x/6QG3x and the SITOR interface ITDC-X7 is established using pre-assembled cables SC17.2 (2 m) and SC31.2 (10 m).

Connections to the drive converter can also be established using the adapter module "C" and cables SC17.2 (2 m) and SC31.2 (10 m) (→ Catalog DA91, SITOR thyristor sets).

This adapter should be used to connect two drive converters in parallel. For sets connected in parallel, it should be decided which of the two current actual values should be transferred to the ITDC expansion module.
Signals can be coupled-in or coupled-out at the adapter modules.

No changes have to be made at the SITOR sets and the expansion module.

5.5.2 SITOR cabinet

SITOR cabinet units 6QC5 are connected via the SE20.2 interface module to the SITOR interface of the ITDC expansion module.

The drive converter signals are connected to the SE20.2 and from there, transferred floating to the ITDC.

The SE20.2 interface module can be inserted in the SIMADYN D subrack where it occupies three slots. The module has a rear connector to input the voltage. However, it does not have a coupling to the backplane bus. The depth of the modules differ.

Synchronizing voltages SA60

Synchronization to the line supply is realized using the SA60.1 synchronizing module. The transformer has a delta configuration on the line side. This means that this phase rotation must be taken into consideration at PA6.XDA.

The SA60.1 synchronizing module comprises an SA61 transformer module and the SA20.1 line supply sensing module. These are connected through a ribbon cable.

The line supply voltage is connected, with a clockwise rotating field, to the screw terminals of the transformer module SA61-X2.
The transformed voltages are processed on the SA20.1 electronics module and are transformed to the screw terminals of the SE20.2 -X6 interface module via screw terminals -X2.
The zero crossover signals of phase-to-phase voltages V_{L12}, V_{L13} and the synchronizing voltage are transferred to the ITDC -X7 expansion module via the SITOR interface SE20.2-X3.

When shipped, the SA60.1 synchronizing module is pre-set to a rated input voltage of 400 V (Dip switches S1:3, S1:7 and S2:3 are closed).

For more detailed information on this module, please refer to the description of the SA60.1 synchronizing module.

Connection ITDC - SE20.2 - 6QG5xx

Connector X3 of the SE20.2 is directly connected to the SITOR interface X7 of the ITDC expansion module.

The power section is connected via connectors X1 and X2.

Firing pulses

The firing pulses are output with electrical isolation at connector SE20.2-X1 and terminate in the SITOR cabinet at the pulse distribution (e.g. 6QM2200).
For bridges which are connected in parallel, the distribution is realized within the SITOR cabinet.

The firing pulses are transferred together with a ground cable.

The shields are grounded at the SE20.2 and the pulse distribution and can be separated at the pulse distribution.

The connector assignments can be taken from the User Manual "SITOR interface SE20.2".

Actual values and monitoring functions

The actual values and monitoring signals are collected at the transfer module of the SITOR cabinet from where they are transferred to connector **SE20.2-X2**.

- **Shielding (-X2: z2 and z26)**
  The shields are grounded at the SE20.2 and in the SITOR cabinet and can be separated in the cabinet.

- **Voltage actual value (-X2: b4 (+) , z4 (-))**
  The output voltage is provided from a transducer (e.g. LEM electronic PT), and supplies the actual value signal as analog DC voltage or current signal. The actual value should be normalized at the load resistor module -A1 (on the lefthand component side of the SE20.2).
  The voltage actual value can also be fed from connector -X9 of the interface module where it is connected to a load resistor.
  If the voltage actual value is not used, then the input on the load resistor module -A1 should be short-circuited (e.g. inserting a jumper from R1+R2)

- **Temperature monitoring (-X2: b8)**
  The SITOR cabinet does not have an actual temperature monitoring function. However, temperature monitoring can be practically derived from the "Fan failure" signal of the fan flow monitor. Temperature monitoring is provided for air-water cooling systems.
  When a fault condition develops, the input of the SE20.2 is open or logical "0".
  For disturbance-free operation, the input is kept at logical "1".
  The supply for the NO contact of the airflow monitoring can be taken from SE20.2 (external 24[V]).
  If the signal is not used, it can be permanently connected to 2P24 or can be suppressed in the closed-loop thyristor current control (SOL.HWM bit3=0).

- **Current actual values (-X2: z12, b12, b14 and z14)**
  The current can be formed in the cabinet or at the interface module.

