Configuration Control (Options Handling) for ET 200SP and PROFINET

SIMATIC S7

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Configuration Control for ET 200SP and PROFINET

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Table of Contents

1 Task

1.1 Starting point

The following situation often occurs in serial engineering:

- There are x different variants for 1 machine

The particular variant of a machine is specified for:

- Delivery of the machine
- Upgrade for a machine that is already in use

The variants of the machine are distinguished by:

- Mechanical configuration of the machine
- Automation technology:
  - Different configurations of existing distributed ET 200 stations
  - Various STEP 7 projects

When different STEP 7 projects are used for various variants of a machine, this has the following disadvantages:

- Increased effort for creating and maintaining the software
- For each variant an individual STEP 7 project has to be loaded.

1.2 Task

A single STEP 7 project (STEP 7 basic project) is to cover <u>all</u> variants of a machine:

- Different configurations of the ET 200
- Different programs for automation

For the above task SIMATIC offers a solution:

- Configuration control (options handling) with ET 200

1.3 Example

A lathe that can be delivered in 3 variants serves as an example:

- Variant 1: lathe
- Variant 2: lathe with coolant supply
- Variant 3: lathe with coolant supply and tool magazine

Starting point

The variants are automated with a S7 CPU and an ET 200 station. An individual STEP 7 project exits for each variant:

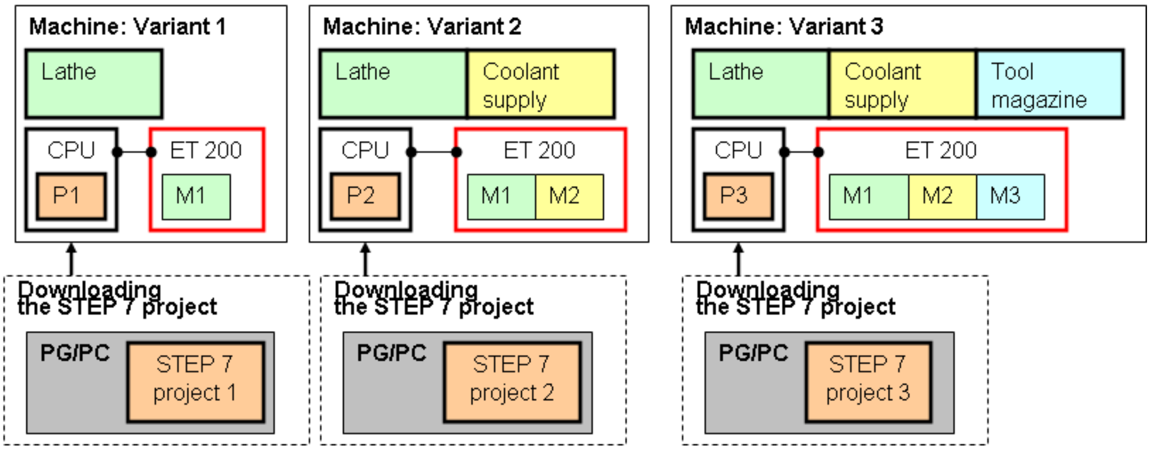
Table 1-1

Variant	Configuration ET 200 (*1)	STEP 7 project
Variant 1	Module 1 (M1)	STEP 7 project 1 (P1)
Variant 2	Module 1 (M1), module 2 (M2)	STEP 7 project 2 (P2)
Variant 3	Module 1 (M1), module 2 (M2), module 3 (M3)	STEP 7 project 3 (P3)

Regarding (*1): "Module" stands for "I/O module"

The figure clarifies the connections:

Figure 1-1



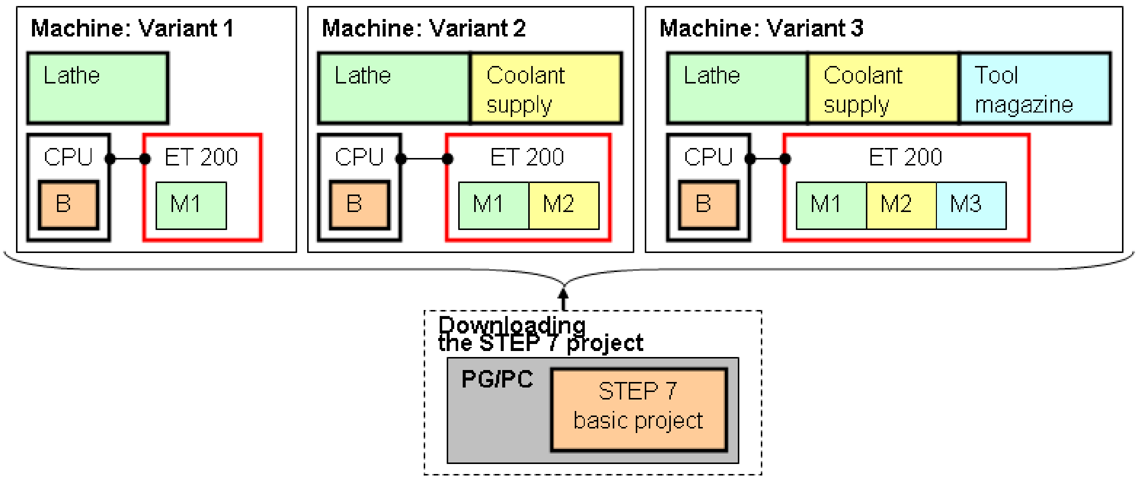
Task

All variants should be automated with the same STEP 7 project:

- STEP 7 basic project (B)

The figure clarifies the connections:

Figure 1-2



2 Solution

2.1 Principle

With the configuration control (options handling) SIMATIC offers a solution for the previously described tasks: All variants of a machine are covered with a single STEP 7 project (STEP 7 basic project).

For this purpose, the configuration control (options handling) uses different procedures:

- Configuration control with empty slots
- Configuration control without empty slots

Configuration control with empty slots

Here, slots in the ET 200SP are executed as empty slots first of all:

- BaseUnits with BU cover (BC) instead of I/O modules (modules)

Procedure for the automation of variant 1 of the machine:

- 1.: Single loading of a STEP 7 project (STEP 7 basic project)
- 2.: Enabling the program of variant 1 (for example via a bit).

Procedure for the change of variant 1 to variant 2:

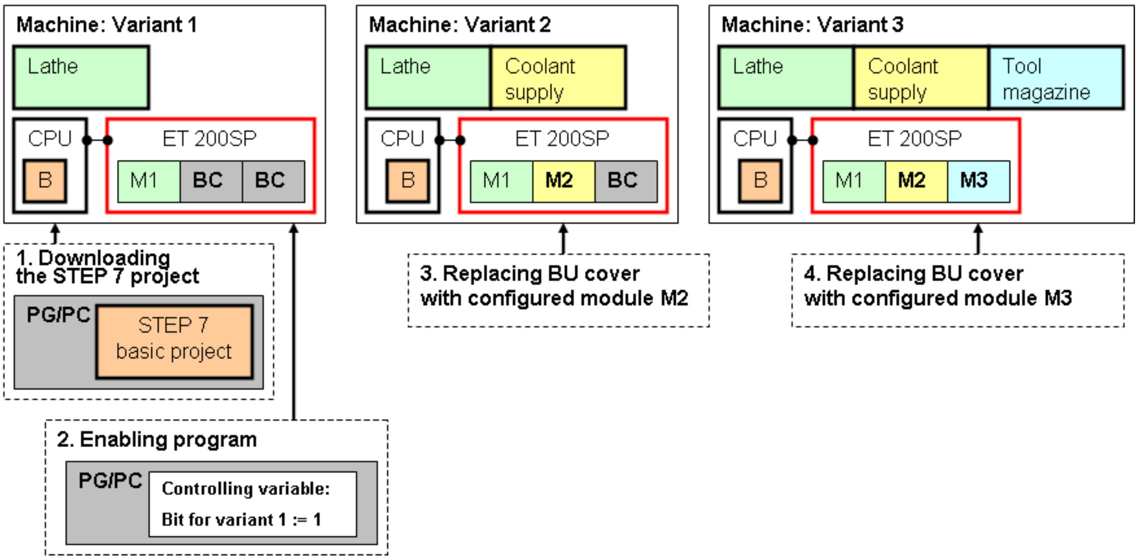
- 3.: Swapping BU cover (BC) for the configured module 2 (M2) in STEP 7 basic project.

Procedure for the change of variant 2 to variant 3:

- 4.: Swapping BU cover (BC) for the configured module 3 (M3) in STEP 7 basic project.

The figure clarifies the connections:

Figure 2-1



Configuration control without empty slots

Here, configured modules can be hidden or any slots can be assigned to the ET 200SP station.

Procedure for the automation of variant 1 of the machine:

- 1.: Single loading of a STEP 7 project (STEP 7 basic project).
- 2.: Enabling the program of variant 1 (for example via a bit).

Procedure for the change of variant 1 to variant 2:

- 3.: Conversion (*1) of the ET 200SP station
- 4. Enabling the program of variant 2 (for example via a bit)

Procedure for the change of variant 2 to variant 3:

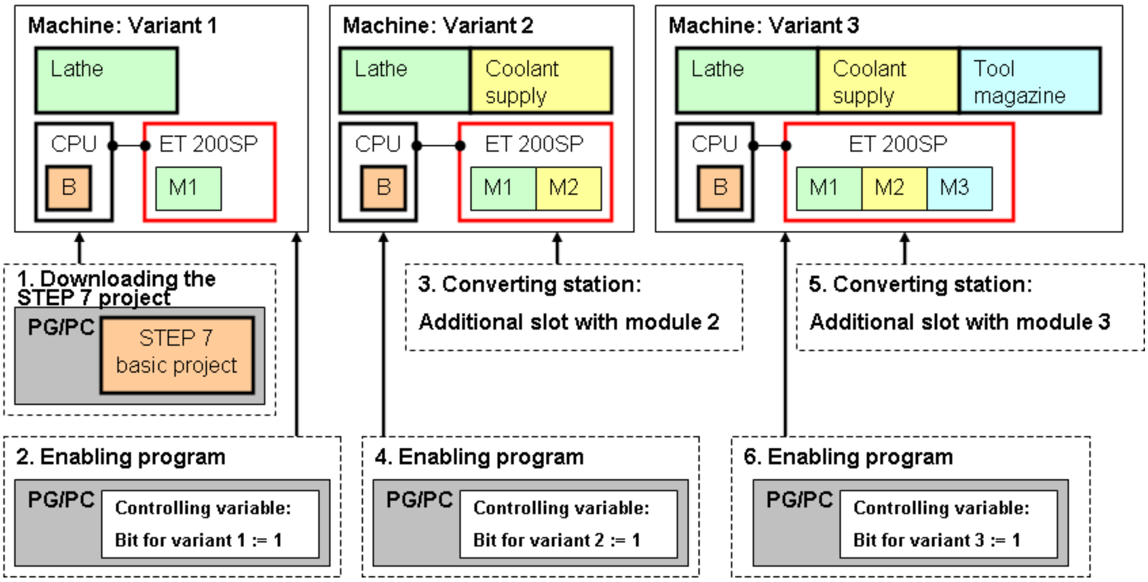
- 5.: Conversion (*1) of the ET 200SP station
- 6. Enabling the program of variant 3 (for example via a bit)

Regarding (*1): With conversion, the following is meant:

- Adding/removing slots (BaseUnits)
- Changing the wiring

The figure clarifies the connections:

Figure 2-2



2.2 Advantages

The solution of the configuration control (options handling) with ET 200SP offers the following advantages:

Table 2-1

Advantage	Explanation
Easier project processing and commissioning	A single STEP 7 project is used for all variants of a machine.
Easier handling for maintenance, versionizing and upgrade	
Savings in hardware costs	Only the modules that are required for the current variant of the machine are built into the ET 200SP station.
Easier change of the variants	<u>When using empty slots:</u> Here, only BU covers are replaced with optional modules. A conversion (*1) of the ET 200SP station is not required.
	<u>Without the use of empty slots:</u> Here, for example, optional modules can be installed at the end of the ET 200SP station. This prevents the elaborate lateral sliding of wired parts of a ET 200SP station.

<u>Regarding (*1):</u> With conversion, the following is meant:

- Adding/removing slots (BaseUnits)
- Changing the wiring

2.3 Functionality of the application

2.3.1 Object

The application shows the configuration control (options handling) for the following boundary conditions:

- Distributed ET 200SP stations
- Communication via PROFINET

All methods for the configuration control are examined:

- Hiding of modules
- Free slot assignment
- Use of empty slots
- Opening of a new potential group
- Combination of the above methods

The application includes:

- Documentation (document on hand)
- Code (STEP 7 project, created with STEP 7 V11)

The document describes the basics of the configuration control.

In the code the individual methods of the configuration control are applied concretely.

Basic knowledge for the following issues is assumed:

- ET 200SP (/1/)
- PROFINET (/3/)
- STEP 7 V11 (/8/)

2.3.2 Range of function of code

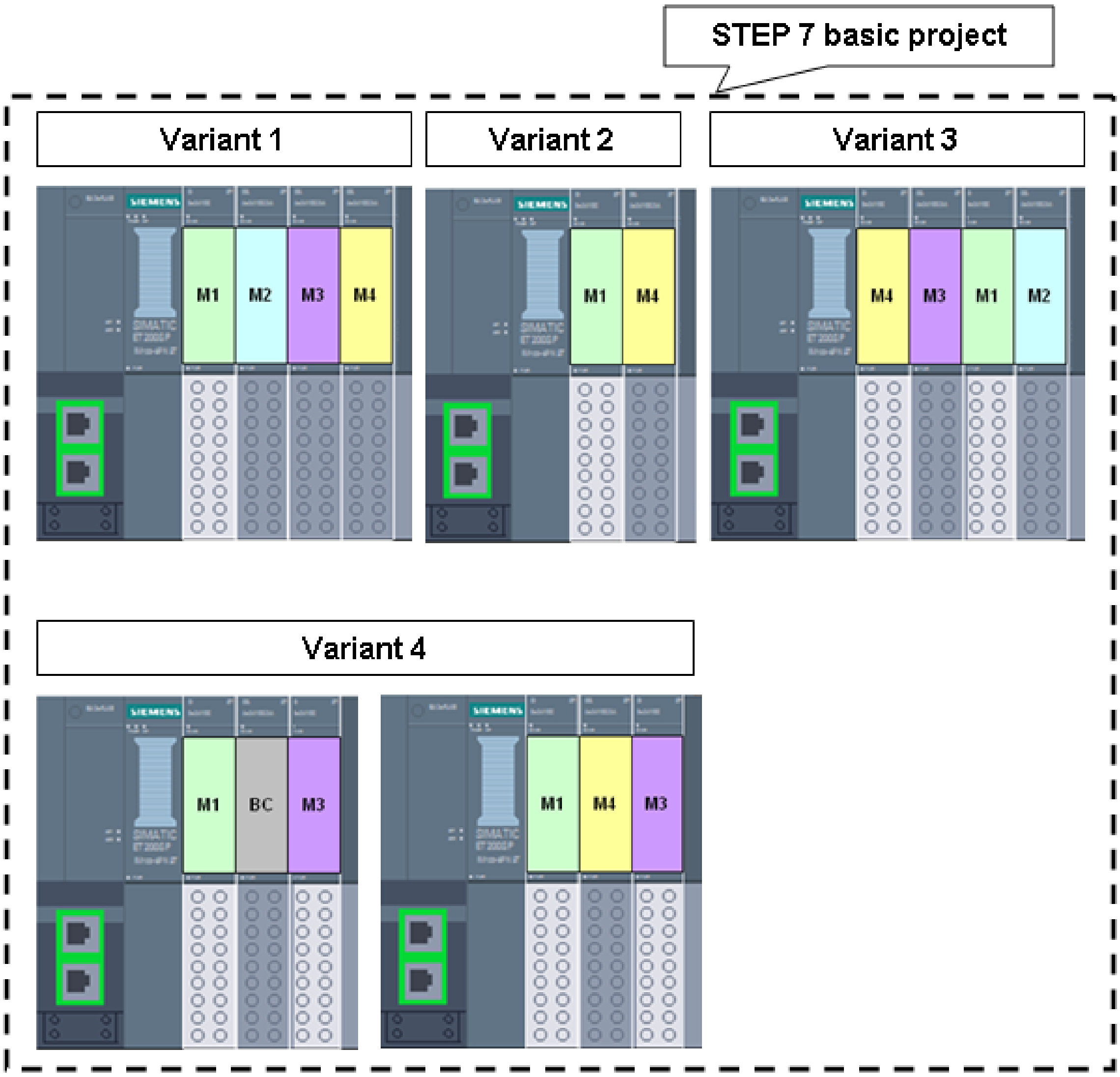
Functional scope

In the STEP 7 project of the application (code) different methods of configuration control (options handling) are used.

The STEP 7 project (STEP 7 basic project) comprises four different variants of an ET 200SP station at PROFINET.

The individual variants are explained in chapter 4.4.

Figure 2-3



Explaining the figure

For clarification purposes, the modules are color coded.

The same colors mean the same modules:

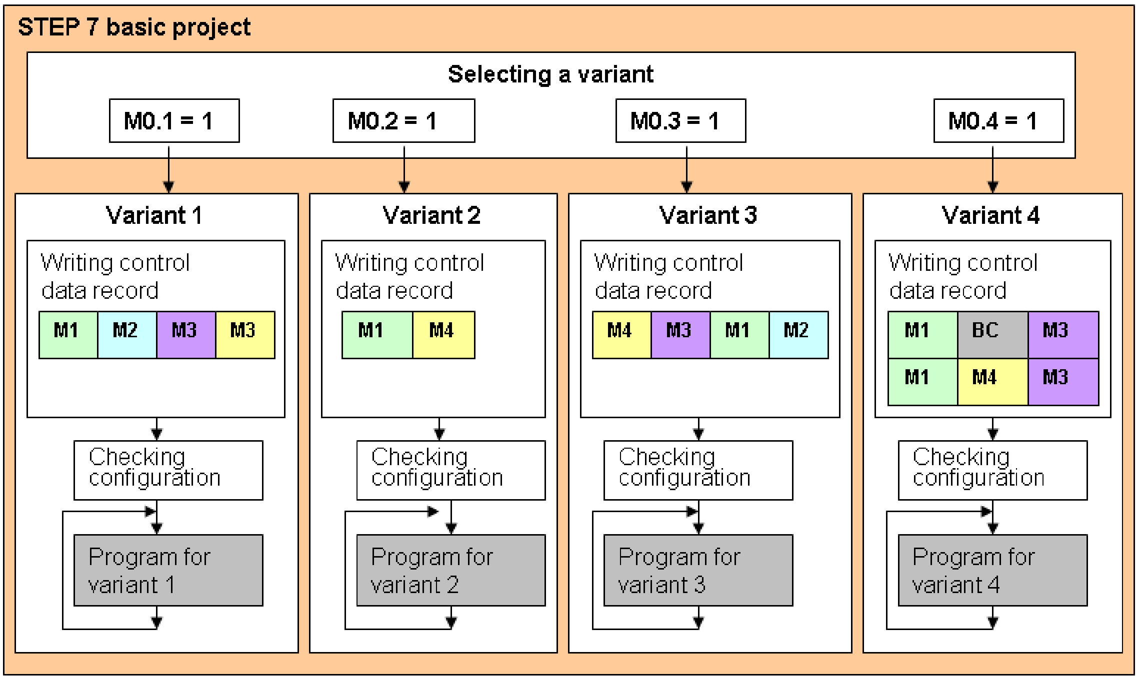
BU Cover (BC) Module 1 (M1) Module 2 (M2) Module 3 (M3) Module 4 (M4)

The variant x is selected above the “Control Variable” on the PG/PC:

- positive edge on flag M0.x

The figure shows the principle:

Figure 2-4



When selecting variant x the following actions are triggered in the code:

- Writing control data record for variant x
- Checking whether the conversion of ET 200SP is correct:
  - Reading of the feedback data record of the ET 200SP
  - Comparison with the expected feedback data record of variant x
- Cyclic call of the program for variant x
  (automation program for variant x)

Remarks regarding the selection of modules for the ET 200SP station

The conversion of the ET 200SP stations has deliberately been kept small in the present application. This makes the application clearer and the principle of the configuration control (options handling) can be better demonstrated.

