

## SIMATIC

### Getting started with FM 458-1 DP

Manual

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## Safety guidelines

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### DANGER

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



### WARNING

indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



### CAUTION

used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

### CAUTION

used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

### NOTICE

used without the safety alert symbol indicates a potential situation which, if not avoided, may result in an undesirable result or state.

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# 1 Prerequisites

## Contents of this section

This is what you read about:

- The target readers for these brief instructions
- Which software and hardware components you require
- Which technological task/function is to be solved

## Introduction

These brief instructions are intended for introductory level personnel and it outlines the basic procedure when generating a project. The emphasis is on the FM 458-1 DP application module. As far as generating the SIMATIC program, only the steps, necessary to link-in the FM 458-1 DP application module are discussed. These instructions assume that you are already experienced in using SIMATIC S7 controls and are knowledgeable about the SIMATIC Manager.

This document **does not replace** the Manuals on STEP7, CFC, D7-SYS, FM 458-1 DP, etc. This is the reason that it is essential that you observe the statements made in the appropriate Manuals, especially those statements relating to safety.

## 1.1 Software and hardware

### Software

You must have at least the following three software packages on your PG/PC with Windows 95/98/ME/NT 4.0/2000

- STEP 7, from Version 5.2 onwards
- CFC, from Version 6.0 onwards
- D7-SYS, from Version 6.0 onwards

installed precisely in this sequence.

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### NOTE

Authorization is required for STEP7 and CFC.

The installation and user instructions are provided in the particular "readme" files.

Please carefully observe the compatibility between the different versions!

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While installing STEP7 you will be prompted for the online interface. In this case, please install the MPI interface (e.g. CP5511 communications processor (MPI/PROFIBUS) for PG/PCs (PCMCIA))

**Hardware**

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

<b>Components</b>	<b>Function</b>	<b>Order No.</b>
<b>Central rack UR2</b> 9 slots	... if the subrack is for an S7-400 station. ... it is used to mechanically accommodate the modules and supply them with power.	6ES7 400-1JA00-0AA0
<b>PS 407 power supply, 10A</b> (at slot 1)	... supplies the modules in the subracks with power.	6ES7 407-0KA01-0AA0
<b>SIMATIC S7-400 CPU module CPU 412-1</b>	... runs the SIMATIC user program. ... exchanges data with other modules via the backplane PC board of the subrack. ... communicates with a PG/PC via the serial interface.	6ES7 412-1XF03-0AB0
<b>MPI cable</b>	... connects the SIMATIC CPU module to the PG/PC.	6ES7 901-0BF00-0AA0
<b>SIMATIC NET CP 5511 PROFIBUS</b> , MPI interface card for PC, S7 couplings, DP master, DP slave, PG functions, PCMCIA	... connects the PC to the SIMATIC CPU module through the MPI cable.  (as an alternative, also SIMATIC NET CP 5611 PROFIBUS, 6GK1 561-1AA00, can be used for the PCI bus)	6GK1 551-1AA00
<b>SIMATIC S7-400 application module FM 458-1 DP</b>	... runs the user program of the FM 458-1 DP application module. ... communicates with the SIMATIC CPU and a PG/PC via the backplane bus.	6DD1 607-0AA1
<b>MMC program memory module</b> (for the FM 458-1 DP application module) Micro Memory Card, 2 Mbyte Flash	... saves the operating system, the user program and the online changes for the FM 458-1 DP application module.	6ES7 953-8LL00-0AA0
<b>PROFIBUS DP bus interface IM 153</b>	... connects the S7-300 I/O to PROFIBUS DP an.	6ES7 153-1AA00-0XB0
<b>SM 322 digital output module</b>	... outputs the values received via PROFIBUS DP .	6ES7 322-1BH01-0AA0
<b>EXM 438-1 expansion module for the FM 458-1 DP application module</b> (located directly next to FM 458-1 DP) Digital I/O, analog I/O incremental encoder inputs.	... expands the FM 458-1 DP application module by technology-specific interfaces. This is especially fast as it is directly inserted onto the FM 458-1 DP application module and uses a local bus independent of the backplane bus.	6DD1 607-0CA1

Components	Function	Order No.
<b>Interface cable SC 52</b> Length: 2 m	... connects the I/O of the EXM 438-1 module with up to 5 interface modules SBxx or SU12.	6DD1 684-0GC0
<b>SB10 interface module</b> 2 x 8 screw terminals, LED displays	... allows you to test the user program during start-up and in operation as the states of the digital outputs are displayed using LEDs.	6DD1 681-0AE2

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

#### NOTE

It is also possible to use other hardware platforms of the SIMATIC control system if this is appropriately taken into account in the engineering and when configuring the system. Additional information and technical data are provided in the SIMATIC Control Systems Catalog ST DA or in Catalog CA 01.