1. Generating the actual value in the SITOR cabinet:
   The current actual value is generated in the SITOR cabinet using a shunt (e.g. LEM electronic CT) or using a
   CT with load resistor and rectification and is transferred as current or voltage signal to SE20.2-X2:b12 and z12.
   The signals are converted with the load resistor at the load resistor module –A2 (righthand component side of the SE20.2), and are normalized by appropriately inserting the load resistors.
2. Generating the actual value on the SE20.2:
   Three or two CTs in a V circuit configuration can be connected to the SE20.2-X2 on the three-phase side of the SITOR cabinet. A load resistor is connected across the current actual value in the plant. If the rectification is used, the 0 Ω resistors R3 and R9 should be removed from the SE20.2 board and 0 Ω resistors should be inserted for resistors R2, R10 and R15, R8. In this case, the maximum current is 1 A.
   - When using two CTs in a V circuit configuration, the first CT is connected to connections b12 and z12; the second CT to connections b14 and z14.
     The current actual value can also be fed from connector -X9 of the interface module or it can also be output through a load resistor there.
     If the current actual value is not used, then the input should be short-circuited, e.g. by jumpering R1/R2 on the load resistor module -A2.
   - When using three CTs, a neutral point is formed in the SITOR cabinet. The remaining three CT connections are connected to connections -X2: b12, z12 and b14.

- **Fuse monitoring (-X2: b16)**
  The external 2P24 voltage is connected to -X2:b16 via the NC contact of the fuse monitoring.
  If there is no fuse monitoring (e.g. for parallel circuit configurations), this monitoring function can be derived from the current monitoring of each bridge.
  - The sum signal is obtained by connecting all of the NC contacts in parallel. Using a parallel circuit configuration of the NC contacts, a fault signal is output if any of the bridges, connected in parallel, fail. In this case, the current limit should be reduced, depending on the failed bridges, using additional digital inputs of the SIMADYN D system!

- **Absolute value of the line supply voltage (-X2: d22 and d24d) pulse suppression (-X2: b30)**

1. Evaluating the absolute value of the line supply voltage via SE20.2
   The synchronizing module SA60.1 generates an absolute value of the line supply voltage $|V_{supply}|$. This voltage signal at -X2:d22 (+), d24 (-) and the pulse supply voltage at -X2:b30 are individually monitored against a limit and are internally OR'ed to form an "Undervoltage"

signal. The absolute value of the line supply voltage can also be read-in via bus connector -X9 and via -X5 / -X6.

2. Evaluating the absolute value of the line supply voltage via SA60.1
   The SA60.1 synchronizing module generates a digital undervoltage signal (line sensing module SA20.1 X2 pins 9, 10 or 11). This signal can be connected (using a suitable circuit) in series with the relay associated with the "Pulse voltage supply" monitoring (e.g. 6QM1038x), and evaluated using a separate digital input of the SIMADYN D system (SOL.HWH bit4=0 \ SOL.UNM=0).

NOTE

The pulse undervoltage signal should be evaluated according to 1. or 2., because, if the power supply voltage fails, the thyristors could fail due to a high trigger power loss.

- **External I=0 signal (-X2: b28 and z28)**
  Standard applications use the internal I=0 signal of the SE20.2. If an external I=0 signal (digital signal, max. 60V) is to be supplied, e.g. from a blocking voltage sensing, then the wire jumper IA-IB (at the bottom lower component side of the SE20.2) should be changed over to IA-IC (solder connection). In this case, the internal I=0 signal is not effective. Adaptation to the input signal is realized via the voltage divider R44, R45 and R46. The internal threshold is 3.6V.

The I=0 signal evaluation is not generally required. In this case, the input at the change-over logic stage SOL.NZM should be set to 1 so that the internal zero current signal is used. However, in this case it should be taken into consideration that the drives lose some of their dynamic response at torque reversal!

Field supply

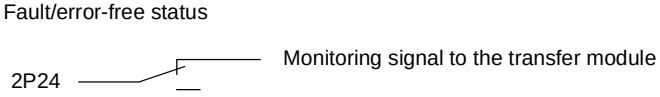
Standard applications with SITOR cabinets provide a special type of field supply. In this case, the "Field current setpoint output" block FB FCS should not be configured, and the fault evaluation associated with the field current monitoring at input SOL.HM1 \ bit 14 should be set to 0.

Connecting-up the monitoring signals

The monitoring signals are, with the exception of the field current monitoring, defined so that a logical "1" signal represents a fault-free status.

A logical "0" signal or an open-circuit input i.e. wire breakage, results in a fault detection (masking of the switch-over logic stage at inputs SOL.HWM/HM1/HM2).

Many signals are output via relays in the SITOR cabinet. If possible, the wiring should be realized as follows to provide the most flexible evaluation possible, regarding other evaluation units:



NOTE The connector assignment for -X2 should be taken from the User Manual "SITOR interface SE20.2". The connecting cable for actual value/monitoring functions can, according to the Section "Connecting cables" be configured by customers themselves.