Of course, in real world conditions, more or several other modules are used in an ET 200SP station.

There is no practical restriction regarding the number, mix and type of modules for the various variants of the configuration control (options handling). Only the technical restrictions of the ET 200SP system (maximum number of slots, have to be observed (/1/).

2.4 Hardware and software used

The application document was generated using the following components:

2.4.1 Hardware components

Table 2-2

Component	Name (*1)	Number	MLFB/order number	Firmware
CPU315-2 PN/DP	---	1	6ES7315-2EH14-0AB0	V3.2
MMC for S7 CPU (e.g. 2 MByte)	--	1	6ES7953-8LLxx-0AA0	---
IM 155-6 PN ST incl. BA 2xRJ45	---	1	6ES7155-6AU00-0BN0	V1.0
Bright BaseUnit (BU_D)	---	2	6ES7193-6BP20-0DA0	---
Dark BaseUnit (BU_B)	---	3	6ES7193-6BP20-0BA0	---
DI 8x24VDC ST	Module 1 (M1)	1	6ES7131-6BF00-0BA0	
just as module 1	Module 2 (M2)	1	just as module 1	---
DQ 4x24VDC/2A ST	Module 3 (M3)	1	6ES7132-6BD20-0BA0	---
DQ 8x24VDC/0,5A ST	Module 4 (M4)	1	6ES7132-6BF00-0BA0	---
BU Cover	BU Cover (BC)	1	6ES7133-6CV15-1AM0	---

Regarding (*1): These names and background colors are later used for the description of the variants.

2.4.2 Software components

Table 2-3

Component	Type	MLFB/order number	Note
STEP 7 Professional V11	SP2	6ES7822-1A.01-..	---

2.4.3 Downloads for the application

The following table includes all downloads of the application (/4/).

Table 2-4

Download	File name	Content
Documentation	29430270_OH_ET200SP_PN_DOKU_v10_en.pdf	Description of the application.
Code	29430270_OH_ET200SP_PN_CODE_v10.zip	STEP 7 project (code).

3 Basics

The chapter describes the basics for the configuration control with ET 200SP.

3.1 Principle of operation

3.1.1 What is the configuration control?

The configuration control (options handling) facilitates the automation of machines that differ in the configuration of ET 200SP stations. This becomes apparent when looking at the different approaches.

Approach without configuration control

In STEP 7 the configuration of the ET 200SP stations is configured. The real configuration of the ET 200SP stations at the machine has to comply with the configured configuration.

A STEP 7 project is only usable for one single real configuration.

Approach with configuration control

Here, the configuration of the ET 200SP stations is also configured in STEP 7. However, this configuration comprises all modules of all variants of the machine. With a single STEP 7 project (STEP 7 basic project) or with a single configuration (maximum configuration), different real configuration of ET 200SP stations can be performed.

A single STEP 7 project can therefore be used for several real configurations of ET 200SP stations.

3.1.2 Overview of the methods

The configuration control uses different methods.

Hiding of modules

Starting point is the maximum configuration configured in STEP 7.

For this method configured slots (modules) can be hidden in the real ET 200SP station. The real station is then assembled without these hidden slots (modules).

Advantage:

Only the modules that are required for the variant x of the machine have to be installed in the real ET 200SP station.

Free slot assignment

Starting point is the maximum configuration configured in STEP 7.

For this method the configured slots (modules) can be assigned to any real slots in the real ET 200SP.

Advantage

Here, for example, optional modules can be installed at the end of the ET 200SP station. An installation on the configured slot in the middle of the station is not necessary. This avoids the elaborate lateral sliding of wired parts of an ET 200SP station.

Use of empty slots

Starting point is the maximum configuration configured in STEP 7.

For this method BU covers are used in the real ET 200SP station instead of configured modules (chapter 3.1.3). The BU cover is used as dummy for modules that can be plugged in later.

Advantage

Optional modules can be pre-wired. For a later upgrade of the ET 200SP station only the BU covers are exchanged with these modules. A conversion of the ET 200SP station is not required.

Note: A slot with BU cover is called an empty slot.

Opening of a new potential group

Starting point is the maximum configuration configured in STEP 7.

For this method, new potential groups can be opened in the real station at any place.

Advantage

This results in a high flexibility for the design of potential groups.

Combination of methods

For an ET 200SP station all of the above methods can be used at the same time.

3.1.3 BU Cover

Properties of a BU cover:

- BU covers are empty slots for I/O modules (modules).
- The BU cover has no connection to the terminals of the BaseUnit. Therefore the BaseUnit can be fully wired in advance.
- BU covers are not configured in STEP 7.

3.1.4 Examples illustrating the function principle

Below, the options of the configuration control are explained on an example:

- Starting point is a configured configuration of the ET 200SP (maximum configuration) with 4 I/O modules (modules).
- In the example, 6 variants of the ET 200SP are discussed.

For all variants a single STEP 7 project (STEP 7 basic project) is required. This STEP 7 basic project describes the maximum configuration.

<u>Note</u>

The above variants are not identical with the variants (chapter 4.4) realized in the code. The above variants only serve as explanation of the basic options for the configuration control.

Table 3-1 shows the maximum configuration and the variants of ET 200SP. Explanations on configuration and abbreviations of the table can be found in chapter 3.1.5.

Table 3-1

			Number of slot of the ET 200SP				
			1	**2**	**3**	**4**	**5**
Configured configuration of the ET 200SP (maximum configuration)		Modules:	M1	M2	M3	M4	SM
		BaseUnits:	BU_D	BU_B	BU_B	BU_B	
Real configuration of the ET 200SP	Variant 1	Modules:	M1	M2	M3	M4	SM
		BaseUnits:	BU_D	BU_B	BU_B	BU_B	
	Variant 2	Modules:	M1	M4	SM	---	---
		BaseUnits:	BU_D	BU_B			
	Variant 3	Modules:	M4	M3	M1	M2	SM
		BaseUnits:	BU_D	BU_B	BU_B	BU_B	
	Variant 4	Modules with BC:	M1	BC	M3	BC	SM
		Modules without BC:	M1	M2	M3	M4	
		BaseUnits:	BU_D	BU_B	BU_B	BU_B	
	Variant 5	Modules:	M1	M2	M3	M4	SM
		BaseUnits:	BU_D	BU_B	BU_D	BU_B	
	Variant 6	Modules with BC:	M3	BC	M1	SM	---
		Modules without BC:	M3	M4	M1		
		BaseUnits:	BU_D	BU_B	BU_D		

Table 3-1 describes what methods of the configuration control are used and what properties the real configurations of the ET 200SP have.

Table 3-2

Variant	**Methods**	**Properties**
Variant 1	---	corresponds to the configured maximum configuration
Variant 2	Hiding of modules	Module 2 and module 3 are hidden
Variant 3	Free slot assignment	Other order of the modules: • The module (M4) configured for slot 4 is inserted in slot 1. • The module (M3) configured for slot 3 is inserted in slot 2. • The module (M1) configured for slot 1 is inserted in slot 3. • The module (M4) configured for slot 2 is inserted in slot 4.
Variant 4	Use of empty slots	• Only module 2 or a BU cover must be inserted in the real slot 2. • Only module 4 or a BU cover must be inserted in the real slot 4.
Variant 5	Opening of a new potential group	• A new potential group is opened in slot 3.
Variant 6	Combination	• Module 2 is hidden • Other order of the modules • Empty slot in slot 2 • New potential group in slot 3

3.1.5 Explanations on the examples

The configuration of Table 3-2 (previous chapter) is explained below on the example of variant 1.

Table 3-3

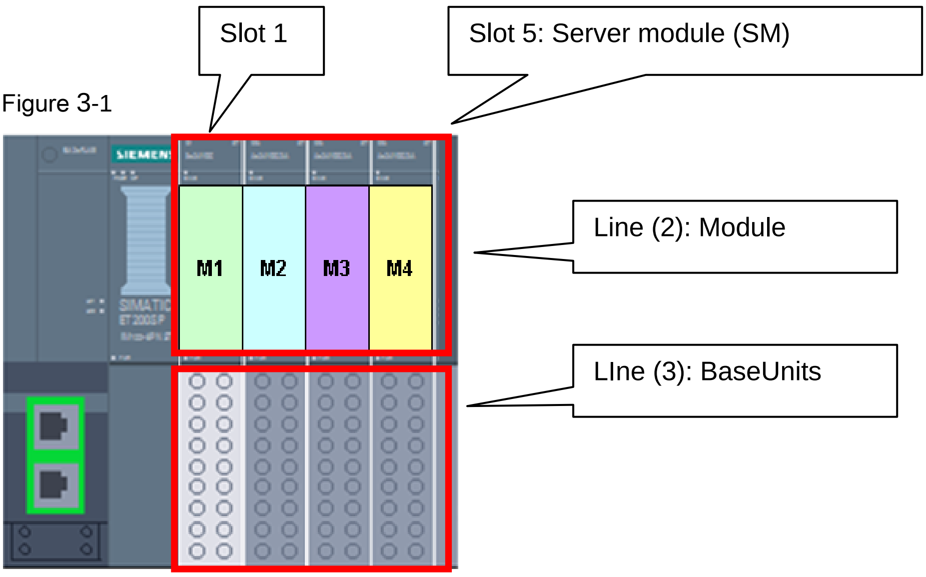
Line			Number of slot of the ET 200SP				
(1)			1	2	3	4	5
(2)	Variant 1	Modules:	M1	M2	M3	M4	SM
(3)		BaseUnits:	BU_D	BU_B	BU_B	BU_B	

Meaning of lines

The line (1) contains the number of the slots in the ET 200SP.

The two lines (2) and (3) symbolize the configuration of the ET 200SP. This following figure illustrates this.

Figure 3-1



Meaning of the abbreviations

BC	BU Cover
Mx	Module x (I/O module)
SM	Server module
---	The slot does not exist in the real station.
BU_D	Bright BaseUnit (opens a new potential group)
BU_B	Dark BaseUnit

3.2 Standard procedure

To use the configuration control (options handling), the following has to be performed in STEP 7:

- Configuration
- Programming

3.2.1 Configuration

The following configuration has to be performed in STEP 7:

- Maximal configuration of the ET 200SP station
- Enable configuration control for the interface module (IM) of the ET 200SP

Maximum configuration

In STEP 7 (device configuration) the maximum configuration of the ET 200SP stations is configured.

Enabling configuration control

Operating the device configuration of STEP 7:

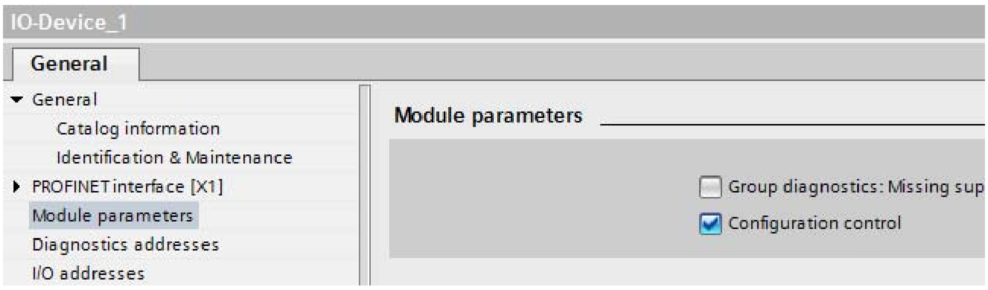
In the work area:

- Open device view > select "IO-Device_1" in the drop-down list
- Select the interface module (IM)

In the inspection window:

- Select "Properties" tab
- At "Module parameters":
  Enable "Configuration control"

Figure 3-2



3.2.2 Programming

The following programming must be performed in STEP 7:

- Writing control data record

The following programming is optional:

- Reading feedback data record

Writing control data record

A control data record has to be written in the ET 200SP station which describes the expected configuration of the station (chapter 3.3.2).

The writing is performed in the program of the S7 CPU with the help of SFBs:
SFB 53 (WRREC), writing data record 196

Reading feedback data record

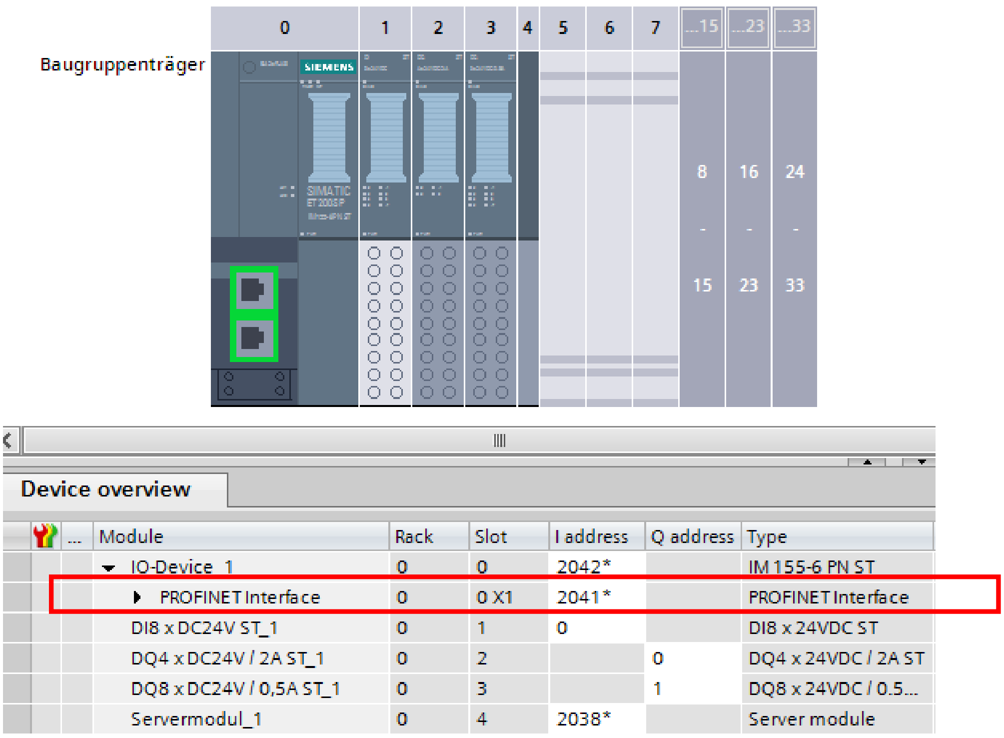
A feedback data record can be read from the ET 200SP station that describes the actual configuration of the station (chapter 3.3.3).

The reading is performed in the program of the S7 CPU with the help of SFBs:
SFB 52 (WRREC), reading data record 197

Addressing the IM on the SFBs

For above SFBs an address has to be specified. You get this address from the device configuration in STEP 7 (address of IO-Device_1). The following figure shows where to find the address.

Figure 3-3



Module	Rack	Slot	I address	Q address	Type
IO-Device_1	0	0	2042*		IM 155-6 PN ST
PROFINET Interface	0	0 X1	2041*		PROFINET Interface
DI8 x DC24V ST_1	0	1	0		DI8 x 24VDC ST
DQ4 x DC24V / 2A ST_1	0	2		0	DQ4 x 24VDC / 2A ST
DQ8 x DC24V / 0,5A ST_1	0	3		1	DQ8 x 24VDC / 0.5...
Servermodul_1	0	4	2038*		Server module

Note: For S7-1200 the following address is used: IO-Device[Head]

Addressing the modules of the ET 200SP

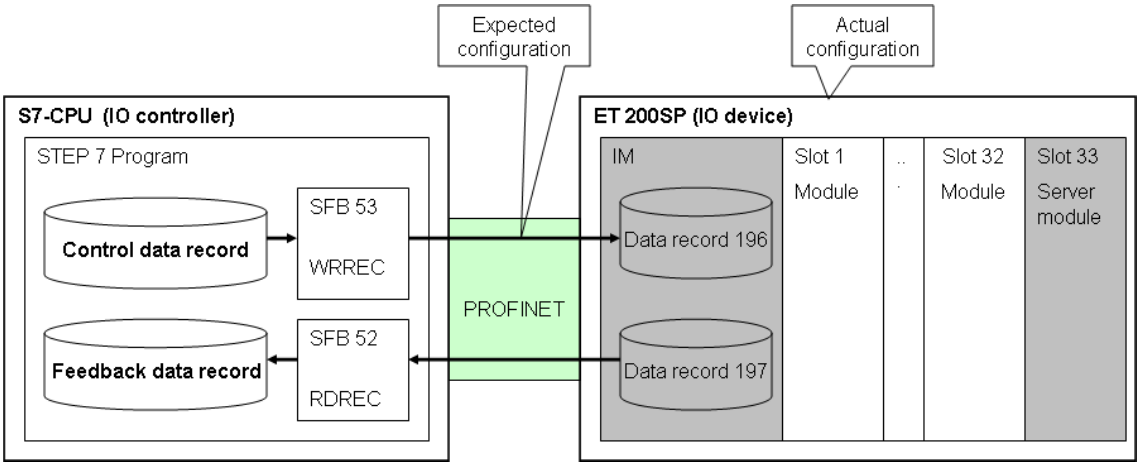
In the program of the STEP 7 basic project, the modules of all variants of the ET 200SP are addressed. The addressing of the modules in the program corresponds to the maximum configuration that was configured in STEP 7.

3.3 Control data record and feedback data record

3.3.1 Overview

The following figure illustrates the relationships.

Figure 3-4



3.3.2 Control data record

Function

With the control data record, the interface module (IM) is informed of the configuration of the station ET 200SP (expected configuration). The IM checks the real configuration (actual configuration) against this configuration (expected configuration). If expected configuration and actual configuration do not match, the diagnostic will report.

The control data record describes the expected configuration of the ET 200SP. The maximum configuration in STEP 7 is the reference point. Slot x, configured in maximum configuration, is represented by a control element in the control data record.

A control element consists of two bytes:

- Assignment byte :
  The assignment of the configured slot x to the real slot y is coded in the byte.
- Byte additional function:
  Additional functions are coded in the byte.