## 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 user program for the SIMATIC CPU in STEP7 using the standard SIMATIC languages LAD/FBD/STL.  
In CFC, you generate the application software for the FM 458-1 DP application module using function blocks. This application software is then compiled.  
You can configure the hardware after all of the checks have been made.
4. **Test the configuring software**  
You can now run the program, test it online and change it on the configured modules.
5. **Archive the project**  
You can subsequently apply this procedure for you own applications.

### The task

The task comprises three sections:

1. **Data exchange** between the SIMATIC CPU and the FM 458-1 DP application module via the backplane bus.  
This influences the behavior of the sawtooth generator.

2. A **sawtooth generator** outputs its value via a D/A converter.
3. **Running Lights** with 8 channels. Output using an ET200 digital output module connected to PROFIBUS DP.

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

1. **Data exchange**

The SIMATIC CPU enters the upper limit value of the sawtooth generator running on the FM 458-1 DP application module. The actual integrator value is sent back to the SIMATIC CPU.

2. **Sawtooth generator**

A sawtooth waveform is generated by an integrator, which resets itself after an upper limit has been exceeded. The value of the integrator is output on the EXM 438-1 via an analog output.


3. **Running light**

Eight comparators compare the sawtooth value with constant values. The results are output through PROFIBUS DP and control the LEDs on the ET200 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.

## 2 Creating a new project

Step	Procedure	Result
1	<b>Double-click</b> on the symbol  . (if the STEP 7 Assistant starts, cancel this.)	The SIMATIC Manager is opened.
2	Select <b>File &gt; New</b> . Enter <b>"My First Project"</b> into the dialog box, Project. In the dialog box, select the path <b>„LW:\Siemens\Step7\S7proj“</b> . Click on <b>OK</b> .	Your new project is displayed.
3	Select <b>Insert &gt; Station &gt; SIMATIC-400</b>	The <b>"SIMATIC-400(1)"</b> hardware object is inserted.



### 3 Defining the hardware

**Contents of this section**

Here you will read about:

- how you start the hardware configuration
- which settings you must carry-out for the individual modules
- how you configure PROFIBUS DP

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

Step	Procedure	Result
4	Select the hardware object <b>"SIMATIC-400(1)"</b> and select <b>Edit &gt; Open object.</b>	<b>HW Config</b> is called-up.
5	Open the hardware catalog, if required with <b>View &gt; Catalog .</b>	The hardware catalog with all of the available family of modules is opened.
6	Select the <b>"UR2"</b> from the <b>"SIMATIC 400"</b> family of modules and Catalog <b>"RACK 400"</b> and drag it to the (upper) window	The subrack is displayed with 9 slots.
7	Locate them one after the other <b>&gt; PS-400 &gt; Standard PS-400 &gt; PS 407 10A at slot 1</b> <b>&gt;CPU-400 &gt; CPU 412-1 &gt; 6ES7 412-1XF03-0AB0 at slot 3</b> <b>&gt; FM-400 &gt; FM 458 components &gt; FM 458-1 DP at slot 4</b> <b>With the following dialog box "Properties, PROFIBUS interface DP" set-up a "New" PROFIBUS DP interface using "new" and acknowledge twice with "OK"</b> <b>&gt; FM-400 &gt; FM 458 components &gt; EXM 438-1 at slot 5</b>	This means that you have assigned a PROFIBUS DP interface to the FM 458-1 DP.  The subrack is equipped.
8	Open the properties dialog box of the FM 458-1 DP application module with <b>Edit &gt; Object properties.</b>	The FM 458-1 DP 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) ein. Click on the <b>cyclic tasks</b> tab and set the sampling time T1 to 2 ms and T2 to 4 ms. Click on <b>OK.</b>	The required sampling times are entered.  The Properties dialog box is closed.
10	Open the properties dialog box of the EXM 438-1 module with <b>Edit &gt; Object properties.</b>	The EXM 438-1 dialog box with general module information and the setting tab for addresses is displayed.