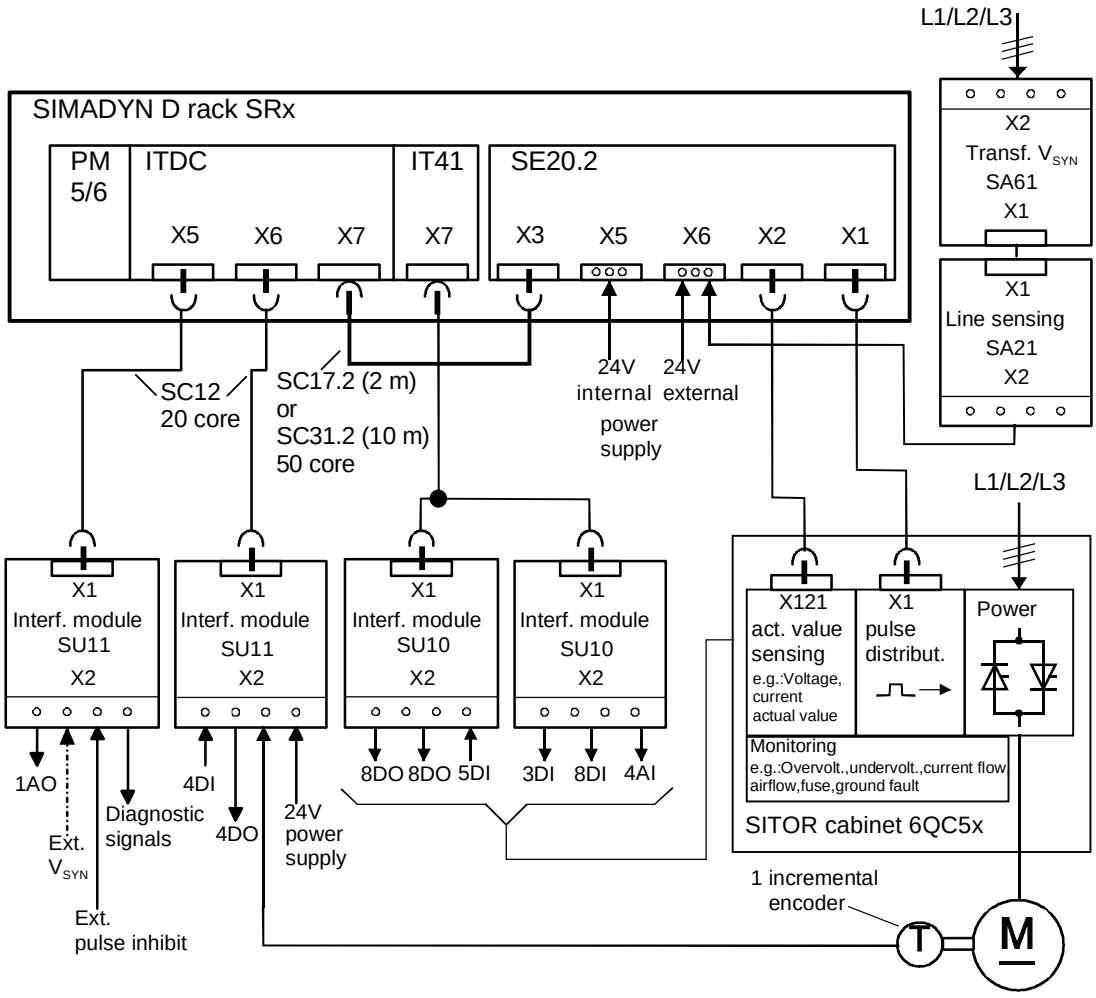


Fig. 5-37 Connecting diagram SIMADYN D – SITOR cabinet

Connecting cable, firing pulses (X1)

Connection 1:1

Pair No.	Contact assignment Z_2 is cable, 4) is shield connection	
	Core A	**Core B**
1	d4	b4
2	d6	b6
3	d8	b8
4	d10	b10
5	d12	b12
6	d14	b14
7	d20	b20
8	d22	b22
9	d24	b24
10	d26	b26
11	d28	b28
12	d30	b30
13	Not assigned	

(contact Z_2 with contact Z_2)

1) 2 x shell-type enclosure A with catches:
   Order No.:A09060480501 GDS A-FL
   Manufacturer: Harting
2) 2 x insulating bodies for crimp connection:
   Order No.:A09060483201 (48 pin)
   Manufacturer: Harting
3) Control cable 13 x 2 x 0.18:
   Order No.:6FC9343-0AC
   Manufacturer: Siemens
4) 2 x cable LIY 1 x 0.5 / 1.6 ws:
   (shield connection)
5) Spring-mounted contacts to crimp:
   Order No.:09060006421 Crimp
   Manufacturer: Harting