Writing the control data record is required in the following cases:

- For the first commissioning of the ET 200SP station (*1)
- For changes in the configuration of the ET 200SP station (*2)A control data record is stored retentively in the ET 200SP station.

The control data record is stored retentively in the ET 200SP station.

Regarding (*1): The data record has to be written at least once, so that the configuration control is ready to operate. Up until then, the following applies:

- All modules of the station have failed.
- The interface module (IM) is exchanging data.

Regarding (*2): When writing the control data record with changed configuration (altered configuration) the station will fail (the cyclic data exchange is interrupted), and the new startup of the station with changed configuration will subsequently take place.

Setup

Table 3-4 shows the configuration of the control data record.

Table 3-4

Number of the byte	Meaning	
0, 1, 2, 3	Header	
4	Assignment for configured slot 1	Control element for configured slot 1
5	Additional function for configured slot 1	
6	Assignment for configured slot 2	Control element for configured slot 2
7	Additional function for configured slot 2	
...	...	...
2*x + 2	Assignment for configured slot **x**	Control element for configured slot **x**
2*x + 3	Additional function for configured slot **x**	

Coding assignment byte

Table 3-5 shows the coding of the assignment byte for slot x.

Table 3-5

Bit 7	Bit 6 to 0	Meaning
0	0	The module configured for configured slot x does not really exist.
0	y	The configured module configured for slot x is inserted in the real slot y.
1	y	The module configured for the configured slot x is inserted in the real slot y, or a BU cover is inserted in the real slot y. Hexadecimal presentation: y + 80H

Coding of additional function byte

Table 3-6 shows the coding of the additional function byte for slot x.

Table 3-6

Bit 7 to 1	Bit 0	Meaning
reserved	0	---
reserved	1	Opening of a new potential group on the real slot y.

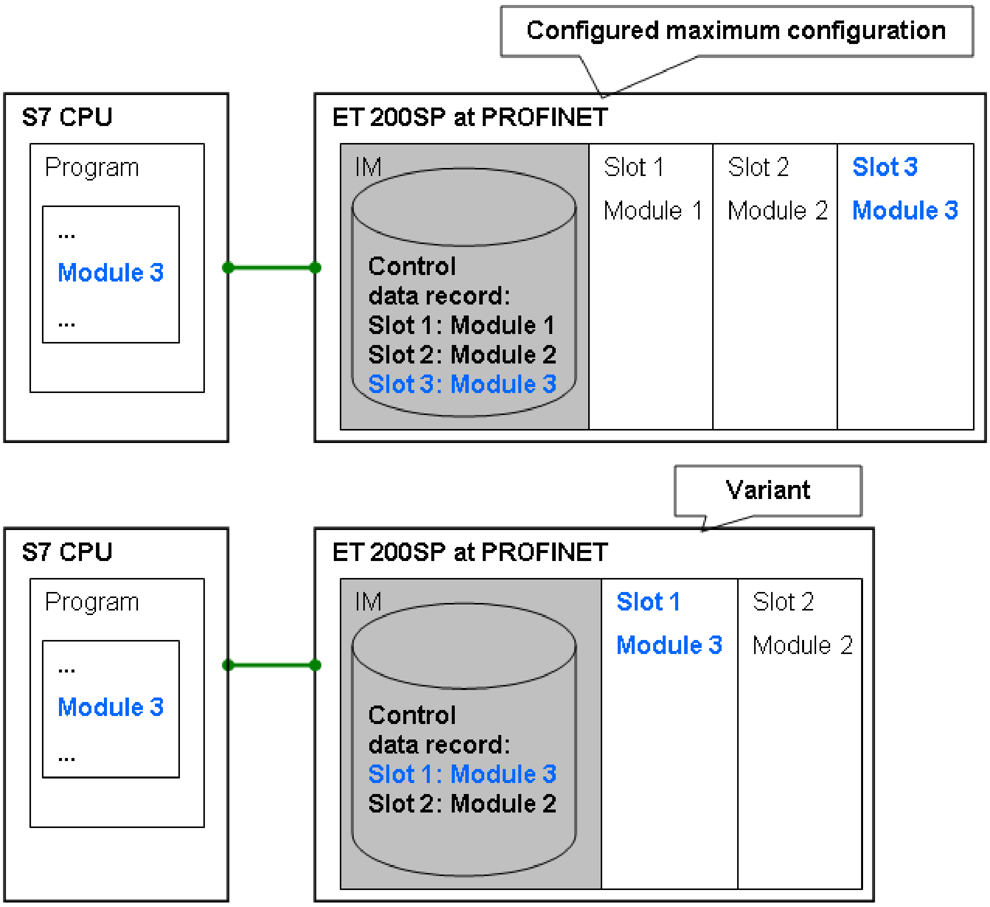
Examples

Example for the clarification of the codings can be found in chapter 3.4.

Correlation of addressing and control data record

The adjustment of the addressing of the modules (I/O modules) on the real configuration is performed in the interface module (IM) with the help of the control data record. The following figure shows the principle:

Figure 3-5



The program in the S7 CPU addresses module 3, irrespective of the variant of the station ET 200SP. With the help of the control data record the interface module is informed of which address the module for the special variant really has in the ET 200SP station.

Diagnostic

Not the number of the real slot is indicated for the diagnostic (reporting system error) but the number of the configured slot.

The number of the real slots can be specified in the program of the S7 CPU when the maximum configuration (STEP 7 basic project) is evaluated together with the control data record.

3.3.3 Feedback data record

Function

By reading the feedback data record, the real configuration of the station can be checked in the program of the S7 CPU. The feedback data record has information whether the real configuration of the station corresponds to the configuration that is defined by: Maximum configuration <u>and</u> control data record.

Structure

Table 3-7 shows the configuration of the feedback data record.

Table 3-7

Number of the byte	Meaning	
0, 1, 2, 3	Header	
4	Status for configured slot 1	configured slot 1
5	Reserved	
6	Status for configured slot 2	configured slot 2
7	Reserved	
...	...	...
2*x + 2	Status for configured slot **x**	configured slot x
2*x + 3	Reserved	

Coding

For each configured slot x there is a status byte. Table 3-8 shows the coding of the status byte. The coding of the byte status depends on the coding of the assignment byte in the control data record.

Table 3-8

Content of assignment byte for slot x in the <u>control</u> data record	Coding status byte for slot x in <u>feedback</u> data record		Meaning
	Bit 7 to 1	**Bit 0**	
The module configured for configured slot x is not really inserted.	reserved	0	The configured module is not really inserted.
The configured module for configured slot x is inserted in the real slot y.	reserved	0	A false module is inserted in the real slot y.
	reserved	1	The correct module is inserted in the real slot y.
The module configured for the configured slot x is inserted in the real slot y, <u>or</u> a BU cover is inserted in the real slot y.	reserved	0	Two options are available: • A BU cover is inserted in the real slot y. • A false module is inserted in the real slot y.
	reserved	1	The correct module is inserted in the real slot y.

Examples

Examples for the clarification of the codings can be found in chapter 3.4.

3.4 Examples for coding

In the present chapter it is shown on concrete examples how the control data record and the feedback data record are coded.

3.4.1 Explanations of the examples

In the examples for coding, uniformly structured tables are used. The structure of the tables will be described in the following.

Table 3-9

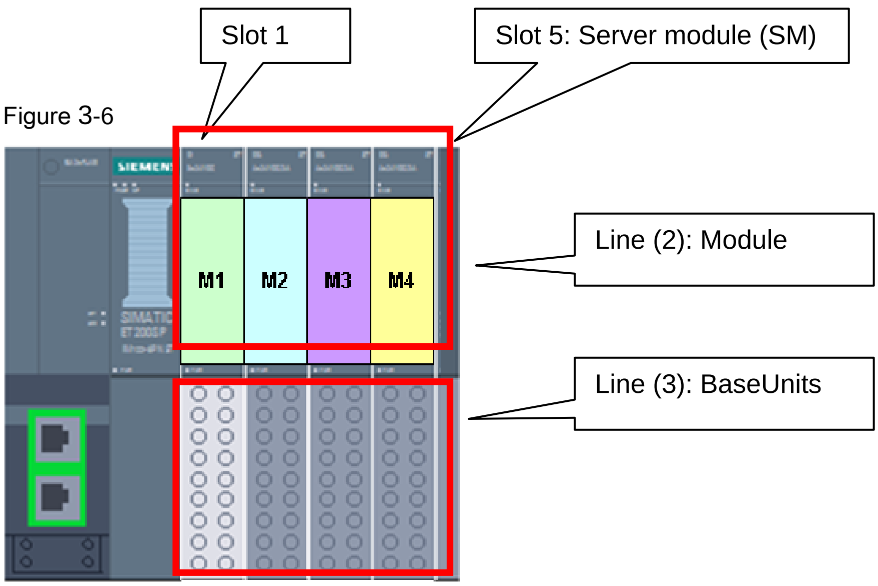
Line						
(1)	**Configuration ET 200SP**	**Slot 1**	**Slot 2**	**Slot 3**	**Slot 4**	**Slot 5**
(2)	Configured configuration	M1	M2	M3	M4	SM
(3)		BU_D	BU_B	BU_B	BU_B	
(4)	Real configuration	M1	M4	SM	---	---
(5)		BU_D	BU_B			
(6)	**Control data record**	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
(7)		**Byte 5**	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
(8)	Coding (hexadecimal)	1 (01H)	0 (00H)	0 (00H)	2 (02H)	3 (03H)
(9)		0	0	0	0	0
(10)	**Feedback data record**	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
(11)	Coding	1	0	0	1	1

Principle of representation

The lines (2) and (3) or (4) and (5) symbolize the configuration of the ET 200SP.

The following figure illustrates this on the example of lines (2) and (3).

Figure 3-6



Meaning of lines (1) to (5)

The lines describe the configured configuration of ET 200SP:

- (1): Number of the slots in the ET 200SP
- (2) and (3): Maximum configuration in STEP 7:
  - (2): Modules
  - (3): Type BaseUnit (*1)
- (4) and (5): Real configuration of the ET 200SP (variant):
  - (4): Modules
  - (5): Type BaseUnit (*1)

Regarding (*1):

BU_D:	Bright BaseUnit (opens a new potential group)
BU_B:	Dark BaseUnit

Meaning of lines (6) to (9)

The lines describe the respective control data record:

- (6) and (7): Number of the bytes in the control data record:
  - (6): Number of assignment byte
  - (7): Number of additional function byte
- (8) and (9): Coding of the bytes:
  - (8): Content of assignment byte
  - (9): Content of additional function byte

Meaning of lines (10) to (11)

The lines describe the feedback data record for the real configuration:

- (10): Number of the bytes status in feedback data record
- (11): Content of byte status

Note

The byte with the name "reserved" is not considered in the example.

Meaning of the abbreviations

BC	BU Cover
Mx	Module x (I/O module)
SM	Server module
---	The slot does not exist in the real station.
BU_D	Bright BaseUnit (opens a new potential group)
BU_B	Dark BaseUnit
xyH	Hexadecimal value

3.4.2 Hiding of modules

The example shows how to hide slots.

Table 3-10

Configuration ET 200SP	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M1	M4	SM	---	---
	BU_D	BU_B			
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	1 (01H)	0 (00H)	0 (00H)	2 (02H)	3 (03H)
	0	0	0	0	0
Comments:	(*1)	(*2)		(*3)	
Feedback data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	0	0	1	1
Comments:	(*4)	(*5)		(*6)	

Comments to the table:

Table 3-11

to	Comment
(*1)	The configured module (M1) that is configured for slot x is inserted in the real slot 1. No new potential group is opened.
(*2)	The module (M2) configured for configured slot 2 is not really inserted.
(*3)	The configured module (M4) configured for slot 4 is inserted in the real slot 2. No new potential group is opened.
(*4)	The correct module (M1) is inserted in the real slot 1.
(*5)	The configured module (M2) is not really inserted.
(*6)	The correct module (M4) is inserted in the real slot 2.

3.4.3 Free slot assignment

The example shows how the free slot assignments works.

Table 3-12

Configuration ET 200S	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M1	M3	M4	M2	SM
	BU_D	BU_B	BU_B	BU_B	
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	**1 (01H)**	**4 (04H)**	**2 (02H)**	**3 (03H)**	**5 (05H)**
	0	**0**	**0**	**0**	**0**
Comments:				**(*1)**	
Feedback data record (*1)	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**1**	**1**	**1**	**1**
Comments:				**(*2)**	

Comments to the table:

Table 3-13

to	Comment
(*1)	The configured module (M4) configured for slot 4 is inserted in the real slot 3.
(*2)	The correct module (M4) is inserted in the real slot 3.

3.4.4 Use of empty slots

The example shows the use of empty slots (slots with BU cover).

Table 3-14

Configuration ET 200SP	Slot 1	Slot 2	Slot 3	Slot 3	Slot 4
Configured configuration	M1	**M2**	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration with BU cover	M1	**BC**	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration with module	M1	**M2**	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 8**	**Byte 10**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 9**	**Byte 11**
Coding (hexadecimal)	1 (01H)	**2+(80H) (82H)**	3 (03H)	4 (04H)	5 (05H)
	0	**0**	0	0	0
Comments:		(*1)			
Feedback data record: Real configuration with BU cover	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	**0**	1	1	1
Comments:		(*2)			
Feedback data record: Real configuration with module	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	**1**	1	1	1
Comments:		(*3)			

Comments to Table 3-14:

Table 3-15

to	Comment
(*1)	The module (M2) configured for the configured slot 2 is inserted in the real slot 2 <u>or</u> a BU cover is inserted in the real slot 2.
(*2)	A real BU cover (BC) is inserted in the real slot 2.
(*3)	The correct module (M2) is inserted in the real slot 2.

3.4.5 Opening of a new potential group

The example illustrates how a new potential group is opened.

Table 3-16

Configuration ET 200SP	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_D	BU_B	
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	1 (01H)	2 (02H)	3 (03H)	4 (04H)	5 (05H)
	0	0	1	0	0
Comments:	(*1)		(*2)		
Feedback data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	1	1	1	1
Comments:	(*3)		(*4)		

Comments to the table:

Table 3-17

to	Comment
(*1)	The configured module (M1) configured for slot x is inserted in the real slot 1. No new potential group is opened.
(*2)	The module (M3) configured for configured slot 3 is inserted in the real slot 3. A new potential group is opened.
(*3)	The correct module (M1) is inserted in the real slot 1.
(*4)	The correct module (M3) is inserted in the real slot 3.

3.4.6 Combination of the methods

The example shows a combination of the previously shown methods.

Table 3-18

Configuration ET 200S	**Slot 1**	**Slot 2**	**Slot 3**	**Slot 4**	**Slot 5**
Configured configuration	M1	M2	M3	**M4**	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration with BU cover	M3	**BC**	M1	SM	---
	BU_D	BU_B	BU_D		
Real configuration with module	M3	**M4**	M1	SM	---
	BU_D	BU_B	BU_D		
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	3 (03)H	0 (00)H	1 (00)H	**2+(80H) (82)H**	4 (04)H
	1	0	1	**0**	0
Comments	(*1)	(*2)		(*3)	
Feedback data record: Real configuration with BU cover	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	0	1	**0**	1
Notes	(*4)	(*5)		(*6)	
Feedback data record: Real configuration with module	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	1	0	1	**1**	1
Notes				(*7)	

Comments to Table 3-18:

Table 3-19

to	Comment
(*1)	The configured module (M1) configured for slot 1 is inserted in the real slot 3. A new potential group is opened in slot 3.
(*2)	The module (M2) configured for configured slot 2 is not really inserted.
(*3)	The module (M4) configured for the configured slot 4 is inserted in the real slot 2 or a BU cover (BC) is inserted in the real slot 2.
(*4)	The correct module (M3) is inserted in the real slot 1.
(*5)	The configured module (M2) is not inserted.
(*6)	A real BU cover (BC) is inserted in the real slot 2.
(*7)	The correct module (M4) is inserted in the real slot 2.

4 Functional Mechanisms of the Application

4.1 Overview functional scope

The functionality of the application is described in chapter 2.3.

4.2 Description of the code

4.2.1 Preliminary remarks

The STEP 7 program is written with the help of flow charts in the document. Uniform elements are used for the description:

Display of the flow charts

Example:

Figure 4-1

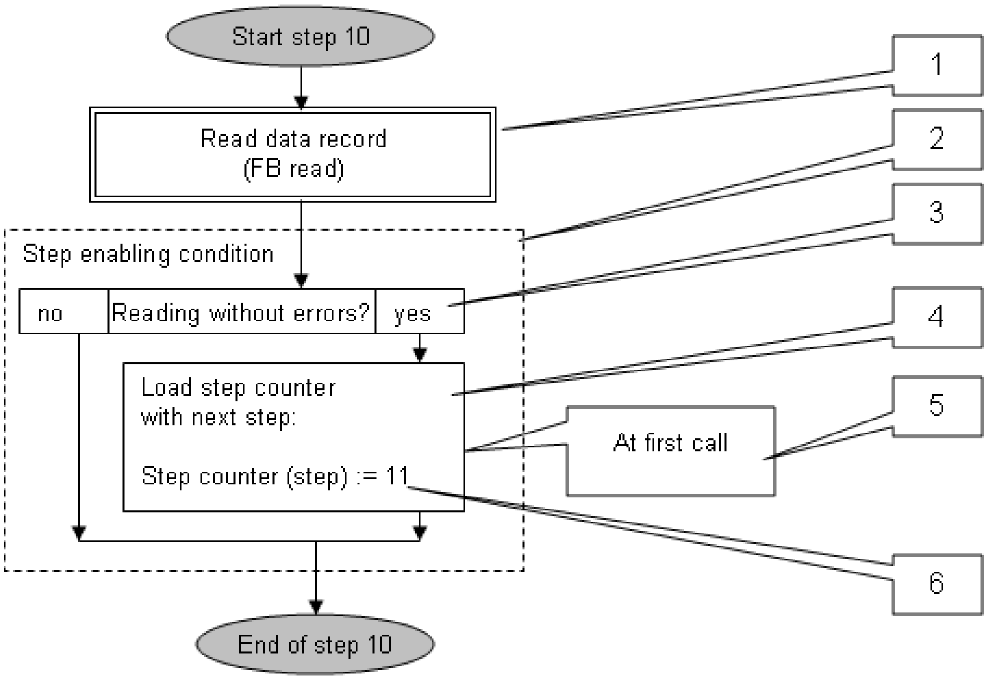


Table 4-1

to	Meaning
(1)	Function block call
(2)	Name (summary) of a program part
(3)	Query or branching
(4)	Description of an action
(5)	Additional comment to the action
(6)	In order to facilitate the relation to the STEP 7 program, important icons of the program are mentioned in brackets. In the example: step. Assignments are displayed with ":=". In the example the step counter is assigned the value 11.

Commenting the steps in the STEP 7 program

The STEP 7 program is implemented as a sequencer and consists of several steps. For better readability of the STEP 7 program uniform network comments are used per section of a step. The following table shows the conventions for commenting within a step.