<p><b>11</b></p>	<p>Under the <b>Peripheral addresses</b> tab, click on the <b>Pre-assign</b> button. Click on <b>OK</b>.</p>	<p>All of the addresses are assigned symbolic names for subsequent use in CFC charts.</p>
<p><b>12</b></p>	<p>Now configure PROFIBUS DP. Locate &gt; PROFIBUS DP &gt; ET 200M &gt; IM 153 at the PROFIBUS DP line assigned to the FM 458-1 DP by dragging and dropping  In the "Properties" dialog box "PROFIBUS interface IM 153" change the address to 3.  Click on OK.</p>	<p>This means that you have assigned the IM 153 module the slave address on the PROFIBUS DP line.</p>
<p><b>13</b></p>	<p>Locate &gt; PROFIBUS DP &gt; ET 200M &gt; IM 153 &gt; DO-300 &gt; SM 322 DO16xDC24V/0.5A at slot 4 in the lower window by dragging and dropping.</p>	<p>This means that you have assigned the digital output module SM 322 to the IM 153 station.</p>
<p><b>14</b></p>	<p>Check your hardware with <b>Station &gt; Check consistency</b>.</p>	<p>If fault/error-free, continue with Step 15, otherwise check the hardware configuration.</p>
<p><b>15</b></p>	<p>Compile your hardware configuration with <b>Station &gt; Save and compile</b>.</p>	<p>The hardware has been fully configured.</p>

## 4 Generating a STEP7 program

Step	Procedure	Result
16	<p>Now generate the user program for the SIMATIC CPU module as you know it from STEP7.</p> <p>In the following (Fig. 1: OB1 of SIMATIC CPU) OB1 program example – only the points necessary for data exchange with the FM 458-1 DP application module are discussed.</p>	

```

SIMATIC          My First Project\SIMATIC 400(1)\CPU
                  OB1 - <offline>

Baustein: OB1  "Main Program Sweep (Cycle)"

Netzwerk: 1

//Generation of the upper integrator limit
//read the peripheral output-address from HWKonfig (I/O-Adress of the FM 458-1 DP)
L    1.125000e+004
T    PAD 512 //transfer it to FM 458-1 DP;

//Reading the actual integrator value from FM 458-1 DP
//read the peripheral input-address from HWKonfig (I/O-Adress of the FM 458-1 DP)
L    IED 512 //read the actual value from FM 458-1 DP
T    MD  22

Fehlerprotokoll:
My First Project\SIMATIC 400(1)\CPU 412-1\...\OB1 - <offline>

```

The screenshot shows the HW Config interface for a SIMATIC 400(1) system. The hardware rack is configured as follows:

S...	Baugrup.	B...	Fl...	M...	E-Adresse	A-Adresse
1	PS 405 4A	6ES7				
2	CPU 412-1	6ES7	2			
3	4581DP	6DD			512..639	512..639
X3	DP				422*	
4	X438_1	6DD1			444	

Red arrows in the original image point from the circled '512..639' addresses in the table to the 'PAD 512' and 'IED 512' lines in the program code on the left.

Fig. 1: OB1 of SIMATIC CPU

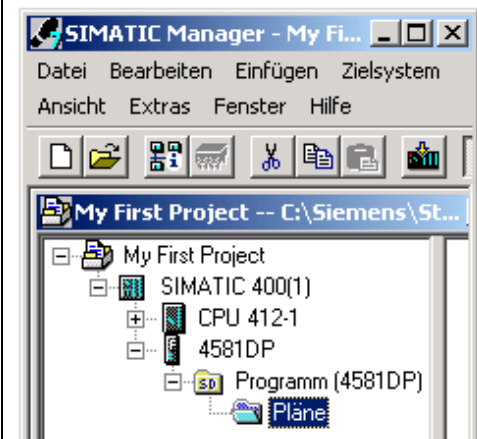
## 5 Creating a CFC chart

### Contents of this section

Here you will read about:

- how you create CFC charts for the project example
- the possibilities which you have when parameterizing and interconnecting the function blocks

### 5.1 Creating a new chart

Step	Procedure	Result
17	Go into the SIMATIC Manager and open the project tree down to the Charts object below the FM 458-1 DP application module. Select the charts by clicking on them.	
18	Create a new CFC chart three times with <b>Insert &gt; S7 software &gt; CFC</b> .	The CFC 1, CFC 2 and CFC3 charts are displayed as new objects at the righthand side of the project window.
19	Select chart CFC2 in the project window and open the properties dialog box with <b>Edit &gt; Object properties</b> . Enter the "data exchange" name. Click on <b>OK</b> .	You obtain the properties dialog box of the CNC chart.  The Properties dialog box is closed.
20	Repeat step 17 with the CFC2 chart and re-name it "sawtooth generator".	The charts appear in the project window under their new name.
21	Repeat step 17 with the CFC2 chart and re-name it "Running lights".	The charts appear in the project window under their new name.