Connecting cable, actual values (X2)

Connection 1:1

Pair No.	Contact assignment (Z_2 is cable, 4) is shield connection)	
	Core A	Core B
1	b4	z4
2	b8	z8
3	b12	z12
	(b14)	(z14)
4	b16	z16
5	b18	z18
6	b20	z20
7	b22	z22
8	b24	z24
9	b28	z28
10	b30	z30

(contact Z_2 with contact Z_2)

Connection b14/z14 only for current actual value sensing in a V circuit configuration

1) 2 x shell-type enclosure A with catches:
   Order No.:A09060480501 GDS A-FL
   Manufacturer: Harting
2) 2 x insulating bodies for crimp connection
   Order No.:A09060483201 (48 pin)
   Manufacturer: Harting
3) Control cable 10 x 2 x 0.18 – W -:
   Order No.:6FC9343-0AB
   Manufacturer: Siemens
4) 2 x cable LIY 1 x 0.5 / 1.6 ws:
   shield connection
5) Spring-mounted contacts to crimp:
   Order No.:09060006421 Crimp
   Manufacturer: Harting

5.6 Definitions

Closed-loop current control

All of the current-dependent quantities are referred to the rated system current CAV.ARC (e.g. rated motor current) and normalization factor CAV.NF, specified by the user.

All of the voltage-dependent quantities are referred to the rated system voltage EMF.ARV (e.g. rated motor voltage) and the normalization factor EMF.NF.

If the instantaneous drive converter output voltage Vd is the same as the value configured at input ARV (Vd=ARV), then in the normalized representation type (NF=1), the output value YUA=1.

Double firing

For DZ=1, a firing pulse pair of a phase is constantly output in the constellation 1-4, 2-5, 3-6 or 4-1, 5-2, 6-3.

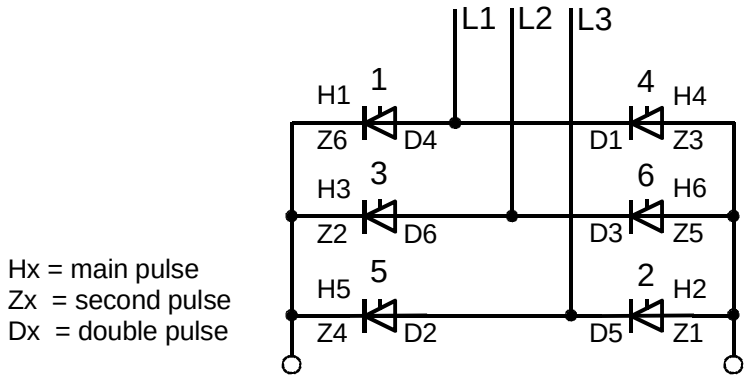


Fig. 5-38 Assignment of the firing pulses to the semiconductor devices

Normal operation with the actual firing pulses is resumed as soon as the double firing mode has been de-activated.
The switch-over logic stage corrects the current controller and therefore the firing angle setpoint during double firing operation.

5.6.1 Formats

Format data

16#FFFF = hexadecimal value

Firing angle

The “Firing angle” format is an internal format for calculations. A value can be converted into degrees using the following formula:

$$ASG = 1 - \frac{\alpha}{90}$$

The value range of the ASG format

$$-1 \quad \Leftrightarrow \quad 0 \quad \Leftrightarrow +1 = [\mathrm{ASG}]$$

corresponds to

$$180° \Leftrightarrow 90° \Leftrightarrow 0° = [°]\ \textit{f}\mathrm{iring\ angle}$$

16MHz The line supply frequency is emulated as a line supply value using a 16MHz counter (21 bit resolution). The format is specified with [16MHz].

A counter status of 320000 $\hat{=}$ 50 [Hz],
266667 $\hat{=}$ 60 [Hz]

5.6.2 Designations

Various symbols are used in this document.

Dimension data	[A , V , Hz , kHz , Ω , mΩ, °]
Value range	{ value data , limit data }
Comments	(text)
Connection	→ , this is also used as reference.
Result, sequence of	⇒
Change	

5.7 Abbreviations

A-Z	Significance 1	Significance 2
B6C	Fully-controlled 3-phase bridge	
(B6)A (B6)C	Anti-parallel circuit Fully-controlled B6 bridge	
CFC	Graphic configuring	
D7-SYS	Program for CFC	
FB	Function block	
ITDC	Interface Technology DC	DC current
HW	Hardware	
LE-Bus	Local expansion bus	
LE-I1	Interrupt 1 for ITDC from PM	
M0	No torque direction selected	
M1	Torque direction 1	
M2	Torque direction 2	
SW	Software	
SITOR	Sitor family of drive converters	
TA	Armature time constant	Sampling time = computation cycle
U SYN	Synchronizing voltage	
α	Firing angle	
1Q	Operation in only one current direction	
4Q	Operation in only two current directions	