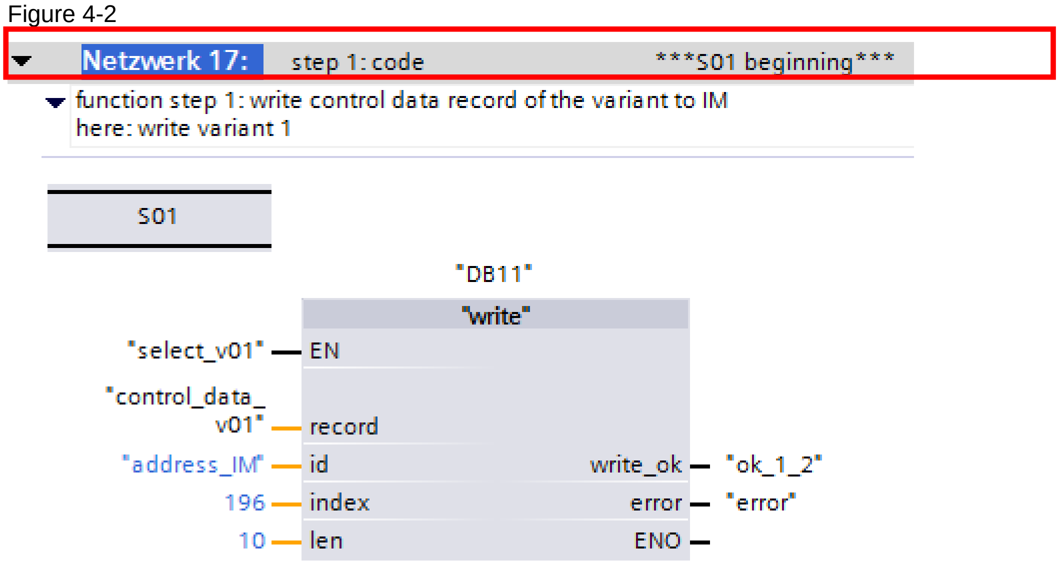
Table 4-2

Section step x	Network x	Network comment
Code	First network	step x: code *****S0x beginning*****
	Other networks	step x: code
error	All networks	step x: error handling
Step enabling condition	All networks	step x: step enabling condition
End of step	Network	step x: end of step ***** S0x end*****

<u>Example</u>

The figure shows the first network for step 1.

Figure 4-2



Structure of a step

The structure of a step is explained in chapter 4.2.3.

4.2.2 Concept of the STEP 7 program

The STEP 7 program for the configuration control (options handling) is implemented in OB1 as sequencer.

Principle of the sequencer

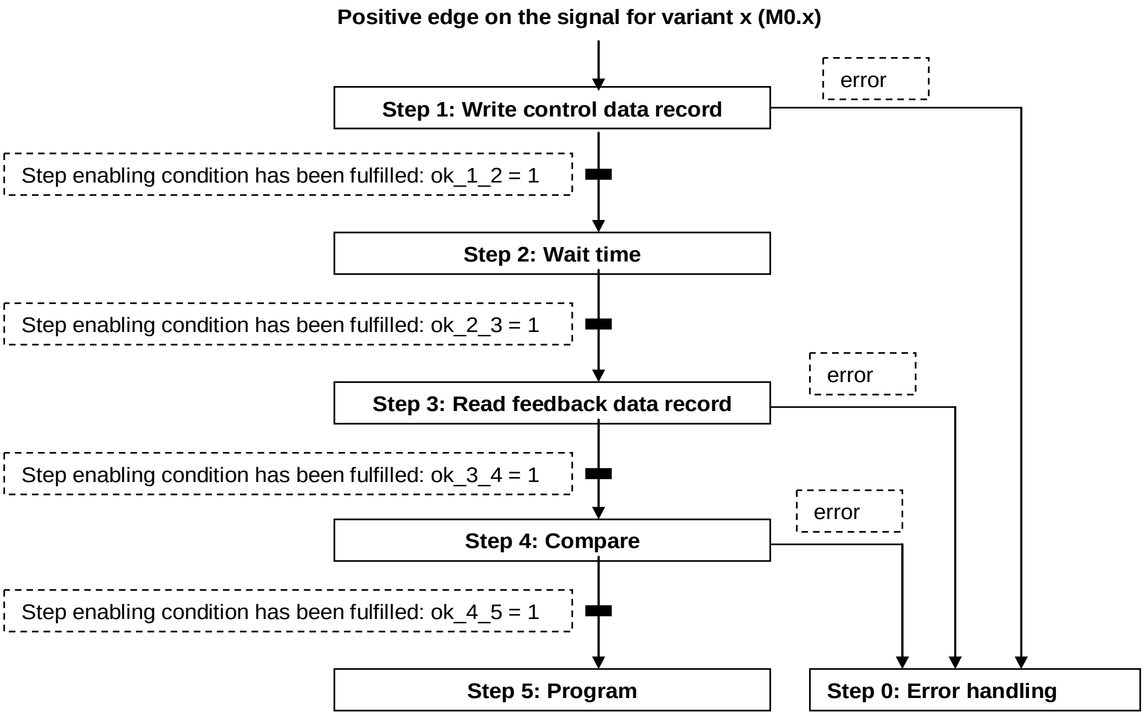
The sequencer in OB1 is made up of steps and step enabling conditions.

Features of the sequencer:

- Functions are executed in the steps.
- A step is exited under the following conditions:
  - step enabling condition has been fulfilled
  - an error occurred

The figure below shows the time sequence of the steps.

Figure 4-3



Functions of the steps

In the steps, the following functions are implemented:

Table 4-3

Steps	Designation	Function
Step 0	Error handling	If errors occur, there it will be branched to this step. Note: Step 0 is no longer exited.
Step 1	Writing control data record	Writing control data record for the variant x in the ET 200SP station.
Step 2	Wait time	Waiting until the wait time has expired.
Step 3	Reading feedback data record	Reading feedback data record from ET 200SP station.
Step 4	Compare	Check whether the read feedback data record matches with the expected feedback data record for variant x.
Step 5	Program	Cyclic call of the automation program for variant x. Note: Step 5 is no longer left.

Step enabling conditions

If the step enabling condition is met (ok_x_y = 1), a transition from step x to step y takes place. The following step enabling conditions exist in the program:

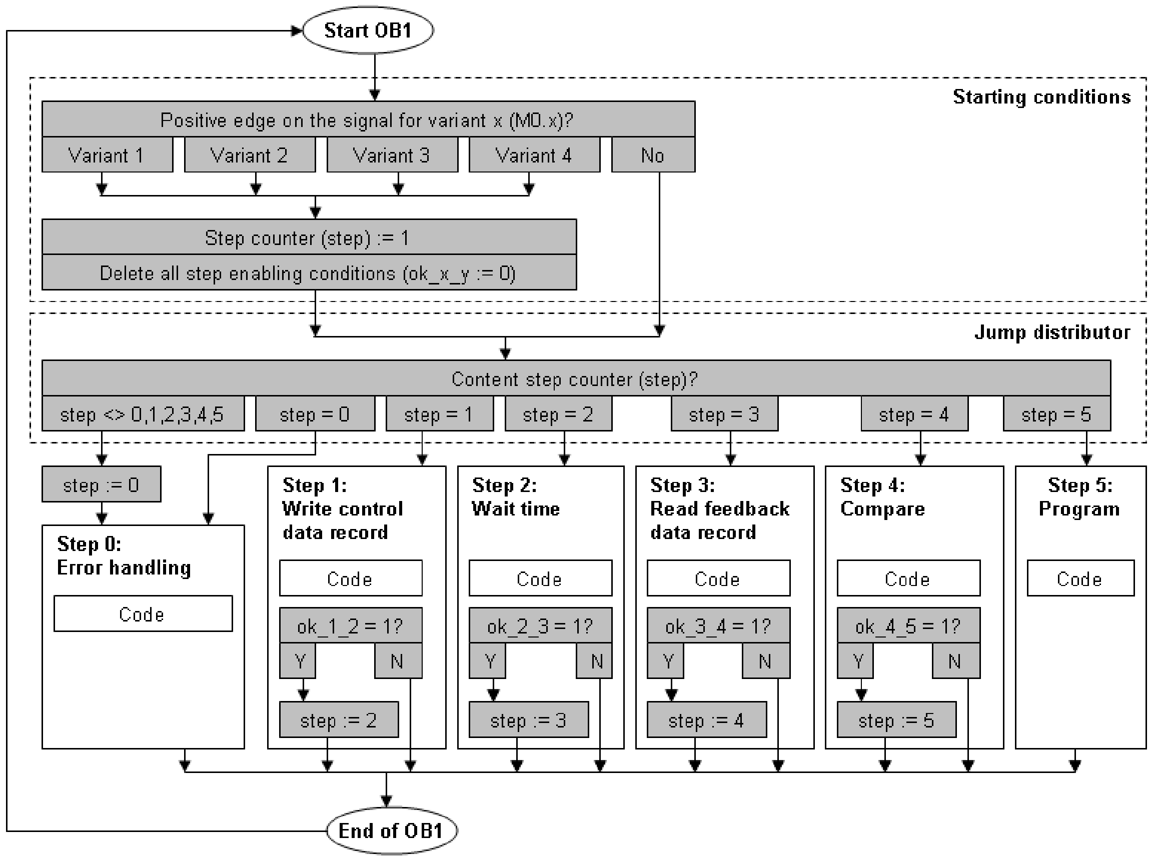
Table 4-4

Step enabling condition		Transition
Designation	Condition for fulfilling the step enabling condition	
ok_1_2	Writing of control data record without error	Step 1 -> step 2
ok_2_3	Wait time expired	Step 2 -> step 3
ok_3_4	Reading of feedback data record without error	Step 3 -> step 4
ok_4_5	Read feedback data record corresponds with expected feedback data record for variant x.	Step 4 -> step 5

Implementing the sequencer

The sequencer is realized in OB1. The following figure shows the structure of the STEP 7 program. The program parts in gray are used for controlling (managing) the sequencer.

Figure 4-4



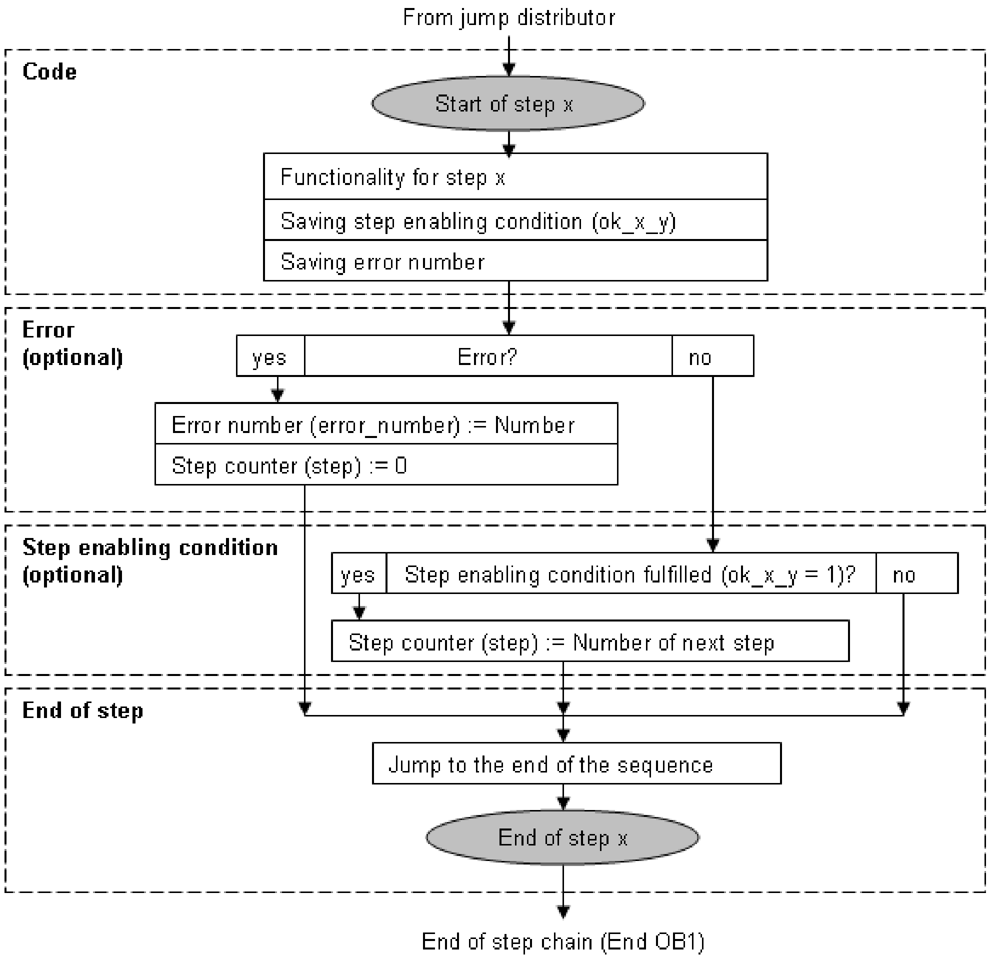
In the following chapters these issues are described:

- Structure of a step
- Step 0 to step 5
- Function blocks of the steps
- Overview of all blocks of the STEP 7 program
- Program structure of the STEP 7 program

4.2.3 Structure of a step

A step consists of different sections. Some sections of a step are optional. The figure below shows the structure of a step

Figure 4-5



Code section

The first network includes a jump label that is triggered by the jump distributor (Figure 4-4).

The following tasks are executed in the other networks:

- Executing the actual function of the step (e.g. writing of control data record)
- Decision whether advancing to the next step is to take place or whether an error is apparent.

Error section (optional)

If an error was detected in the code section, an error number is stored and the step counter is loaded with zero. The sequencer will branch to step 0 (error handling).

Step enabling condition section (optional)

If the step enabling condition is met (ok_x_y = 1), the step counter will be loaded with the number of the next step.

End of step section

At the end of step a jump to the end of the step chain will be performed. At the same time, this is the end of OB1.

4.2.4 Step 0: Error handling

Call of the step

First call: The step is activated when an error has occurred in the jump distributor or a step (Table 4-5).

Subsequent calls: The step is constantly called. I.e. the step chain ends here.

Function

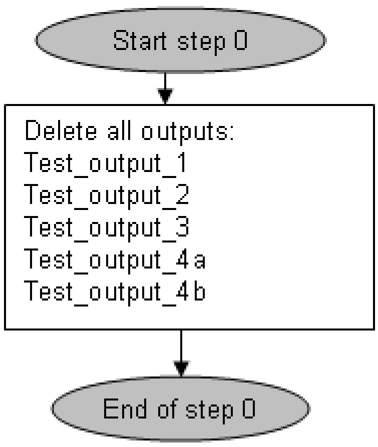
Deleting all outputs used in the program.

Called blocks

none

Flow chart

Figure 4-6



Error overview

Table 4-5

Error number	Cause of error	Location of origin
1	Invalid step number	Jump distributor
2	Error when writing the control data record	Step 1
3	Error when reading the feedback data record	Step 3
4	Error when comparing the read feedback data record with the expected feedback data record	Step 4

4.2.5 Step 1: Writing control data record

Call of the step

First call: The step is activated when a positive edge is detected on the signal of variant x (M0.x).

Subsequent calls: The step is repeated until the complete control data record has been written in the ET 200S station. This is required because the SFB 53 WRREC (write data record) is called. SFB 53 is working asynchronous. This means that the SFB can run over several OB1 cycles.

Function

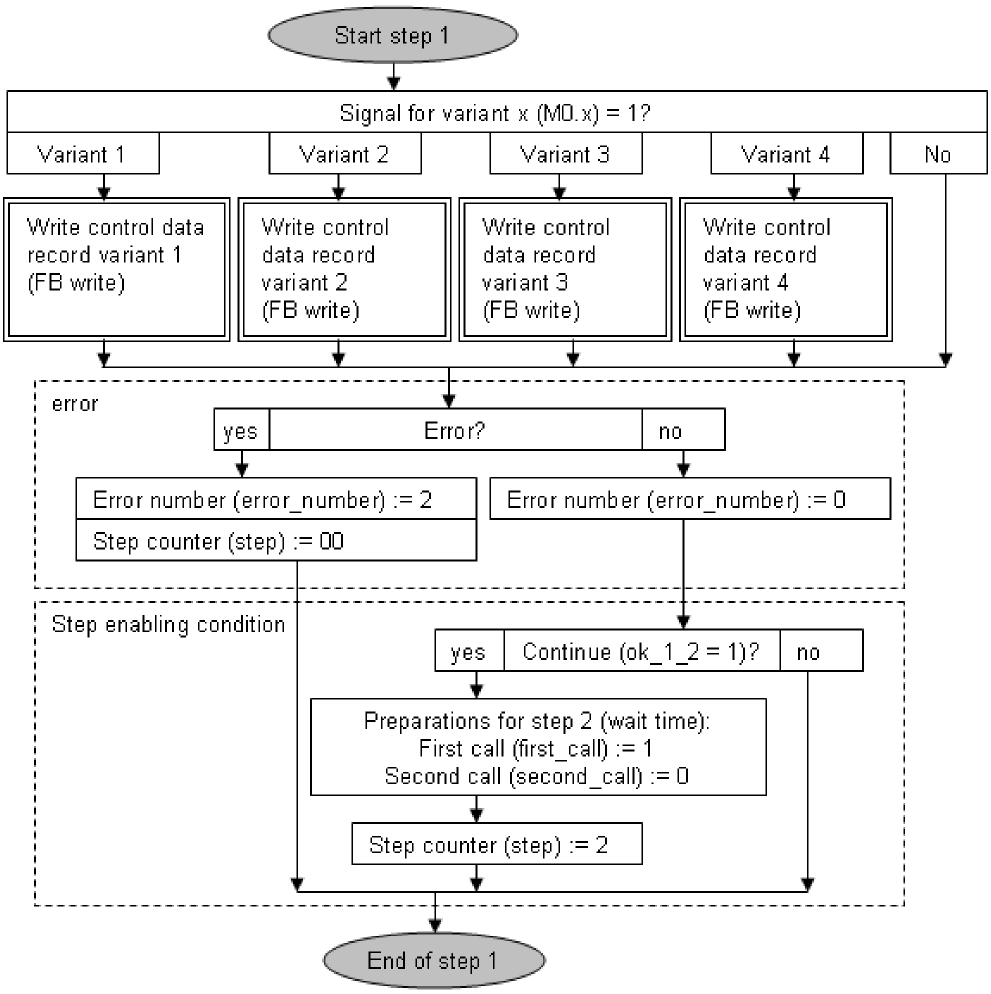
In the step the control data record is written in the ET 200SP station for variant x. If writing is performed without errors then it is passed on to step 2. If an error occurs, the sequencer will branch to step 0.

Called blocks

FB write (see chapter 4.2.10)

Flow chart

Figure 4-7



4.2.6 Step 2: Wait time

Call of the step

First call: This step is activated when the control data record has been successfully written to the ET 200SP (step 1).

Subsequent calls: The step is repeated until the wait time has elapsed. The wait time can be configured; it is 10 sec in the application example.