## 5.2 Inserting, parameterizing and inter-connecting function blocks

Step	Procedure	Result
22	Select the "sawtooth generator" chart and open the "CFC Editor with <b>Edit &gt; Open object</b> .	The CFC Editor is opened with the working area (>1 sheet) and the block catalog. (Catalog missing? Select <b>View &gt; Catalog</b> ) (>1 Sheet? Select <b>View &gt; Sheet</b> view)
23	Open the family of blocks <b>Closed-loop control</b> and drag the function block <b>INT</b> (integrator) to the working area.	The block is now located on the sheet and has the ID for running in cyclic task T1.
24	Open the properties dialog box of function block INT with <b>Edit &gt; Object properties</b> .	The INT dialog box with general block information and the setting tab I/O appears.
25	Under the <b>General</b> tab, change the name to „sawtooth“.	
26	Under the <b>I/O</b> tab, enter the values for the block inputs, e.g. <ul style="list-style-type: none"> <li>• X = 1</li> <li>• TI = 5 ms</li> </ul> Click on <b>OK</b> .	The Properties dialog box is closed and the function block inputs now have values assigned.
27	First <b>click on</b> output QU and then on input S.	The output QU (upper limit) is now coupled back to input S (set).
28	Select <b>DAC</b> (analog output) from the block family <b>ON/OFF</b> and locate it next to function block INT. Open the dialog box using <b>Edit &gt; Object properties</b> and change the name to "analog output". Enter, for example under the <b>I/O</b> tab: <ul style="list-style-type: none"> <li>• DM = 0</li> <li>• OFF= 0</li> <li>• SF = 1E4</li> </ul> Click on <b>OK</b> . Select connection AD (hardware address), and call-up the dialog box to interconnect the object with <b>Insert &gt; Connect to operand</b> . Then mark the selection window. Select the X438_1_AOut1 entry and click on <b>OK</b>	The block inputs are parameterized.  The hardware address of the first analog output channel is assigned.
29	In the "sawtooth" block, <b>click on</b> 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 (from Step 22) for the other two sub-tasks (data exchange, running light).

Change into the SIMATIC Manager, open the CFC chart "data exchange" or "running lights", insert the function blocks into the CFC chart, parameterize and connect them.

You can take all of the necessary information and data (block number, type and parameters) from the "My first project" project provided on the CD. Arrange the first function block and all others, via **Edit > Run sequence** in cyclic task T2. A CFC window changeover (**Window > ...**) is used to interconnect from the "sawtooth" block to the send/receive function blocks (Chart "data exchange") or comparators (Chart "running lights").

## 6 Testing, compiling and downloading the project

### Contents of this section

Here you will read about:

- how you can check your project to ensure that it is free of errors
- the possibilities you have of downloading the user program into the FM 458-1 DP application module

### 6.1 Checking the project consistency and compiling

Step	Procedure	Result
30	<b>Now please check the consistency of the SIMATIC CPU module as you know it from STEP7.</b>	
31	<p>Go into the SIMATIC Manager and open the project tree down to the Object Charts below FM 458-1 DP application module.</p> <p>Select the charts by clicking on them.</p> <p>Start to check the consistency of your project with Edit &gt; <b>Check consistency</b>.</p> <p>Click on OK.</p> <p><b>Acknowledge</b> the dialog window or evaluate the error messages using <b>Details</b>.</p>	<p>The result is displayed in a dialog window.</p>
32	<p>After a successful consistency check, start compilation of the project with Edit &gt; <b>Compile</b> .</p> <p>Select "Compile everything" and click on OK.</p> <p><b>Acknowledge</b> the dialog window or evaluate the error messages using <b>Details</b>.</p>	<p>This means that all charts (your user program on the FM 458-1 DP) are compiled.</p> <p>The result is displayed in a dialog window.</p> <p>You have created your first user project.</p>

## 6.2 Downloading the user project into the FM 458-1 DP application module

### Introduction

Now load the SIMATIC CPU module as you know it from STEP7.

For the FM 458-1 DP application module, you can download your user project, either

- online or
- offline into the FM 458-1 DP memory module.