Table 5-13 Abbreviations

5.8 Appendix

5.8.1 Standard configuration of parameters

Connection	Significance	Value	Value change	Type
PA6.SYX	Mode: Source, synchronizing voltage	0		Init
PA6.XDA	Offset angle { -180°…+180° }	0.0		
PA6.NAZ	No. of failed line supply periods Condition: 0 ≤ NAZ ≤ 3050, > QSF\bit 9 = 1	8		Init
PA6.NEP	No. of line supply periods Condition: 0 ≤ NEP ≤ 5000, > QSF\bit 9 = 1	5		Init
PA6.NCM	Mode : Line supply handling { 0…4 , >4= 0 }	0		
PA6.FAM	For NCM=1: Refer to 4 For NCM=2: Average value generation { ≥1…<8 } For NCM=3: Decrease phase difference { ≥1…≤1000 } For NCM=4: Decrease phase step { ≥1…≤1000 }	0		
PA6.INV	Mode for rotating field detection	0		Init
PA6.FNT	Line frequency [Hz] for start of synchronization Condition: 6 ≤ FNT ≤ 600, > QSF\bit 9 = 1	50		Init

Connection	Significance	Value	Value change	Type
EMF.RRV	Rated Sitor voltage of the sensing [V]. Condition: RRV ≥ ARV, > QSF\bit 14 = 1	0.0		Init
EMF.ARV	Rated system / motor voltage [V] Condition: RRV ≥ ARV ≠ 0, > QSF\bit 14 = 1	0.0		Init
EMF.NF	Normalization of the voltage actual value at YUA	1.0		Init
EMF.AAV	Line supply voltage [V]. Condition: $AAV \geq \cdot ARV \frac{\sqrt{2} * \pi}{3}$, >QSF\bit 14 = 1	(0.0)		
EMF.XFO	Offset frequency of the V/f converter [kHz] Condition: -6 kHz ≤XFO≤ 6 kHz, > QSF\bit 14 = 1	0.0		Init
EMF.RA	Normalized armature resistance	0.0		
EMF.TA	Armature time constant [ms]	0 ms		
EMF.T	Smoothing time for YEV value (the smoothing is switched-out with T=0)	20 ms		

Connec-tion	Significance	Value	Value change	Type
SOL.TH0	Thyristor hold-off time [ms] Condition: 0.5 ms ≤ TH0 ≤ 131 ms, > YW2\bit10 =1	10 ms		Init
SOL.TCP	Thyristor pulse suppression time [ms] Condition: 0.0 ms ≤ TH0 ≤ 20000 ms , > YW2\bit10 =1	20 ms		Init
SOL.TCD	Monitoring time for torque change M1 ⇔ M2	1000 ms		
SOL.IPL	Pulse inhibit = 1 effective immediately !	0		
SOL.UNM	Mode: Handling the undervoltage (Sitor)	2		
SOL.ION	On command, closed-loop thyristor current control	0		
SOL.IOF	Off command, closed-loop thyristor current control	0		
SOL.ON1	Enable, only torque direction M1	0		
SOL.OF1	Off command, torque direction M1	0		
SOL.ON2	Enable, only torque direction M2	0		
SOL.OF2	Off command, torque direction M2	0		
SOL.IEF	Mode: Use calculated EMF value (FB EMF available)	1		
SOL.NZM	Zero current signal from the SITOR set Y/N=0/1	0		
SOL.WC1	Current setpoint 1 (or connection)	0.0		
SOL.WC2	Current setpoint 2 (or connection)	0.0		
SOL.WCL	Switch-on threshold for torque direction (abs. value)	0.01		
SOL.TM0	Monitoring time for torque direction M0	2000ms		
SOL.IF1	Fault, external 1	0		
SOL.IF2	Fault, external 2	0		
SOL.HMH	Enables bits for the hardware signaling word YHW	16#FFFF		
SOL.HM1	Enables bits for the fault word YF1	16#FFFF		
SOL.HM2	Enables bits for the fault word YF2	16#FFFF		
SOL.HP1	Enables bits from YF1 for immediate pulse inhibit	16#0000		
SOL.HP2	Enables bits from YF2 for immediate pulse inhibit	16#0000		
SOL.MNE	Group inhibit, fault word YF1 and YHW	16#067E		

Connec-tion	Significance	Value	Value change	Type
CSP.WCU	Positive current limit (absolute value)	1.0		
CSP.WCL	Negative current limit (absolute value)	1.0		
CSP.GLI	Gradient for setpoint smoothing	0.6		
CSP.IL	Gradient for integrator inhibit	0.6		