Function

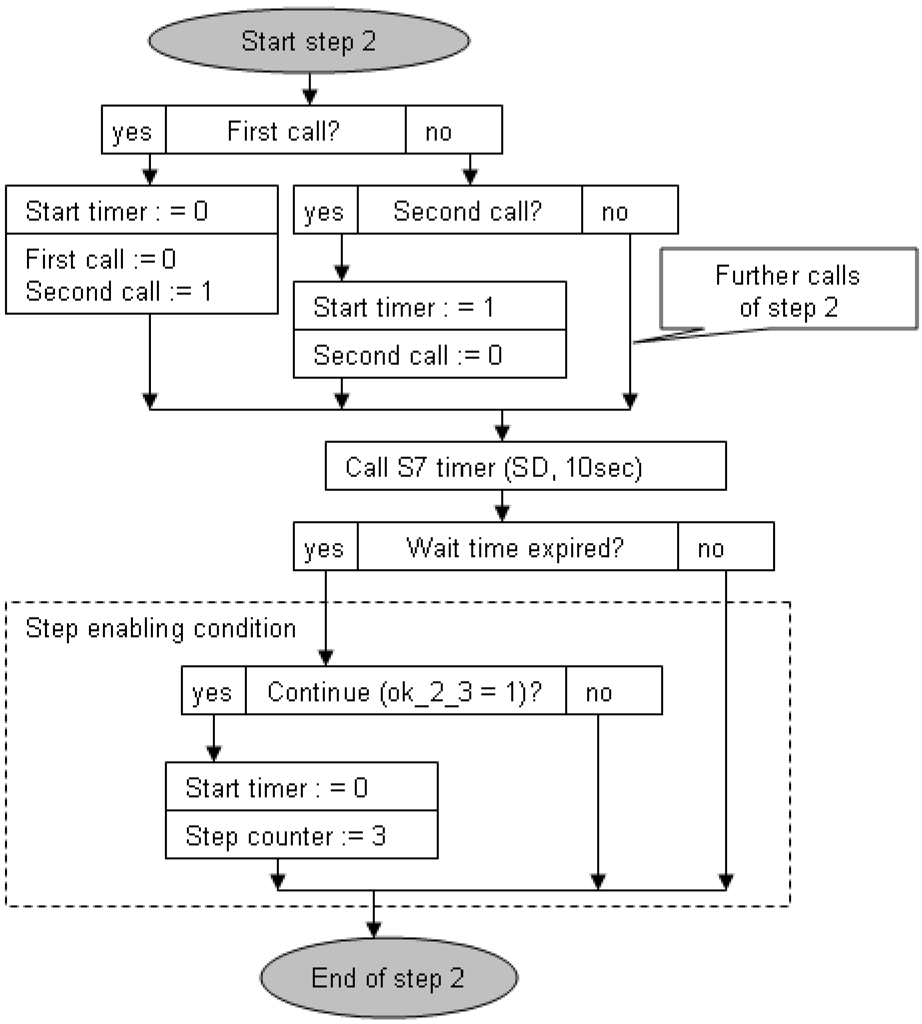
If a changed or new control data record is written in the ET 200SP there will be a station failure and subsequently the station will restart. The wait time ensures that there is enough time after writing the control data record (step 1) and before reading the feedback data record (step 3).

Called blocks

None

Flow chart

Figure 4-8



4.2.7 Step 3: Reading feedback data record

Call of the step

First call

The step is activated when the wait time has elapsed (step 2).

Subsequent calls

The step is repeated until the complete feedback data record of the ET 200SP station has been read.

This is required because the SFB 52 RDREC (read data record) is called. SFB 52 is working asynchronous. This means that the SFB can run over several OB1 cycles.

Function

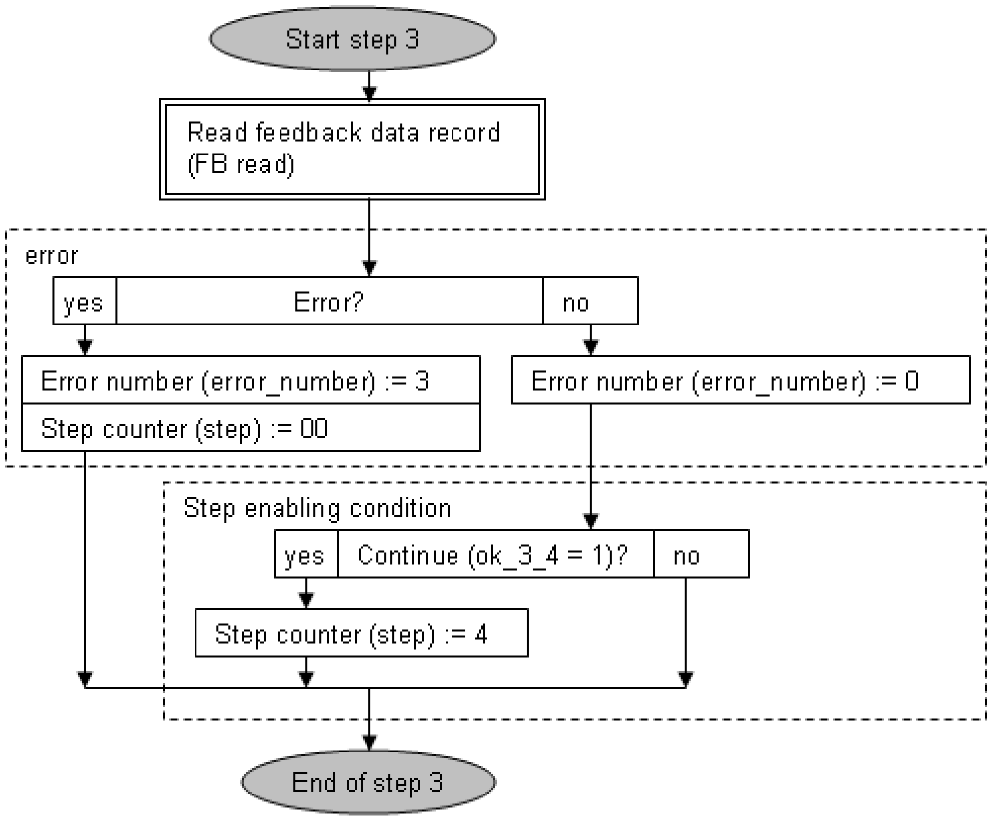
The step reads the feedback data record out of the ET 200SP station and stores it in a data block. If reading is performed without errors then it is passed on to step 4. If an error occurs, the sequencer will branch to step 0.

Called blocks

FB read (see chapter 4.2.11)

Flow chart

Figure 4-9



4.2.8 Step 4: Compare

Call of the step

First call: This step is activated when the feedback data record has been successfully read in the ET 200S (step 3).

Subsequent calls: There are no subsequent calls. The step is processed in a single OB1 cycle.

Function

It is checked in the step whether the real configuration of the ET 200SP corresponds with the configuration of the selected variant. For this purpose, the following data records are compared:

- the feedback record read in step 2
- expected feedback data record

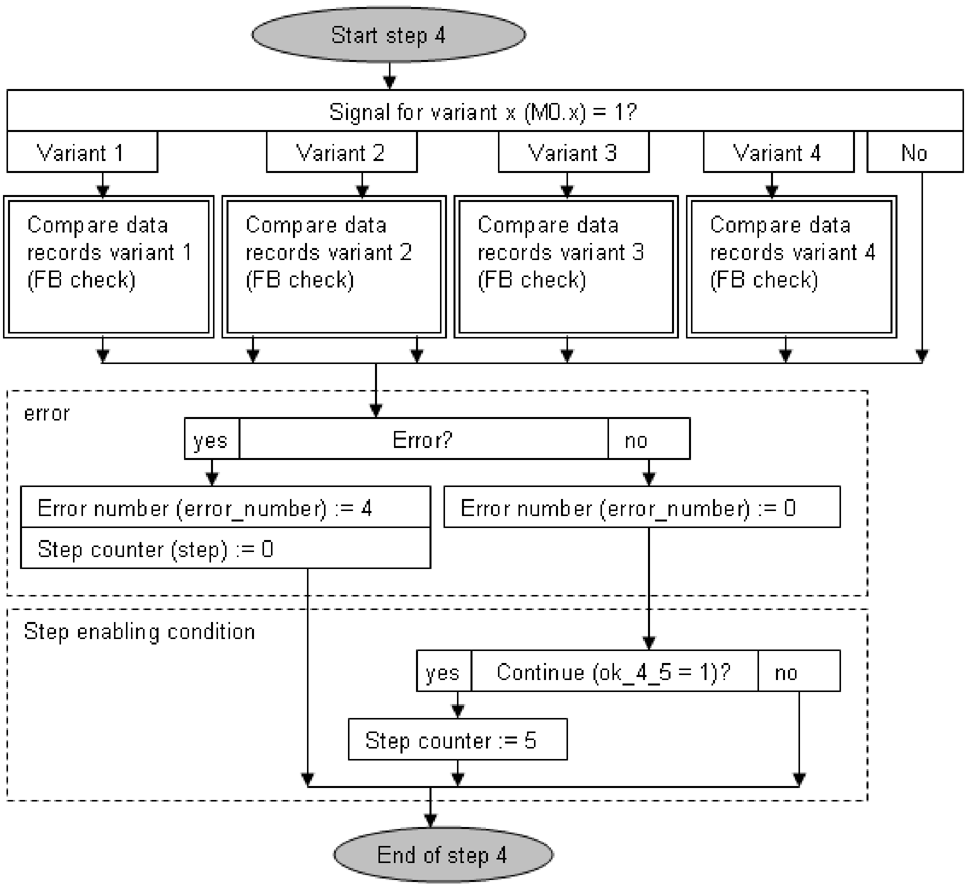
If there is a match, step 5 will be enabled. If an error occurs, the sequencer will branch to step 0.

Called blocks

FB check (see chapter 4.2.12)

Flow chart

Figure 4-10



4.2.9 Step 5: Program

Call of the step

First call

The step is activated when the result of the check in step 4 was that the real configuration matches the configuration of the selected variant.

Subsequent calls

The step is constantly called. I.e. the step chain ends here.

Function

The automation program for variant x is called in the step.

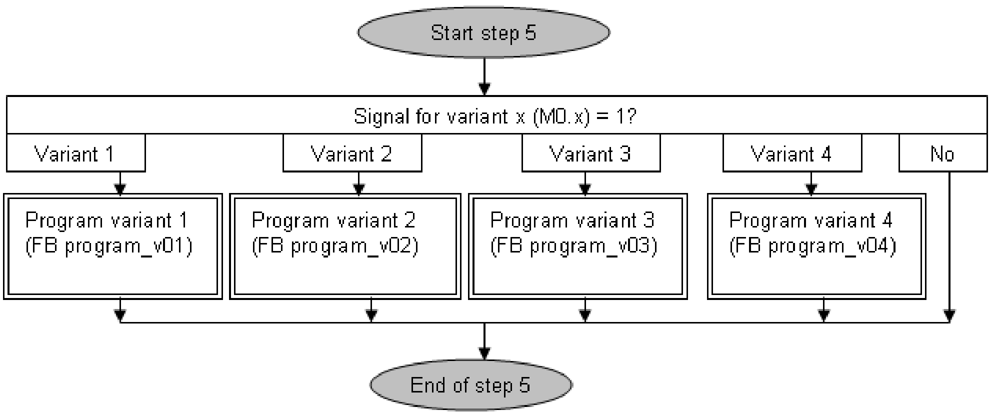
Called blocks

Depending on the variant:

- FB user_program_v01
- FB user_program_v02
- FB user_program_v03
- FB user_program_v04

Flow chart

Figure 4-11



4.2.10 FB write

FB call

The FB is called in step 1.

An individual call is programmed in the step for each variant.

Function

The function block writes the control data record of the variant x in the ET 200SP station:

- Source is the control_data_v0x data block
- Target on the ET 200SP is data record 196

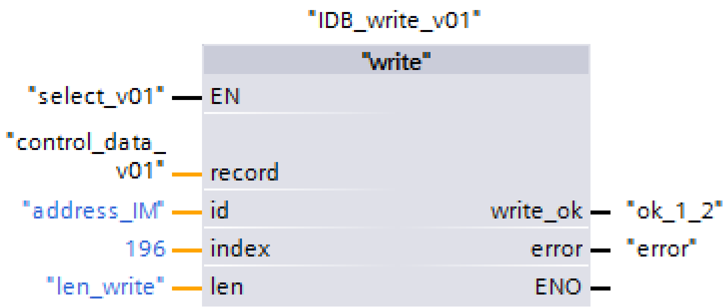
Called blocks

SFB 53 WRREC (write data record)

Parameter

The figure shows the call for variant 1.

Figure 4-12



The parameters of the function block:

Table 4-6

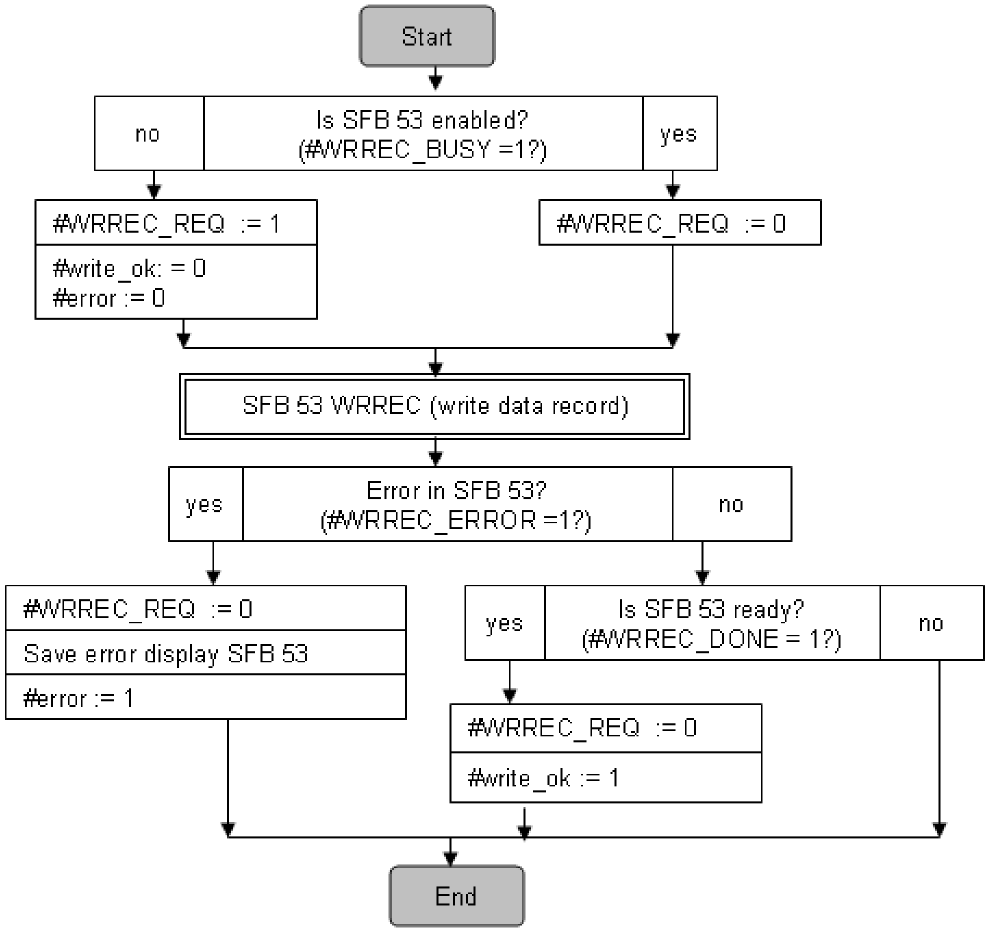
Parameter	Declaration	Type	Description
record	IN	ANY	Pointer on the control data record to be written (source)
id	IN	DWORD	Address of ET 200SP station (*1)
index	IN	INT	Number of data record (target)
len	IN	INT	Length of data record:
write_ok	OUT	BOOL	"1", if writing was successfully ended
error	OUT	BOOL	"1", if an error occurred

Regarding (*1):

The address can be found in the device configuration in STEP 7 (chapter 3.2.2).

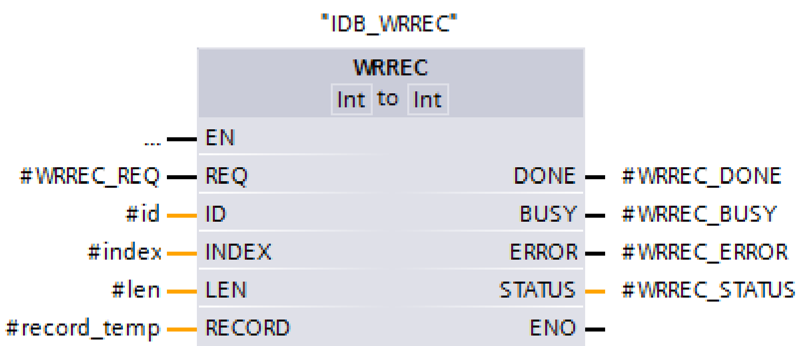
Flow chart

Figure 4-13



Call interface SFB 53:

Figure 4-14



4.2.11 FB read

FB call

The FB is called in step 3.

Function

The function block reads the feedback data record from the ET 200SP station and stores it in a data block:

- Source is data record 197 on ET 200SP
- Target is the actual_feedback_data data block

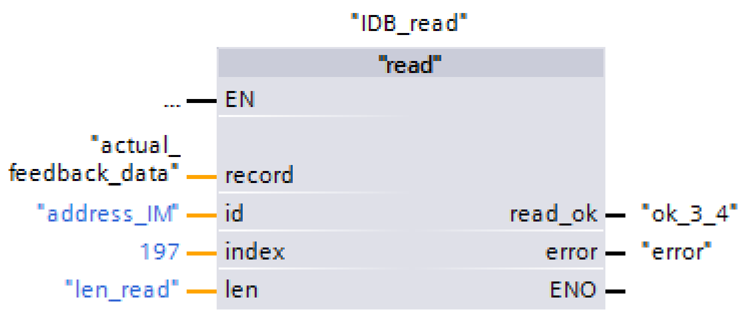
Called blocks

SFB52 RDREC (read data record)

Parameter

The figure shows the call.