### Downloading offline

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

Step	Procedure	Result
33	Go into the SIMATIC Manager and open the project tree down to the Object Charts below FM 458-1 DP application module. Select the charts by clicking on them. Select <b>Target system &gt; Download</b> .	You obtain the dialog window with options.
34	Select the "System and user program", "Online" and initialization when first downloading the user program. <b>Note:</b> If a user program is downloaded again, you can also specify "Only user program" without "Initialization". Insert the memory module into the appropriate slot of the PG/PC. Start to download with <b>OK</b> .	A progress display shows how the system and your user program are being downloaded into the memory module.
35	Move the memory module into the FM 458-1 DP application module and re-start the station.	Your user programs are now started on the SIMATIC CPU module and on the FM 458-1 DP application module.



**Downloading online** You have established a connection from your PC/PG to the SIMATIC station and you can download the program memory module into the application module.

Step	Procedure	Result
36	Result Check whether your SIMATIC 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!
37	Insert the memory module into the FM 458-1 DP application module and start the SIMATIC station.	The STOP LED goes bright on the FM 458-1 DP application module
38	In the SIMATIC Manager, install the interface between the SIMATIC station and the PC using the following menu command <b>Options &gt; Set PG/PC interfaces....</b>	You obtain a dialog window "Install/uninstall interfaces" in which the various interfaces are listed.
39	In the dialog box window select "CP5611 (MPI)" and install this protocol with <b>Install</b> → Acknowledge with "yes" and then <b>close</b> the dialog window. Select the interface used and acknowledge with <b>"OK"</b> .	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 S7ONLINE (STEP 7) > CP5611 (MPI).
40	Select the <b>Target system &gt; Download</b> .	You obtain the dialog window with options.
41	Select the "System and user program", "Online (COM1)" and initialization when first downloading the user program. <b>Note:</b> 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. A dialog window is displayed where you can select whether the FM458 should go into STOP by either entering a "yes" or "no".
41a	If you select yes	If the download has been completed, the dialog window "Operating state" is displayed with "STOP" and you can make a warm start with RESTART. STOP is displayed on the CPU module.
41b	If you select restart	A dialog window is displayed where you can select whether you want to restart by entering either "Yes" or "No".
42	Start the FM 458-1 DP application module with "Yes" then select "Close".	Your user program is started and "RUN" is displayed on the FM458.

## 7 Testing the user project on the FM 458-1 DP

### Contents of this section

Here you will read about:

- how you can test your user program
- the possibilities which you have of testing your user program

### Introduction

Now test the program, which has been downloaded into the SIMATIC CPU module. The test procedure is the same as you already know for.

The test mode of the FM 458-1 DP application module offers you an extensive range of functions. 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 SIMATIC station.
- You have downloaded the actual project into the memory module, which is located in the FM 458-1 DP module.
- The associated CFC chart (e.g. "running lights") has been opened.

Step	Procedure	Result
43	Select the menu command: <b>Target system &gt; Compare</b> , 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 FM 458-1 DP application module can communicate.
44	Select the menu command: <b>Test &gt; Test settings</b> 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

<p><b>45</b></p>	<p>Before you go into the test mode, change over the test mode from "Process operation" to "laboratory operation" with <b>Test &gt; Laboratory operation</b>.</p> <p><b>Note:</b> In "Process operation", the default setting is that <b>no</b> I/O are registered for monitoring. In this test mode, you must select the appropriate blocks and explicitly log them-on for monitoring.</p>	<p>This means that all of the block I/O are automatically switched-in for "monitoring" (the values have a yellow background).</p>
<p><b>46</b></p>	<p>Select the menu command: <b>Test &gt; Test mode:</b></p>	<p>The "Test: RUN (laboratory)" appears in green in the status bar.</p> <p>In the test mode, you can monitor and change the dynamic behavior (online).</p>

## 7.1 Disconnecting the connections between the block I/O 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.

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

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## 7.2 Establishing the connections between block I/O 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.

## 7.3 Changing the parameterization of block I/O 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

## 7.4 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.

---

## 7.5 Deleting blocks online

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

## 8 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 SIMATIC station. 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 SIMATIC 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 SIMATIC station. The assignment of the pins at output connector X1 of the EXM 438-1 expansion module is shown in the following table. The output voltage range extends from -10 V to +10 V.

You can monitor the change of the upper integrator limit value as a result of your SIMATIC CPU program at this analog input (e.g. a change which is made using a SIMATIC OperatorPanel which is not part of this simple example).

Pin	Function	Output
11/12	Analog output 1	Sawtooth
20	Ground	

Table 8-1 Excerpt from the pin assignment of EXM 438-1, connector X1

### Running light

You can observe the running light function at the LED display of the ET200 module SM 322.