Connec-tion	Significance	Value	Value change	Type
CPC.VCI	Current setpoint at the discontinuous limit {0 < VCI < discontinuous limit}	0.1		
CPC.ALP	Pre-control angle in the discontinuous range [°], {≥25°…30°≤}	25.0		

Connec-tion	Significance	Value	Value change	Type
CAV.RRC	Rated DC current of the SITOR set [A] Condition: RRC ≥ ARC , > QSF\bit 12 = 1	0.0		Init
CAV.ARC	Rated system / motor current [A] Condition: RRC ≥ ARC ≠ 0 , > QSF\bit 12 = 1	0.0		Init
CAV.NF	Normalization of the current actual value at YC Condition: NF > 0 ,	1.0		Init
CAV.XFO	Offset calibration [kHz] {≥-6.0…+6.0≤}	0.0		Init
CAV.XF2	Current-dependent inverter stability limit [1] {≥0.0…0.2≤} Condition: 0.0 ≤ XF2 ≤ 0.2, > QSF\bit 12 = 1	0.0		Init
CAV.IAV	Correction for the inverter stability limit [1] {≥0.7…1.3≤} Condition: 0.7 ≤ IAV ≤ 1.3, > QSF\bit 12 = 1	1.0		Init
CAV.AL1	Positive correction, current actual value sensing Condition: -0.1 ≤ AL1 ≤ 0.1,	0.0		Init
CAV.AL2	Negative correction, current actual value sensing Condition: -0.1 ≤ AL2 ≤ 0.1,	0.0		Init
CAV.CX1	Max. current for torque direction M1 (abs. value)	0.1		
CAV.CX2	Max. current for torque direction M2 (abs. value)	0.1		

Connec-tion	Significance	Value	Value change	Type
CPI.CLU	Limit of the current-dependent inverter stability limit [°]	150.0		
CPI.ALU	Inverter control limit, firing angle [°]	150.0		Init
CPI.ALL	Rectifier control limit, firing angle [°]	30.0		Init
CPI.SVC	Mode: Pre-control of the CPI	0		
CPI.KP	Proportional gain [1]	0.01		
CPI.TN	Integral action time [ms]	10000 ms		
CPI.PC	Inhibit integrator component	0		

Connection	Significance	Value	Value change	Type
PC6.LDP	Selects the firing pulse waveform: LDP = 0: 7kHz pulse chain, LDP = 1: Long pulses.	0		Init
PC6.LDU	Absolute inverter (INV) control limit [°] Condition: 90 ≤ LDU ≤ 180, > QSF\bit 9 = 1	150		Init
PC6.LDL	Absolute rectifier (RECT) control limit [°] Condition: 0 ≤LDL ≤ 90, > QSF\bit 9 = 1	30		Init
PC6.LMP	Main pulse length [ms] { < 45[°] el. }	1.1ms		
PC6.LFP	Second pulse length [ms] { < 45[°] el. }	1.1ms		
PC6.AQL	Test operation: Firing angle setpoint [°]	150		
PC6.AWS	Shift to INV operation: Firing angle setpoint [°] Condition: 90 ≤ AWS ≤ 180, > QSF\bit 9 = 1	150		Init
PC6.DAG	Max. angular change/TA in the direction of rectifier op. Condition: 0 ≤ DAG ≤ 180, > QSF\bit 9 = 1	60		Init
PC6.DAW	Max. angular change/TA in the direction of inverter op. Condition: 0 ≤ DAW ≤ 180, > QSF\bit 9 = 1	150		Init
PC6.DIL	Tolerance of the pulse position [°]	1.0		
PC6.DIZ	No. of permissible limit violations DIL	3		
PC6.DZ	Operation: Double firing	0		

Connection	Significance	Value	Value change	Type
FCS.RRC	Rated current of the field current rectifier [A] Condition: RRC ≥ ARC ≠ 0, > QSF\bit 12 = 1	0.0		Init
FCS.ARC	Rated field current of the DC motor excitation [A] Condition: RRC ≥ ARC ≠ 0, > QSF\bit 12 = 1	0.0		Init
FCS.NF	Normalization factor to interpret the setpoint	1.0		Init
FCS.ION	On command, field current	0		
FCS.IOF	Switch-out field setpoint output	0		
FCS.FC	Field current setpoint Condition: FC ≥ 0 > QSF\bit 12 = 1	0		
FCS.EN	Enables inputs ION,IOF	0		
FCS.IE	Option: Field present	0		
FCS.T	Delay time when switching-in and when switching-out Condition: 0 ≤ T ≤ 100000 ms, > QSF\bit 12 = 1.	1500 ms		Init