Figure 4-15



The parameters of the function block:

Table 4-7

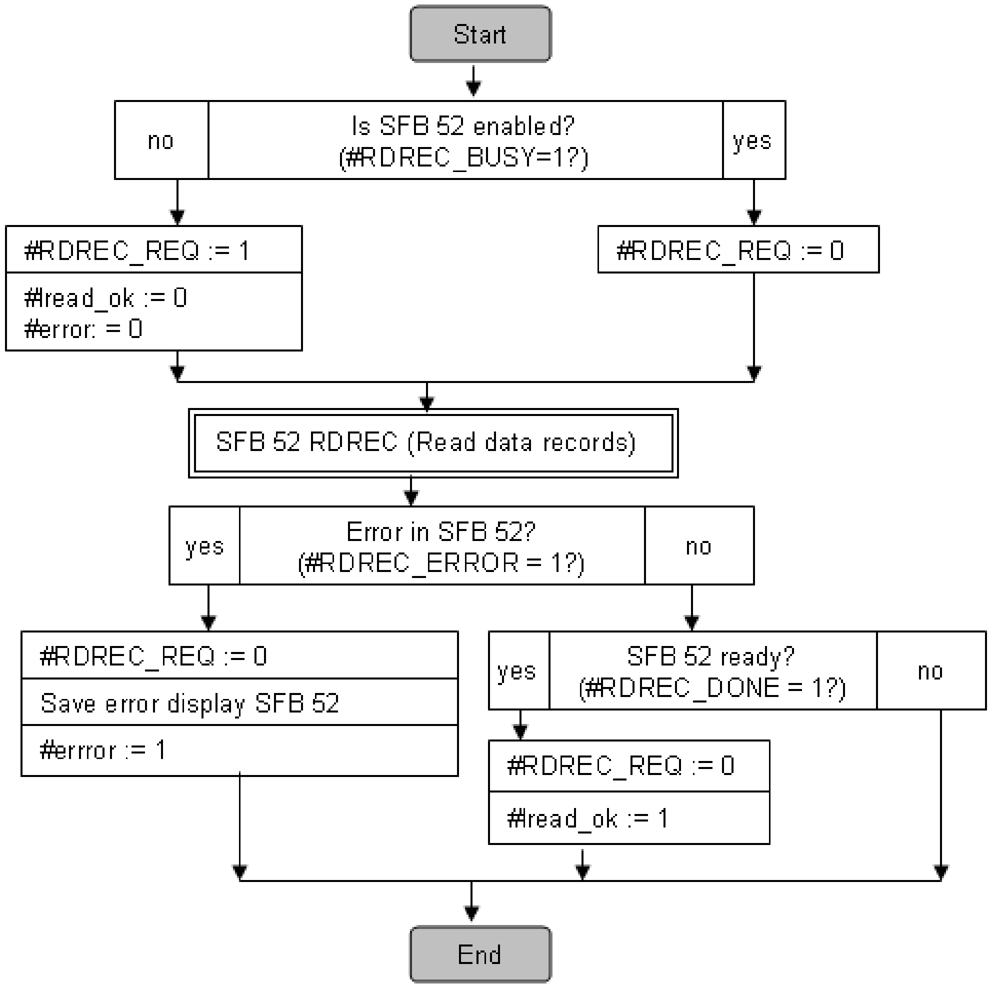
Parameter	Declaration	Type	Description
record	IN	ANY	Pointer on a data block in which the feedback data record to be read is stored (target)
id	IN	DWORD	ET 200SP (*1) address
index	IN	INT	Number of data record (target)
len	IN	INT	Length of data record
read_ok	OUT	BOOL	"1", if reading was successfully ended
error	OUT	BOOL	"1", if an error occurred

Regarding (*1):

The address can be found in the device configuration in STEP 7 (chapter 3.2.2).

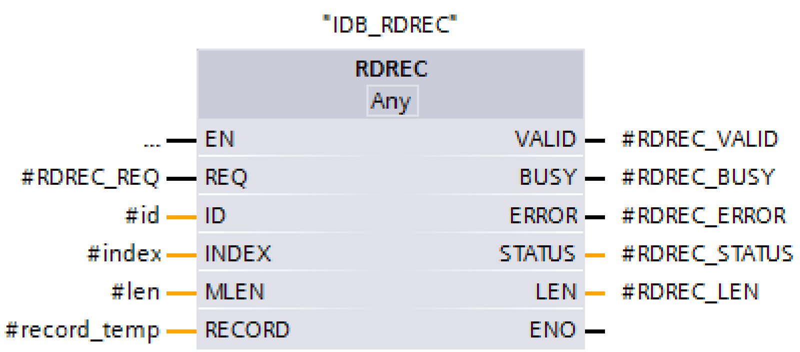
Flow chart

Figure 4-16



Call interface SFB 52:

Figure 4-17



4.2.12 FB check

FB call

The FB is called in step 4.
An individual call is programmed in the step for each variant.

Function

The function block compares the two data records:

- Feedback data record of the ET 200SP station: actual_feedback_data
- Expected feedback data record for variant x: set_feedback_data_v0x

Both data records are stored in data blocks with the following structure:

- Byte 0 to 3: Header
- Byte 4: Configured slot 1
- Byte 6: Configured slot 2
- Byte 8: Configured slot 3
- Byte 10: Configured slot 4
- Byte 12: Configured slot 5

Note: When comparing the slots, only the "Status" bytes are considered. The "Reserved" bytes are not considered.

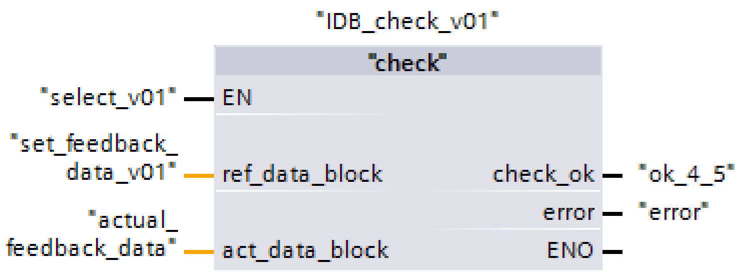
Called blocks

None

Parameter

The figure shows the call for variant 1:

Figure 4-18



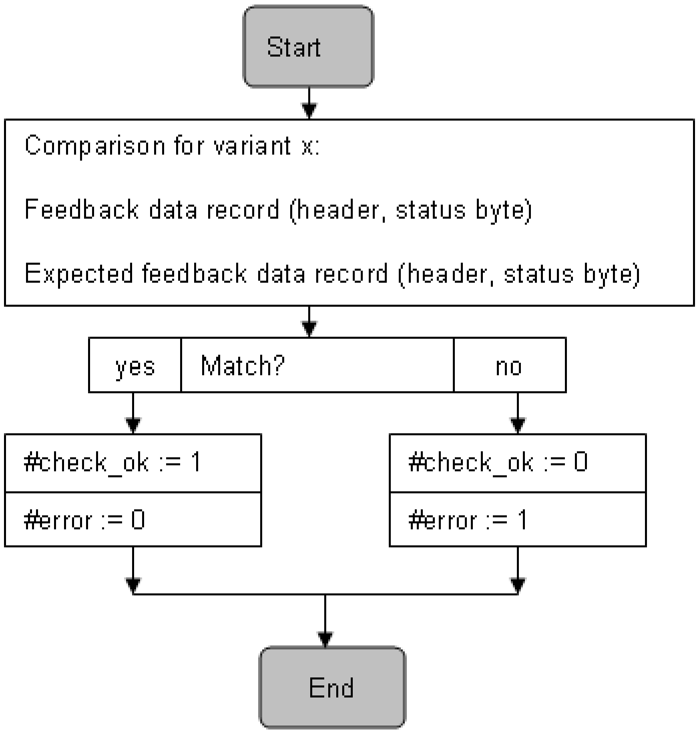
The parameters of the FBs:

Table 4-8

Parameter	Declaration	Type	Description
ref_data_block	IN	BLOCK_DB	Expected feedback data record
act_data_block	IN	BLOCK_DB	Feedback data record
check_ok	OUT	BOOL	"1", when both data records match
error	OUT	BOOL	"1", if an error occurred

Flow chart

Figure 4-19



4.2.13 FB progam_v0x

There is an individual FB for each variant:

FB program_v01, FB program_v02, FB program_v03, FB program_v04

FB call

The call is performed in step 5.

Function

The FB includes the automation program for variant x.

Depending on the variant, various outputs of the ET 200SP station are set in the function block. With the help of these outputs it can be detected on the ET 200SP which variant is enabled.

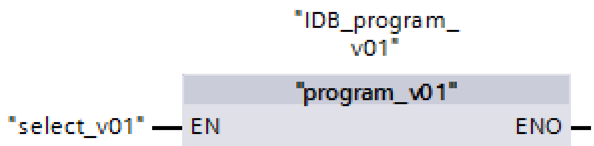
Called blocks

None

Parameter

The figure shows the call for variant 1:

Figure 4-20



Overview of the outputs

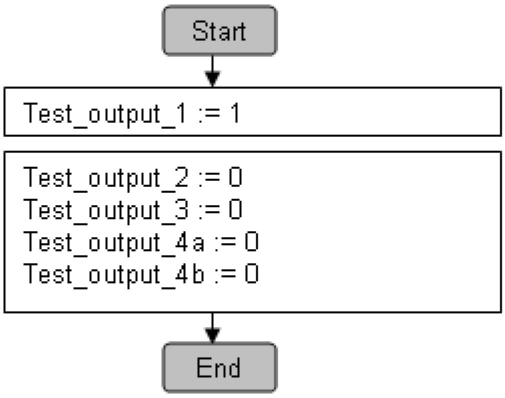
See also: Chapter 6.6

Table 4-9

Variant		Module 3 (4DO)	Module 4 (8DO)
Variant 1		---	LED .1
Variant 2		---	LED .2
Variant 3		---	LED .3
Variant 4	a BU cover is inserted instead of module 4	LED .0	---
	module 4 is inserted instead of BU cover	LED .0	LED .0

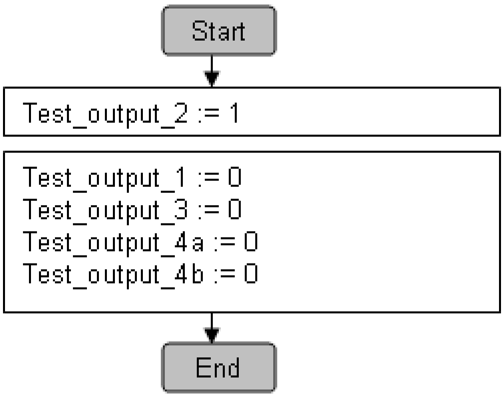
Flow chart for variant 1 (program_v01)

Figure 4-21



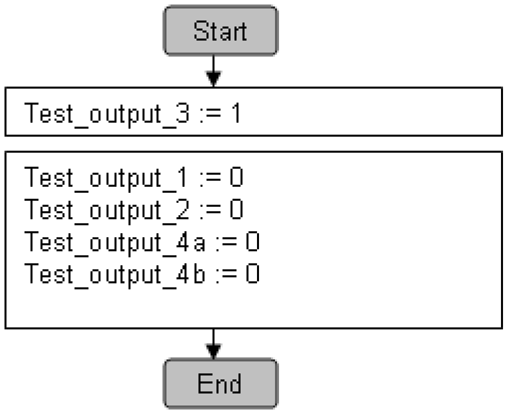
Flow chart for variant 2 (program_v02)

Figure 4-22



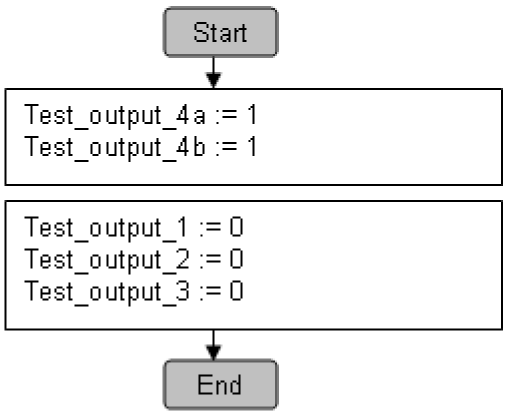
Flow chart for variant 3 (program_v03)

Figure 4-23



Flow chart for variant 4 (program_v04)

Figure 4-24



4.2.14 OB 100

FB call

The call is performed during startup of the S7 CPU.

Function

All step enable conditions (ok_x_y) are deleted in the block.

Called blocks

None

Parameter

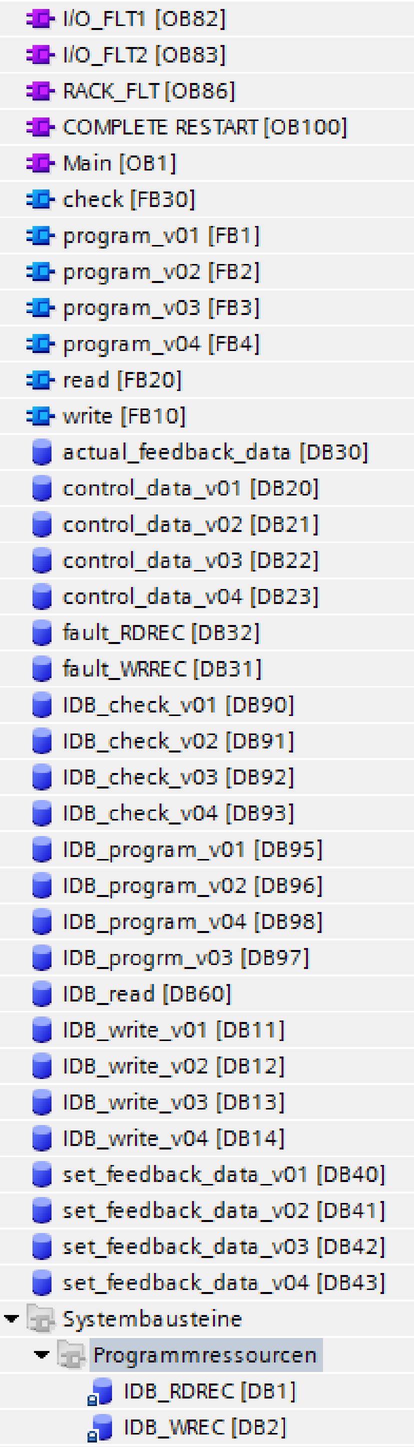
None

4.2.15 Overview of the blocks

Content of the program block folder

Screenshot from the STEP 7 project:

Figure 4-25



Overview of the blocks

Table 4-10 shows the blocks for all variants.

Table 4-10

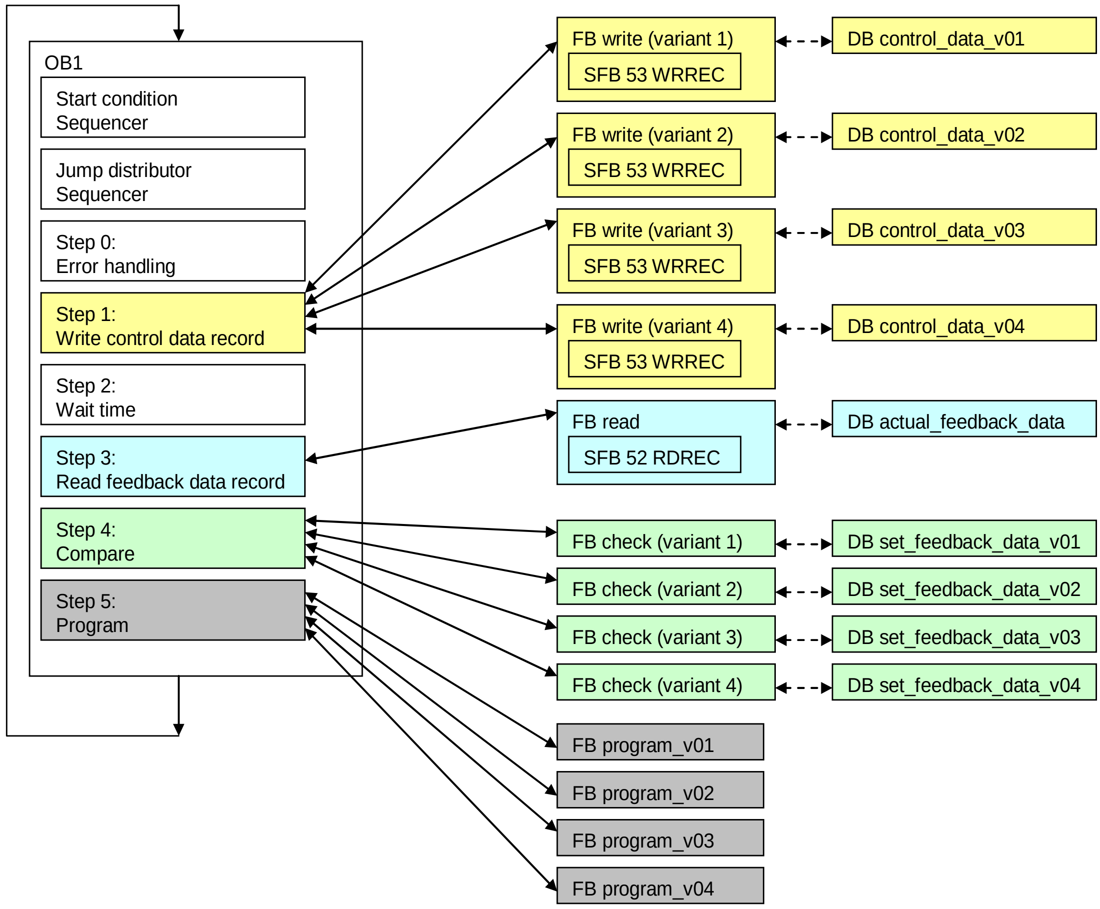
Block types	Designation	Function
FB	program_v01	Program of variant 1
	program_v02	Program of variant 2
	program_v03	Program of variant 3
	program_v04	Program of variant 4
	write	Writing control data record
	read	Reading feedback data record
	check	Comparison of feedback data with the expected feedback data
DB	control_data_v01	Control data record of variant 1
	control_data_v02	Control data record of variant 2
	control_data_v03	Control data record of variant 3
	control_data_v04	Control data record of variant 4
	actual_feedback_data	Feedback data record
	set_feedback_data_v01	Expected feedback data record of variant 1
	set_feedback_data_v02	Expected feedback data record of variant 2
	set_feedback_data_v03	Expected feedback data record of variant 3
	set_feedback_data_v04	Expected feedback data record of variant 4
	fault_WRREC	Error display when writing data record (for test)
	fault_RDREC	Error display when reading data record (for test)
OB	OB82	OB for diagnostic
	OB83	OB for removing/inserting modules
	OB86	OB for module rack failure
	OB100	OB for startup

4.2.16 Program structure

Overview

Figure 4-26 shows the call structure of the blocks in OB1. For easier orientation the individual steps are marked in color.