## 9 Archiving the project

Step	Procedure	Result
47	In the SIMATIC Manager, select <b>File &gt; Archive</b> .	The "archiving" dialog field is displayed.
48	In the dialog field "Archiving", select the user project with "My First Project". Click on <b>OK</b> .	The "archiving - select archive dialog field" is displayed. The default file "My_first.zip" has already been entered with archiving path.
49	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.

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## 10 Background information on FM 458-1 DP

### Contents of this section

Here you will read about:

- which **basic system properties** the FM 458-1 DP application module can offer you

### Note

**Detailed information** about all of the properties/features of the FM 458-1 DP application module are provided in the **User Documentation** which is installed in the system (Start->Simatic-> Documentation)

### 10.1 The coupling to SIMATIC CPU

The **FM 458-1 DP application module** has a RAM memory (128 Kbytes) which is used to connect it to the P bus. You can exchange data with **one** SIMATIC S7-CPU via this P-bus memory. In this case, the FM 458-1 DP application module is passive on the P bus. This means that you cannot directly access other SIMATIC station modules using the FM 458-1 DP application module.

You have 3 ways of exchanging data with the SIMATIC-CPU:

- You can transfer 4 bytes to the SIMATIC CPU using a **process interrupt**
- You can send and receive 128 bytes using **SIMATIC I/O access operations** (in our "my first project" project, we use this type of data exchange to transfer the upper limit value of the integrator from the SIMATIC CPU to the FM 458-1 DP application module)
- Using **data sets**, you can send and receive a large quantity of data

Designation	Number of data	Configuring	Speed	Computation time (on the FM 458)
Process interrupt	4 bytes to the SIMATIC-CPU	FM 458-1 DP: Function block PAS7  SIMATIC CPU: OB40, etc.	When PAS7 is called, an interrupt is immediately initiated on the SIMATIC-CPU, e.g. OB40 (if a higher-priority interrupt is not being presently processed).	Extremely low (only for PAS7)
Data transfer with I/O access operations	128 bytes in both the send and receive directions	<i>FM 458</i> : Blocks S7RD, S7WR  <i>SIMATIC-CPU</i> : Transfer commands for the I/O	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: approx. 5µs.
Transfer of data sets	For extremely high quantities of data: Max. approx. 125 data sets, each with max. 240 bytes	<i>FM 458</i> : Virtual connections with the blocks @CPB, CRV/CTV  <i>SIMATIC-CPU</i> : System functions SFC58/59  Consistency: All data associated with a telegram are consistent with one another, i.e. they are transferred in a data package.	When the block is called, the data to a telegram are read or sent.	For each data set, there is a computation time to process the telegram (approx. 30µs for each CRV/CTV) and copying the net data into/out of the P bus memory.  For large data quantities and a high P bus utilization, increased computation time must be expected.

Fig. 2: Overview of the 3 ways to exchange data



## 10.2 The run properties

With the FM 458-1 DP application module, you can define up to 5 cyclic sampling times. A cyclic sampling time  $T_x$  is always a power of 2 to the basic sampling time  $T_0$ . The cyclic sampling time  $T_1$  is always the fastest, the  $T_5$  the slowest sampling time. The blocks are computed in these sampling times. The call of the individual sampling times is shown in the following diagram:

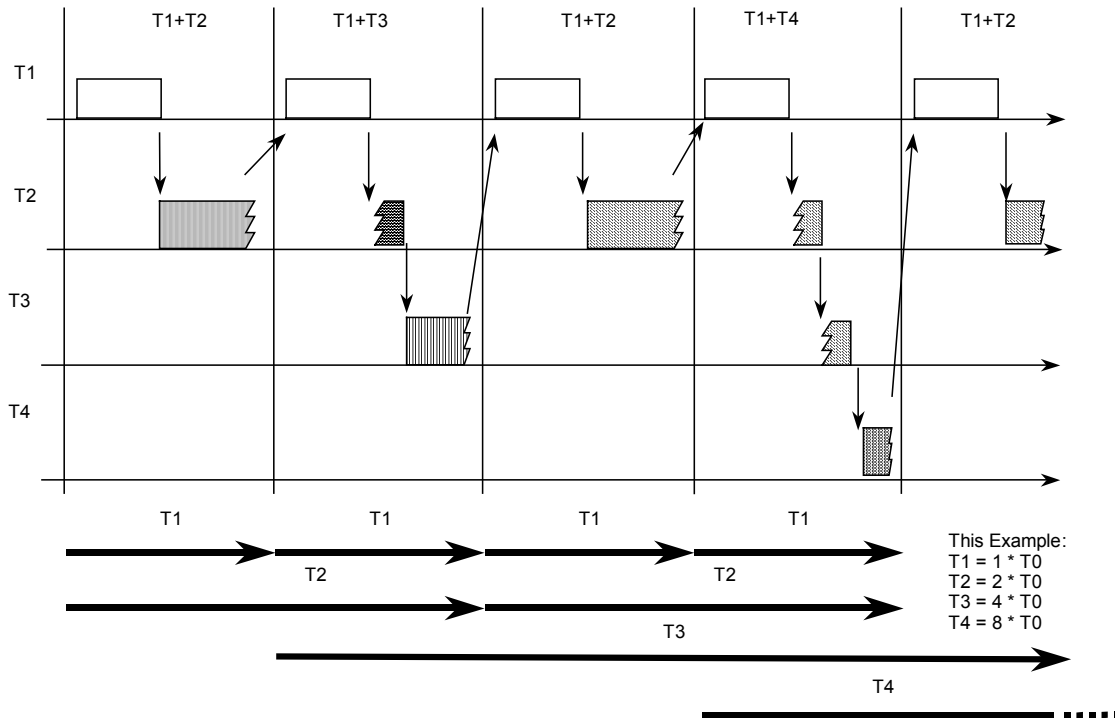


Fig. 3: Run properties of the FM 458-1 DP

Using these properties, you can split-up your complete application into individual sub-tasks. You can arrange that these sub-tasks are computed at different speeds. This allows you to finely distribute the available computation performance to the particular application. Such a distribution can, for example, look like this:

Sampling time	Functions
T1 1 ms	Closed-loop speed control
T2 4 ms	Higher-level closed-loop position control
T3 8 ms	Communications
T4 32 ms	Reading-in binary signals of an input field
T5 256 ms	System blocks

## 10.3 Addressing the hardware

For the FM 458-1 DP application module, you can address all of the hardware inputs and outputs using symbolic addresses. You designate the inputs and outputs in the HWConfig hardware configuration. These symbolic addresses are then available in CFC. Inputs/outputs, which you do not designate in HW Config, are not available in CFC.