5.8.2 Standard connections

Connections, internal

Connection	Type		Significance	Source
PA6.ZPA	ON	NV	Firing pulse number	PC6.ZPA
PC6.CTH	ON	NV	Firing pulse output, time value	PA6.CTH
PC6.CTS	ON	NV	Time value, start of FB PA6	PA6.CTS
PC6.EN	ON	NV	Enable firing angle controller	PA6.RDY
PC6.X6R	ON	NV	Numerical $\hat{=}$ 60° of the line supply periods [16 MHz]	PA6.Y6R
PC6.XAS	ON	NV	Firing angle actual value [ASG]	PA6.XAS
PC6.WAS	ON	SP	Firing angle setpoint [ASG]	CPI.Y
PC6.ICC	ON	NV	Control word	SOL.QCC
PC6.ACI	ON	NV	Handshake from the CAV block	CAV.ACO
EMF.XC	ON	SP	Current actual value (with sign)	CAV.YC
EMF.ACI	ON	NV	Handshake from the PC6 block	PC6.ACO
SOL.ION	ON	SP	On command of the closed-loop thyristor current control (,FCS present)	FCS.QON
SOL.DZM	ON	NV	Operating signal, double firing	PC6.DZM
SOL.XC	ON	NV	Current actual value (with sign)	CAV.YC
SOL.XEV	ON	NV	EMF value calculated	EMF.YEV
SOL.QSC	ON	NV	Fault word from CAV	CAV.QSF
SOL.QSM	ON	NV	Fault word from EMF	EMF.QSF
SOL.QSA	ON	NV	Fault word from PA6	PA6.QSF
SOL.QSP	ON	NV	Fault word from PC6	PC6.QSF
SOL.QSS	ON	NV	Fault word from FCS (, if programmed)	FCS.QSF
CAV.IM1	ON	NV	Torque direction M1 operational $\Rightarrow$ “+” = CX1	SOL.Q01
CAV.IM2	ON	NV	Torque direction M2 operational $\Rightarrow$ “-” = CX2	SOL.Q02
CAV.ACI	ON	NV	Handshake from the EMF block	EMF.ACO
CPC.WC	ON	NV	Current setpoint (absolute value)	CSP.YWC
CSP.WC	ON	SP	Current setpoint from the switch-over logic stage	SOL.YWC
CPI.WC	ON	SP	Current setpoint (absolute value)	CSP.YWC
CPI.XC	ON	NV	Current actual value (with sign)	CAV.YC
CPI.SV	ON	NV	Setting value, integrator from the switch-over logic stage	SOL.YSV
CPI.S	ON	NV	Setting the integrator with value SV	SOL.QCS
CPI.EN	ON	NV	Controller enable	SOL.QCE
CPI.ILU	ON	NV	Inhibits the integrator, positive direction	CSP.QIU
CPI. ILL	ON	NV	Inhibits the integrator, negative direction	CSP.QIL

NV=Connection required
SP=Standard connection according to the standard configuring

Connections, external

Connection	Significance	Source	
SOL.IPL	Pulse inhibit = 1, effective immediately!		
SOL.ION	On command, closed-loop thyristor current control		
SOL.IOF	Off command, closed-loop thyristor current control		
SOL.WC1	Current setpoint 1		
SOL.WC2	Current setpoint 2		
SOL.IF1	External fault 1		
SOL.IF2	External fault 2		
SOL.MNE	Group inhibit, fault words YF1 and YHW		
SOL.QUI	Acknowledgement, faults YF1 and YF2		
FCS.ION	On command, field current		
FCS.IOF	Switch-out field setpoint output		
FCS.FC	Field current setpoint		
FCS.EN	Enable inputs ION,IOF		

5.8.3 Configuring example for normalization

The closed-loop thyristor current control can be used with normalized (standard) and absolute values.

For the example for the settings of the system parameters, the following are used as basis: A 6QG3230-2AB SITOR set (3-ph./400[V], AC 30[A] + field) and a DC motor with the rated data:

Armature: V_A=400 [V], I_A=10 [A], R_A=500 [mΩ],
Field: I_F=1.5 A

and the phase-to-phase line supply voltage: UL=400 V.