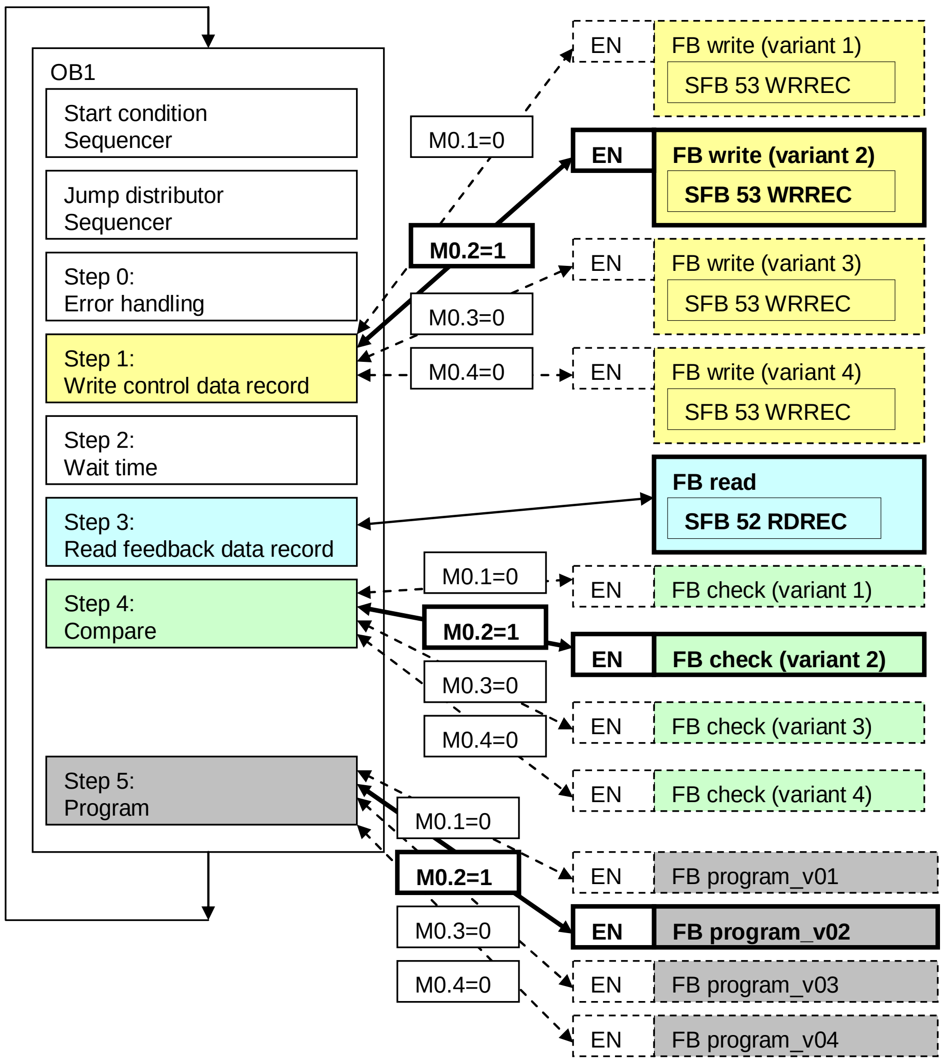
Figure 4-26



Blocks of a variant

Figure 4-27 shows what blocks are called if, for example, variant 2 has been selected (M0.2 = 1). For clarification purposes, the enable inputs of the blocks (EN) are indicated in the figure.

Figure 4-27



4.3 Adjusting code

The code has a modular structure; this is why it can be relatively easy adjusted to other requirements.

- Other configuration of the ET 200SP station
- Other variants of the machine

Below, the main places are listed where changes have to be performed.

Other configuration of the ET 200SP station

Table 4-11

Steps	Revisions
Step 1: Write control data record	Adjust data blocks with control data records (control_data_v0x) Adjust parameter length on the FB write (len_write)
Step 2: Wait time	Adjusting wait time
Step 3: Read feedback data record	Adjust data block to the current feedback data record (actual_feedback_data) Adjust parameter length on the FB read (len_read)
Step 4: Compare	Adjust data blocks with expected feedback data record (set_feedback_dat_v0x) Adjust code for FB check
Step 5: Program	Adjust automation programs (program_v0x)

Other variant of the machine

Table 4-12

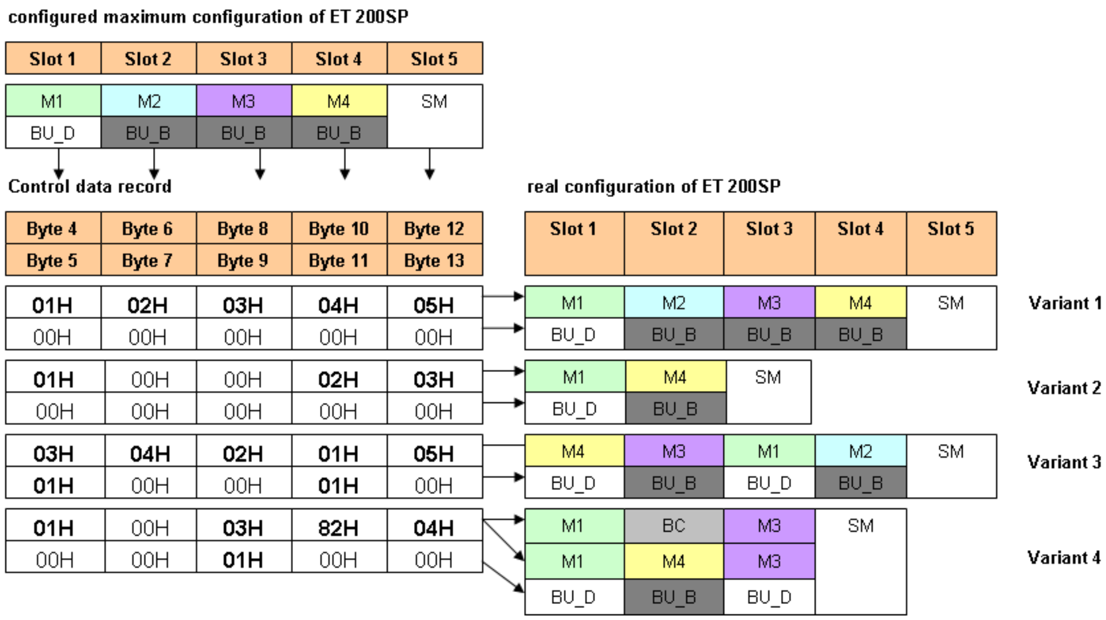
Steps	Revisions
Step 1: Write control data record	Adjust number of calls for FB write Additional data blocks with control data blocks (control_data_v0x)
Step 2: Wait time	---
Step 3: Read feedback data record	---
Step 4: Compare	Adjust number of calls for FB check Additional data blocks with expected feedback data records (set_feedback_data_v0x)
Step 5: Program	Adjust number of calls and contents for FB program_v0x

4.4 Implemented variants

4.4.1 Overview

The figure below shows all variants implemented in the application example and the respective control data records.

Figure 4-28



<u>Explanations</u>

BC	BU Cover
Mx	Module x (I/O module)
SM	Server module
BU_D	Bright BaseUnit (opens a new potential group)
BU_D	Dark BaseUnit
xyH	Hexadecimal value

Table 4-13 shows what methods of the configuration control are used for the variants.

Table 4-13

Variant	Method
Variant 1	The configuration of the ET 200SP corresponds to the configured maximum configuration.
Variant 2	Hiding of modules
Variant 3	Free slot assignment Opening of a new potential group
Variant 4	Hiding of modules Free slot assignment Using empty slots (BU cover) Opening of a new potential group

All variants are implemented in the STEP 7 project (code) of the application example. What modules are concretely used can be found in chapter 2.4.1.

An extensive description of the implemented variants will follow. An explanation of the structure of the following tables can be found in chapter 3.4.1.

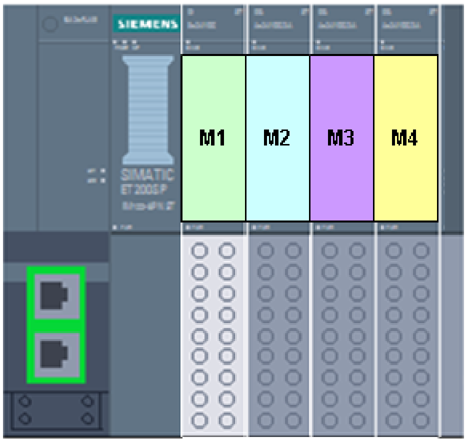
4.4.2 Variant 1

Real configuration

Characteristic of the variant:

- The configuration of the ET 200SP corresponds to the configured maximum configuration.

Figure 4-29



Control data record and feedback data record

Table 4-14

Configuration ET 200S	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	**1 (01H)**	**2 (02H)**	**3 (03H)**	**4 (04H)**	**5 (05H)**
	0	**0**	**0**	**0**	**0**
Feedback data record (*1)	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**1**	**1**	**1**	**1**

Regarding (*1): used as expected feedback data record in the code.

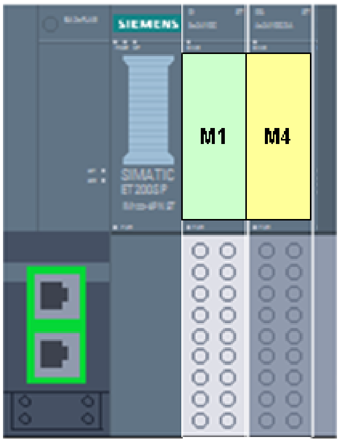
4.4.3 Variant 2

Real configuration

Characteristic of the variant:

- Hiding of modules

Figure 4-30



Control data record and feedback data record

Table 4-15

Configuration ET 200S	**Slot 1**	**Slot 2**	**Slot 3**	**Slot 4**	**Slot 5**
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M1	M4	SM	---	---
	BU_D	BU_B			
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	**1 (01H)**	**0 (00H)**	**0 (00H)**	**2 (02H)**	**3 (03H)**
	0	**0**	**0**	**0**	**0**
Feedback data record (*1)	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**0**	**0**	**1**	**1**

Zu (*1): used as feedback data record in the code.

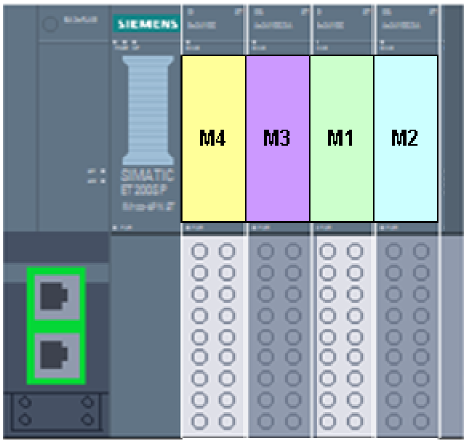
4.4.4 Variant 3

Real configuration

Characteristic of the variant:

- Free slot assignment of the modules
- Opening of a new potential group

Figure 4-31



Control data record and feedback data record

Table 4-16

Configuration ET 200S	**Slot 1**	**Slot 2**	**Slot 3**	**Slot 4**	**Slot 5**
Configured configuration	M1	M2	M3	M4	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration	M4	M3	M1	M2	SM
	BU_D	BU_B	BU_D	BU_B	
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	**3 (03H)**	**4 (04H)**	**2 (02H)**	**1 (01H)**	**5 (05H)**
	1	**0**	**0**	**1**	**0**
Feedback data record (*1)	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**1**	**1**	**1**	**1**

Regarding (*1): used as feedback data record in the code.

4.4.5 Variant 4

Real configuration

Characteristic of the variant:

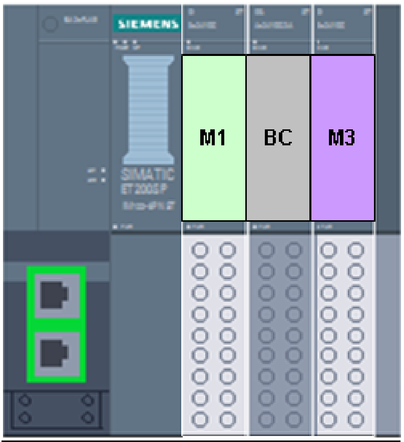
- Hiding of modules
- Free slot assignment
- Using of an empty slot (BU cover)
- Opening of a new potential group

Two real configurations of the ET 200SP are permitted here. Both configurations have the same number of slots but different assembly:

- with BU cover instead of the configured module
- with configured module instead of BU cover

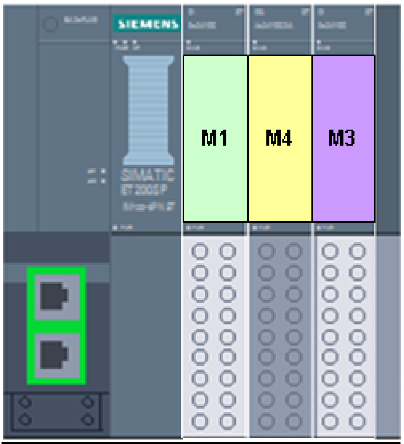
Configuration: BU Cover (BC) inserted

Figure 4-32



Configuration: Module 4 (M4) instead of inserted BU cover (BC)

Figure 4-33



Control data record and feedback data record

Table 4-17

Configuration ET 200S	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Configured configuration	M1	M2	M3	**M4**	SM
	BU_D	BU_B	BU_B	BU_B	
Real configuration with BC	M1	**BC**	M3	SM	---
	BU_D	BU_B	BU_D		
Real configuration with module	M1	**M4**	M3	SM	---
	BU_D	BU_B	BU_D		
Control data record	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
	Byte 5	**Byte 7**	**Byte 9**	**Byte 11**	**Byte 13**
Coding (hexadecimal)	**1 (01H)**	**0 (03H)**	**3 (03H)**	**1+(82H) (82H)**	**4 (04H)**
	0	**0**	**1**	**0**	**0**
Feedback data record: Real configuration with BC (*1)	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**0**	**1**	**0**	**1**
Feedback data record: Real configuration with module	**Byte 4**	**Byte 6**	**Byte 8**	**Byte 10**	**Byte 12**
Coding	**1**	**0**	**1**	**1**	**1**

Regarding (*1): used as feedback data record in the code.

5 Installation and Commissioning

5.1 Overview of steps

The following steps are required for the installation of the application example:

- Load download to PG/PC:
  - Code (STEP 7 project) for S7 CPU
- Install hardware
- Create defined initial state:
  - S7 CPU
  - IM 155-6 PN ST
- Load code (STEP 7 project) into S7 CPU
- Assigning device names

The steps are described in the following chapters.

5.2 Load download to PG/PC

The downloads for the application example are listed in chapter 2.4.3.

For the installation of the code (STEP 7 project) on the PG/PC, the following requirements are necessary:

- Load the "29430270_OH_ET200SP_PN_CODE_v10.zip" file
  into any directory on the PG/PC.
- Unzip the file

5.3 Install hardware

The required hardware components are listed in chapter 2.4.1.
First of all ET 200SP is assembled in variant 1.

NOTICE **The setup guidelines for PROFINET (/3/), ET 200SP (/1/) and S7-300 (/2/) are to be observed. For this purpose, read the respective manuals.**

5.3.1 Installation

Table 5-1 shows the procedure for the configuration of the hardware.

Table 5-1

No.	Hardware	Action
		Centralized configuration:
1.	S7 CPU and MMC	Delete the SIMATIC Micro Memory Card (MMC) for the S7 CPU and insert the MMC into the S7 CPU.
2.	S7 300 mounting rail	Mount the following devices onto the mounting rail: • Power supply • S7 CPU
		Distributed configuration ET 200SP
3.	Standard mounting rail	Assemble the modules in the sequence described: • Interface module (IM) • A bright BaseUnit • Two dark BaseUnits • Server module Insert the I/O modules (modules) in the BaseUnits in the sequence as displayed in Figure 5-1.
4.	PROFINET cable	Connect: • S7 CPU with IM • S7 CPU with PG/PC.
5.	Power supply	Perform all required connections.

5.3.2 Overview of structure

Figure 5-1 schematically shows the structure of the application example. The structure shows the variant 1 of ET 200SP.

Figure 5-1

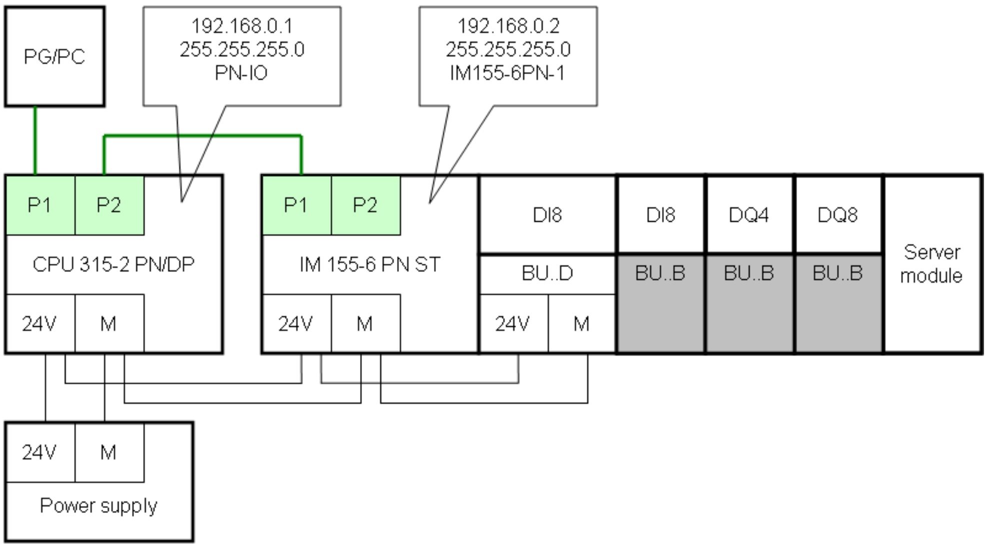
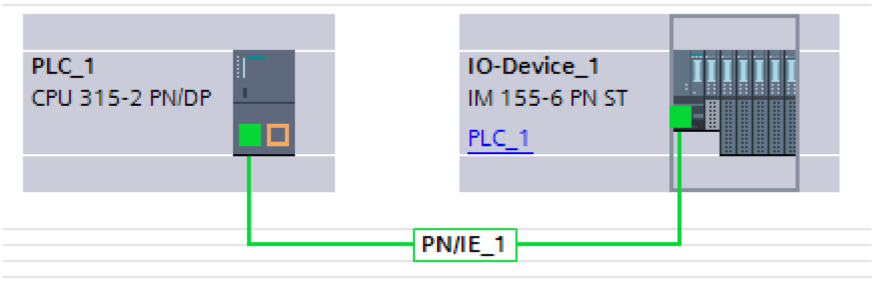


Table 5-2 shows the network view in the device configuration of STEP 7.

Figure 5-2



5.4 Creating initial state for S7 CPU

In the "initial state" the S7 CPU has the following properties:

- S7 CPU has the factory settings.
- SIMATIC Micro Memory Card (MMC) of the S7 CPU has been deleted.

Requirement:

- PG/PC is connected with the S7 CPU via the PROFINET interface.
- STEP 7 V11 is installed on the PG/PC, a STEP 7 project is opened.

Creating factory settings of the S7 CPU

Requirement:

- A MMC is inserted in the S7 CPU.
- The S7 CPU is in STOP mode
(mode switch in STOP position).

Approach:

Table 5-2

No.	Action
1.	Select the S7 CPU in the project navigation (project tree).
2.	Click the "Accessible devices" button in the toolbar.
3.	In the "Accessible devices" window: • Select the line with the S7 CPU • Click the "Show" button.
4.	In the project navigation the "Online accesses" folder opens up: • Open "Online & diagnostics" • Select: "Functions" > "Reset to factory settings" • Click the "Reset" button.

Result:

- Main memory, internal load memory and operand area are deleted.
- All parameters have been reset to their default values.
- Diagnostic buffer and time have been deleted.
- IP address and PROFINET device name have been deleted.