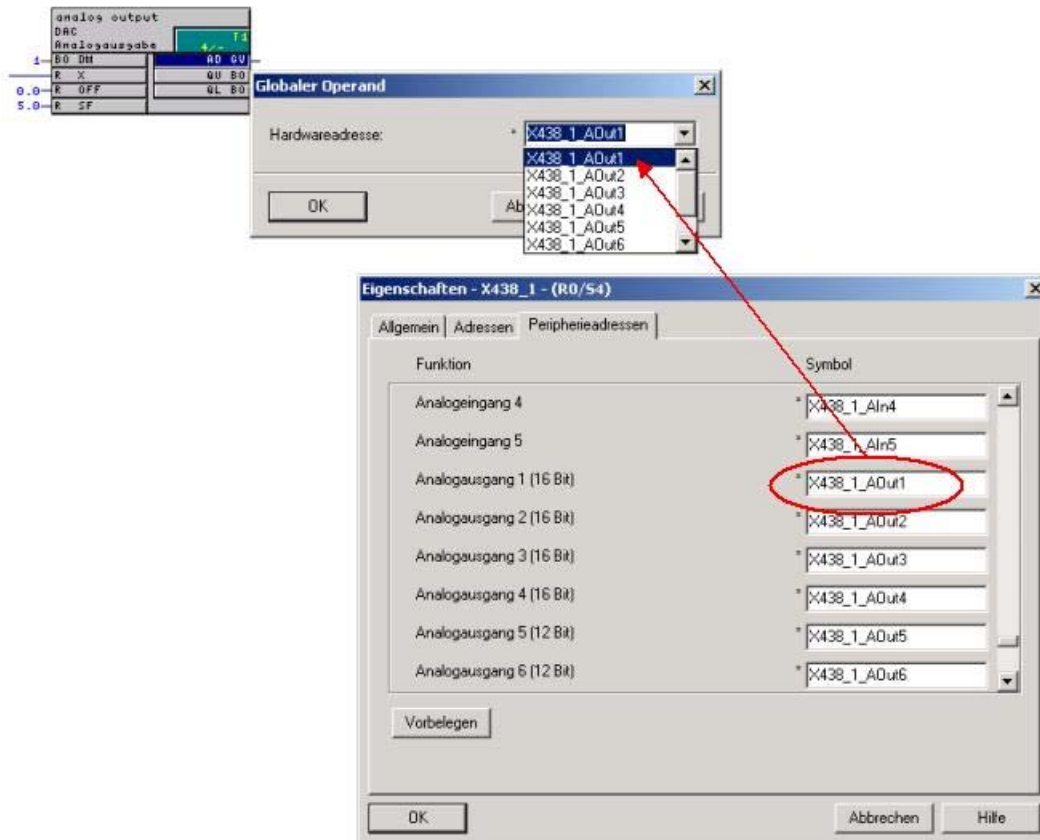


Fig. 4: Example of a completed address field with reference to the CFC

## 10.4 Process data communications

You (almost) always configure the process data communications (e.g. for PROFIBUS DP) on the FM 458-1 DP application module in the same way:

You require the following

- one **central block** (e.g. @PRODP for the PROFIBUS DP coupling) which initializes and monitors the communications. You configure communication-specific tasks (e.g. the baud rate) and the (Port) at this central block.
- **Send and receive blocks CTV and CRV**. Using these function blocks, you send/receive net data to/from the hardware.
- **Virtual connections**. The connections (I/O) of the function blocks which you configured, are used as data sources or data drains (receivers). These virtual connections represent the interrelationship between the data to be sent/received (function block connections) and the send/receive function blocks CTV/CRV.

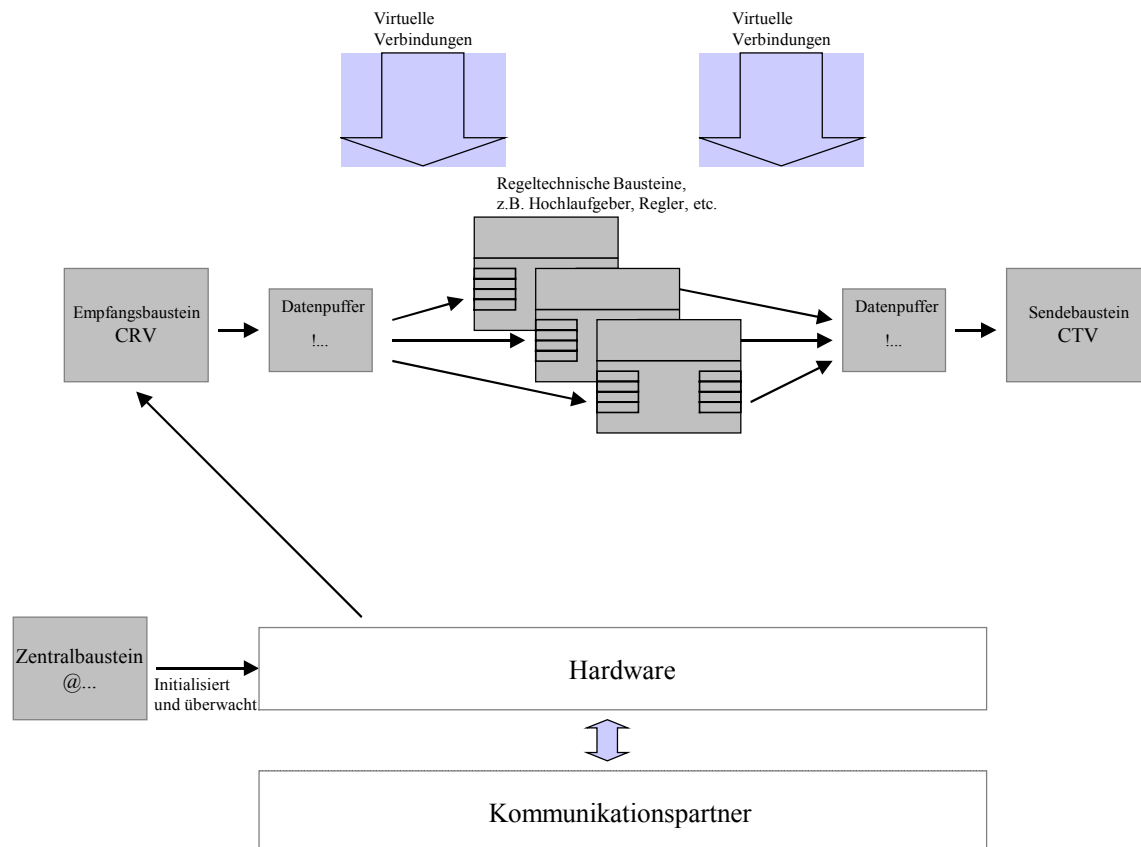


Fig. 5: Principle of the process data communications