5.8.3.1 Representation with normalized values

Current actual value sensing

Parameter	Significance
CAV.RRC = 30[A]	Rated DC current [A] of the SITOR set current [A] for V_{Iact}=5 V/CT SITOR
CAV.ARC =10 [A]	Rated system/motor current [A] current [A] for CAV.YC=1
CAV.NF =1	Current normalization factor
CAV.CX1=+1.5	Absolute value, overcurrent, torque direction 1 [%] permissible overcurrent 15 A
CAV.CX2=+1.5	Absolute value, overcurrent, torque direction 2 [%] permissible overcurrent -15 A
CAV.YC	Current actual values, normalized – 10A ⇔ 0A ⇔ +10A ≙ CAV.YC = –1... 0 ... + 1

Voltage actual value sensing

Parameter	Significance
EMF.RRV=1000 [V]	SITOR set voltage normalization [V] voltage [V] at Vact=10 V/PT
EMF.ARV=400 [V]	Rated system/motor voltage [V] voltage [V] for YUA=1
EMF.NF=1	Voltage normalization factor
EMF.AAV=400 [V]	Phase-to-phase line supply voltage [V]
EMF.RA=0,0125	Normalized armature resistance $EMF.RA = RA[\Omega] * \frac{NF(EMF)}{ARV(EMF)} * \frac{ARC(CAV)}{NF(CAV)}$ $EMF.RA = 500m\Omega * \frac{1}{400V} * \frac{10A}{1} = \underline{12.5 \cdot 10^{-3}}$
EMF.YEM, YUA ,YUR, YUL	Voltage actual values, normalized $-400V \Leftrightarrow 0 \Leftrightarrow +400V \mathrel{\hat{=}} -1...0...+1$
EMK.YEV	Pre-control $YEV = \frac{YEM}{\sqrt{2} \cdot AAV}$

Field current setpoint output

Parameter	Significance
FCS.RRC=5 [A]	Rated current, field unit [A]
FCS.ARC=1,5 [A]	Rated field current [A]
FCS.NF=1	Normalization factor
FCS.FC=1	Field current setpoint

5.8.3.2 Representation with absolute values

Current actual value sensing

Parameter	Significance
CAV.RRC = 30[A]	Rated DC current [A] of the SITOR set current [A] at V_{lact}=5 V/CT SITOR
CAV.ARC =10 [A]	Rated system/motor current [A] current [A] for CAV.YC=1
CAV.NF =10	Current normalization factor
CAV.CX1=+15	Absolute value for overcurrent, torque direction 1 permissible overcurrent +15 [A]
CAV.CX2=+15	Absolute value for overcurrent, torque direction 2 permissible overcurrent –15 [A]
CAV.YC	Current actual values, absolute $-10A \Leftrightarrow 0A \Leftrightarrow +10A \mathrel{\hat{=}} CAV.YC = -10...0...+10$

NOTE

The blocks use normalized values for internal calculations. This means, in this particular case, the current setpoint and the current actual value for the current controller CPI should be divided by the normalization factor CAV.NF using a division block (CPI.WC/CAV.NF and CPI.XC/CAV.NF).

Refer to the example, the following applies:

- For DIV block 1:
  - Connect CAV.YC with X1
    Enter the configured value of CAV.NF=10 at X2
    Connect output Y of DIV block 1 with CPI.XC
- For DIV block 2:
  - Connect SOL.YWC with X1
    Enter the configured value of CAV.NF=10 at X2
    Connect output Y of DIV block 2 with CPI.WC

The division blocks should be configured in the sequence that they are run directly in front of the current controller block CPI!

Voltage actual value sensing

Parameter	Significance
EMF.RRV=1000 [V]	SITOR set voltage normalization [V] voltage [V] at Vact=10 V/PT
EMF.ARV=400 [V]	Rated system/motor voltage [V] voltage [V] for YUA=1
EMF.NF=400	Voltage normalization factor
EMF.AAV=400 [V]	Phase-to-phase line voltage [V]
EMF.RA=0,0125	Normalized armature resistance $EMF.RA = RA[\Omega] * \frac{NF(EMF)}{ARV(EMF)} * \frac{ARC(CAV)}{NF(CAV)}$ $EMF.RA = 500[m\Omega] * \frac{400}{400[V]} * \frac{10[A]}{10} = \underline{500 \cdot 10^{-3}}$
EMF.YEM, YUA ,YUR, YUL	Voltage actual values, normalized $-400V \Leftrightarrow 0 \Leftrightarrow +400V \mathrel{\hat{=}} -400...0...+400$
EMK.YEV	Pre-control $YEV = \frac{YEM}{\sqrt{2} \cdot AAV} = \frac{-400...0...+400}{\sqrt{2} \cdot AAV} \mathrel{\hat{=}} \underline{\frac{-1...0...+1}{\sqrt{2} \cdot AAV}}$ YEV is, as shown in the normalized representation, normalized to 1 and referred to the line supply amplitude. For normalized and absolute values, YEV has the same value range!

Field current setpoint output

Parameter	Significance
FCS.RRC=5 [A]	Rated field unit current [A]
FCS.ARC=1.5 [A]	Rated field current [A]
FCS.NF=1.5	Normalization factor
FCS.FC=1.5 [A]	Field current setpoint

NOTE The system must be restarted (Initialization quantities) when changing between representation with normalized or absolute values.

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