Display for the S7 CPU for "Accessible devices":

Table 5-3

Device	Device type	Type	Address	MAC address
Accessible device	S7-300	ISO	---	00-0E-8C-B0-6A-C5 (Example)

Deleting the MMC of the S7 CPU

Requirement:

- The power supply of the S7 CPU is switched off

Approach:

Table 5-4

No.	Action
1.	Remove the MMC from the S7 CPU.
2.	Insert the MMC into the programming device
3.	In the project navigation (project tree): • Open: "SIMATIC Card Reader" > "Internal prommer" • Select "Micro Memory Card"
4.	Select "Options" in the menu: "SIMATIC Card Reader" > "Format memory card"
5.	Insert the MMC again in the S7 CPU

5.5 Creating initial state for IM 155-6 PN ST

In the "initial state" the IM 155-6 PN ST has the following properties:

- The interface module (IM) has factory settings.

Creating IM factory settings

Requirement:

- The S7 CPU is in "initial state" (chapter 5.4).
- The power supply is switched on

Approach:

Table 5-5

No.	Action
1.	Select the S7 CPU in the project navigation (Project tree).
2.	Click the "Accessible devices" button in the toolbar.
3.	In the "Accessible devices" window: • Select the line with the IO device • Click the "Show" button.
4.	In the project navigation the "Online accesses" folder opens up: • Open "Online & diagnostics" • Select: "Functions" > "Reset to factory settings" • Click the "Reset" button.

Result:

- PROFINET device name is deleted.
- IP address is deleted

Display for the IM for the "Accessible devices":

Table 5-6

Device	Device type	Type	Address	MAC address
Accessible device	IM155-6	ISO	---	00-1B-1B-20-F2-6A (Example)

5.6 Load code (STEP 7 project) into S7 CPU

Requirement

- Initial state for S7 CPU and IM has been created (chapter 5.4 and 5.5)
- PG/PC is connected with the S7 CPU via the PROFINET interface.

Instruction

Table 5-7

No.	Action
1.	Start the TIA Portal
2.	Open the project view
3.	Open the "OH_ET200SP_01" project
4.	In the project navigation: • Select "PLC_1 [CPU 315-2 PN/DP]“ • Confirm with the right mouse button and select: "Download to device“ > "all"
5.	In the "Extended download to device" window: • Enable the "Show all accessible devices" option • Select line "S7-300“ in "Accessible devices in target subnet" • Click the "Load" button
6.	In the "Load preview" window: Click the "Load" button
7.	In the "Load results" window: Click on the "Finish" button.
8.	Switch the S7 CPU to RUN (mode switch in RUN position)

Result

Display for "Accessible devices":

Table 5-8

Device	Device type	Type	Address	MAC address
PLC_1	CPU 315-2 PN/DP	PN/IE	192.168.0.1	00-0E-8C-B0-6A-C5 (example)
io-device_1	IM155-6 PN ST	PN/IE	192.168.0.2	00-1B-1B-20-F2-6A (example)

Display S7-CPU:

- Red LED SF: on
- Red LED BF: flashes

Display IM of IO device:

- LED RN: flashes green

Display module of IO device:

- LED DIAG: flashes green

5.7 Assigning device names

Instruction

Table 5-9

No.	Action
1.	Open the project view
2.	Open the "OH_ET200SP_01" project
3.	In the project navigation: • Open the device: "PLC_1[CPU 315-2 PN/DP]" • Open the device configuration
4.	Select the work area: "Network view"
5.	Select the "PN/IE_1" subnet
6.	Click the right mouse button
7.	Select "Assign device name"

Result:

- The "Assign PROFINET device name" window opens up

<u>Device S7-CPU</u>

Operations in the "Assign PROFINET device name" window

Table 5-10

No.	Action
1.	Click the "Accessible devices in the network" button
2.	Select the "plc_1" entry in the "PROFINET device name" drop-down list
3.	Select line "S7-300" in the table
4.	Click the "Assign Name" button.
5.	Click the "Accessible devices in the network" button

Device IM

Operations in the "Assign PROFINET device name" window

Table 5-11

No.	Action
1.	Click the "Accessible devices in the network" button
2.	Select the "io-device_1" entry in the "PROFINET device name" drop-down list
3.	Select line "IM155-6" in the table
4.	Click the "Assign Name" button.
5.	Click the "Accessible devices in the network" button

Result

Display for "Accessible devices":

Table 5-12

Device	Device type	Type	Address	MAC address
io device_1	IM155-6 PN ST	ISO	---	00-1B-1B-20-F2-6A (example)
PLC_1	CPU 315-2 PN/DP	ISO	---	00-0E-8C-B0-6A-C5 (example)

Display S7 CPU:

- Red LED SF: on

Display IM of IO device:

- LED RN: on green
- LED ER: flashes red

Display module of IO device:

- LED DIAG: flashes green

6 Operation of the Application Example

Requirement:

- Hardware and software have been installed as described in chapter 5.

The following operations are described in the chapter:

- Enable variant 1
- Enable variant 2
- Enable variant 3
- Enable variant 4

For monitoring and testing the application example the watch_table_1 watch table is used.

6.1 Watch table

The watch table (watch_table_1) has the following structure:

Figure 6-1

Name	Address	Display format	Monitor value	Modify ...		Comment
"select_v01"	%M0.1	Bool	TRUE	TRUE		select variant 1
"select_v02"	%M0.2	Bool	FALSE			select variant 2
"select_v03"	%M0.3	Bool	FALSE			select variant 3
"select_v04"	%M0.4	Bool	FALSE			select variant 4
"step"	%MW10	DEC_signed	5			step counter
"ok_1_2"	%M100.1	Bool	TRUE			step enabling condition: 1 to 2
"ok_2_3"	%M100.2	Bool	TRUE			step enabling condition: 2 to 3
"ok_3_4"	%M100.3	Bool	TRUE			step enabling condition: 3 to 4
"ok_4_5"	%M100.4	Bool	TRUE			step enabling condition: 4 to 5
"wait_time"	%T1	SIMATIC Time	S5T#0MS			wait time for step 2
"test_output_1"	%Q1.1	Bool	TRUE			test output for variant 1
"test_output_2"	%Q1.2	Bool	FALSE			test output for variant 2
"test_output_3"	%Q1.3	Bool	FALSE			test output for variant 3
"test_output_4a"	%Q1.0	Bool	FALSE			test output for variant 4
"test_output_4b"	%Q0.0	Bool	FALSE			test output for variant 4
"actual_feedback_data".projektierter_Slot_1	%DB30.DBB4	Hex	16#01			feedback data real slot 1
"actual_feedback_data".projektierter_Slot_2	%DB30.DBB6	Hex	16#01			feedback data real slot 2
"actual_feedback_data".projektierter_Slot_3	%DB30.DBB8	Hex	16#01			feedback data real slot 3
"actual_feedback_data".projektierter_Slot_4	%DB30.DBB10	Hex	16#01			feedback data real slot 4
"actual_feedback_data".projektierter_Slot_5	%DB30.DBB12	Hex	16#01			feedback data real slot 5
"error_number"	%MB104	Hex	16#00			error number
"fault_WRREC".WRREC	%DB31.DBD0	Hex	16#0000_0000			error write
"fault_RDREC".RRREC	%DB32.DBD0	Hex	16#0000_0000			error read

To change or to select variants only the above marked variables are required. Chapter 6.2 describes how a variant is enabled.

The remaining variables can be used for test purposes.

6.2 Enable variant 1

Note: Information on variant 1 is available in chapter “4.4.2”.

Requirement:

- The configuration of station ET 200SP corresponds to variant 1

Opening the watch table

Operation:

- Open the watch_table_1 watch table
- Click the "Monitor all" button

Positive edge on the signal for variant 1

Operation:

- Control all signals for the variants (select_v0x) to "0"
- Control the signal for variant 1 (select_v0x) to "1"

Result:

- LED .1 lights up on module 4 (DQ8) on the ET 200SP station. This indicates that the program for variant 1 is active (see chapter 6.6).

Figure 6-2

Name	Address	Display format	Monitor value	Modify ...		Comment
"select_v01"	%M0.1	Bool	TRUE	TRUE		select variant 1
"select_v02"	%M0.2	Bool	FALSE			select variant 2
"select_v03"	%M0.3	Bool	FALSE			select variant 3
"select_v04"	%M0.4	Bool	FALSE			select variant 4
"step"	%MW10	DEC_signed	5			step counter
"ok_1_2"	%M100.1	Bool	TRUE			step enabling condition: 1 to 2
"ok_2_3"	%M100.2	Bool	TRUE			step enabling condition: 2 to 3
"ok_3_4"	%M100.3	Bool	TRUE			step enabling condition: 3 to 4
"ok_4_5"	%M100.4	Bool	TRUE			step enabling condition: 4 to 5
"wait_time"	%T1	SIMATIC Time	S5T#0MS			wait time for step 2
"test_output_1"	%Q1.1	Bool	TRUE			test output for variant 1
"test_output_2"	%Q1.2	Bool	FALSE			test output for variant 2
"test_output_3"	%Q1.3	Bool	FALSE			test output for variant 3
"test_output_4a"	%Q1.0	Bool	FALSE			test output for variant 4
"test_output_4b"	%Q0.0	Bool	FALSE			test output for variant 4
"actual_feedback_data".projektierter_Slot_1	%DB30.DBB4	Hex	16#01			feedback data real slot 1
"actual_feedback_data".projektierter_Slot_2	%DB30.DBB6	Hex	16#01			feedback data real slot 2
"actual_feedback_data".projektierter_Slot_3	%DB30.DBB8	Hex	16#01			feedback data real slot 3
"actual_feedback_data".projektierter_Slot_4	%DB30.DBB10	Hex	16#01			feedback data real slot 4
"actual_feedback_data".projektierter_Slot_5	%DB30.DBB12	Hex	16#01			feedback data real slot 5
"error_number"	%MB104	Hex	16#00			error number
"fault_WRREC".WRREC	%DB31.DBD0	Hex	16#0000_0000			error write
"fault_RDREC".RRREC	%DB32.DBD0	Hex	16#0000_0000			error read

6.3 Enable variant 2

Note: Information on variant 2 is available in chapter 4.4.3.

Starting point:

- ET 200S has the configuration for variant 1
- Variant 1 is enabled

The ET 200SP station is modified.

Approach for changing the variant:

- Switching off (network off)
- Converting the ET 200SP to variant 2
- Switching on (network on)
- Calling watch_table_1 watch table:
  - Control all signals for the variants (select_v0x) to "0"
  - Control signal for variant 2 (select_v02) to "1"

Result:

- The program for variant 2 (FB program_v02) is called cyclically
- LED 0.2 lights up on module 4 (DQ8) on the ET 200SP station. This indicates that the program for variant 2 is active (see chapter 6.6).

Figure 6-3

Name	Address	Display format	Monitor value	Modify ...		Comment
"select_v01"	%M0.1	Bool	FALSE	FALSE		select variant 1
"select_v02"	%M0.2	Bool	TRUE	TRUE		select variant 2
"select_v03"	%M0.3	Bool	FALSE	FALSE		select variant 3
"select_v04"	%M0.4	Bool	FALSE	FALSE		select variant 4
"step"	%MW10	DEC_signed	5			step counter
"ok_1_2"	%M100.1	Bool	TRUE			step enabling condition: 1 to 2
"ok_2_3"	%M100.2	Bool	TRUE			step enabling condition: 2 to 3
"ok_3_4"	%M100.3	Bool	TRUE			step enabling condition: 3 to 4
"ok_4_5"	%M100.4	Bool	TRUE			step enabling condition: 4 to 5
"wait_time"	%T1	SIMATIC Time	S5T#0MS			wait time for step 2
"test_output_1"	%Q1.1	Bool	FALSE			test output for variant 1
"test_output_2"	%Q1.2	Bool	TRUE			test output for variant 2
"test_output_3"	%Q1.3	Bool	FALSE			test output for variant 3
"test_output_4a"	%Q1.0	Bool	FALSE			test output for variant 4
"test_output_4b"	%Q0.0	Bool	FALSE			test output for variant 4
"actual_feedback_data".projektierter_Slot_1	%DB30.DBB4	Hex	16#01			feedback data real slot 1
"actual_feedback_data".projektierter_Slot_2	%DB30.DBB6	Hex	16#00			feedback data real slot 2
"actual_feedback_data".projektierter_Slot_3	%DB30.DBB8	Hex	16#00			feedback data real slot 3
"actual_feedback_data".projektierter_Slot_4	%DB30.DBB10	Hex	16#01			feedback data real slot 4
"actual_feedback_data".projektierter_Slot_5	%DB30.DBB12	Hex	16#01			feedback data real slot 5
"error_number"	%MB104	Hex	16#00			error number
"fault_WRREC".WRREC	%DB31.DBD0	Hex	16#0000_0000			error write
"fault_RDREC".RRREC	%DB32.DBD0	Hex	16#0000_0000			error read

6.4 Enable variant 3

Note: Information on variant 3 is available in chapter 4.4.4.

Starting point:

- ET 200SP has the configuration for variant 2
- Variant 2 is enabled

The ET 200SP station is modified.

Approach for changing the variant:

- Switching off (network off)
- Converting the ET 200SP to variant 3
- Switching on (network on)
- Calling watch_table_1 watch table:
  - Control all signals for the variants (select_v0x) to "0"
  - Control signal for variant 3 (select_v03) to "1"

Result:

- The program for variant 3 (FB program_v03) is called cyclically
- LED 0.3 lights up on module 4 (DQ8) on the ET 200SP station. This indicates that the program for variant 3 is active (see chapter 6.6).

Figure 6-4

Name	Address	Display format	Monitor value	Modify ...		Comment
"select_v01"	%M0.1	Bool	FALSE	FALSE		select variant 1
"select_v02"	%M0.2	Bool	FALSE	FALSE		select variant 2
"select_v03"	%M0.3	Bool	TRUE	TRUE		select variant 3
"select_v04"	%M0.4	Bool	FALSE	FALSE		select variant 4
"step"	%MW10	DEC_signed	5			step counter
"ok_1_2"	%M100.1	Bool	TRUE			step enabling condition: 1 to 2
"ok_2_3"	%M100.2	Bool	TRUE			step enabling condition: 2 to 3
"ok_3_4"	%M100.3	Bool	TRUE			step enabling condition: 3 to 4
"ok_4_5"	%M100.4	Bool	TRUE			step enabling condition: 4 to 5
"wait_time"	%T1	SIMATIC Time	S5T#0MS			wait time for step 2
"test_output_1"	%Q1.1	Bool	FALSE			test output for variant 1
"test_output_2"	%Q1.2	Bool	FALSE			test output for variant 2
"test_output_3"	%Q1.3	Bool	TRUE			test output for variant 3
"test_output_4a"	%Q1.0	Bool	FALSE			test output for variant 4
"test_output_4b"	%Q0.0	Bool	FALSE			test output for variant 4
"actual_feedback_data".projektierter_Slot_1	%DB30.DBB4	Hex	16#01			feedback data real slot 1
"actual_feedback_data".projektierter_Slot_2	%DB30.DBB6	Hex	16#01			feedback data real slot 2
"actual_feedback_data".projektierter_Slot_3	%DB30.DBB8	Hex	16#01			feedback data real slot 3
"actual_feedback_data".projektierter_Slot_4	%DB30.DBB10	Hex	16#01			feedback data real slot 4
"actual_feedback_data".projektierter_Slot_5	%DB30.DBB12	Hex	16#01			feedback data real slot 5
"error_number"	%MB104	Hex	16#00			error number
"fault_WRREC".WRREC	%DB31.DBD0	Hex	16#0000_0000			error write
"fault_RDREC".RRREC	%DB32.DBD0	Hex	16#0000_0000			error read

6.5 Enable variant 4

Note: Information on variant 4 is available in chapter 4.4.5.

The control data record for variant 4 either permits a BU cover (BC) or the module 4 (M4) on slot 2 of the station.

First of all the ET 200SP is assembled with a BU cover, and then the BU cover is replaced by module 4.

Assembly with BU cover

Starting point:

- ET 200SP has the configuration for variant 3
- Variant 3 is enabled

The ET 200SP station is modified.

Approach for changing the variant:

- Switching off (network off)
- Conversion of ET 200SP to variant 4 with BU cover
- Switching on (network on)
- Call variable table VAT_00:
  - Control all signals for the variants (select_v0x) to "0"
  - Control signal for variant 4 (select_v04) to "1"

Result:

- The program for variant 4 (FB program_v04) is called cyclically
- LED 0.0 lights up on module 3 (DQ4) on the station ET 200SP. This indicates that the program for variant 4 is active (see chapter 6.6).

Figure 6-5

Name	Address	Display format	Monitor value	Modify ...	⚡	Comment
"select_v01"	%M0.1	Bool	FALSE	FALSE		select variant 1
"select_v02"	%M0.2	Bool	FALSE	FALSE		select variant 2
"select_v03"	%M0.3	Bool	FALSE	FALSE		select variant 3
"select_v04"	%M0.4	Bool	TRUE	TRUE		select variant 4
"step"	%MW10	DEC_signed	5			step counter
"ok_1_2"	%M100.1	Bool	TRUE			step enabling condition: 1 to 2
"ok_2_3"	%M100.2	Bool	TRUE			step enabling condition: 2 to 3
"ok_3_4"	%M100.3	Bool	TRUE			step enabling condition: 3 to 4
"ok_4_5"	%M100.4	Bool	TRUE			step enabling condition: 4 to 5
"wait_time"	%T1	SIMATIC Time	S5T#0MS			wait time for step 2
"test_output_1"	%Q1.1	Bool	FALSE			test output for variant 1
"test_output_2"	%Q1.2	Bool	FALSE			test output for variant 2
"test_output_3"	%Q1.3	Bool	FALSE			test output for variant 3
"test_output_4a"	%Q1.0	Bool	TRUE			test output for variant 4
"test_output_4b"	%Q0.0	Bool	TRUE			test output for variant 4
"actual_feedback_data".projektierter_Slot_1	%DB30.DBB4	Hex	16#01			feedback data real slot 1
"actual_feedback_data".projektierter_Slot_2	%DB30.DBB6	Hex	16#00			feedback data real slot 2
"actual_feedback_data".projektierter_Slot_3	%DB30.DBB8	Hex	16#01			feedback data real slot 3
"actual_feedback_data".projektierter_Slot_4	%DB30.DBB10	Hex	16#00			feedback data real slot 4
"actual_feedback_data".projektierter_Slot_5	%DB30.DBB12	Hex	16#01			feedback data real slot 5
"error_number"	%MB104	Hex	16#00			error number
"fault_WRREC".WRREC	%DB31.DBD0	Hex	16#0000_0000			error write
"fault_RDREC".RRREC	%DB32.DBD0	Hex	16#0000_0000			error read

Assembly with module 4

Starting point:

- ET 200SP is configured for variant 4, the BU cover is inserted
- Variant 4 is enabled

The BU cover is replaced by module 4.

Approach:

- Remove the BU Cover
- Insert module 4

Result:

- The program for variant 4 (FB program_v04) is still called cyclically.
- The LED .0 lights up on module 3 (DQ4) at the station ET 200SP and LED .0 on module 4 (DQ8).

Note: Switching off (network off) is not required.

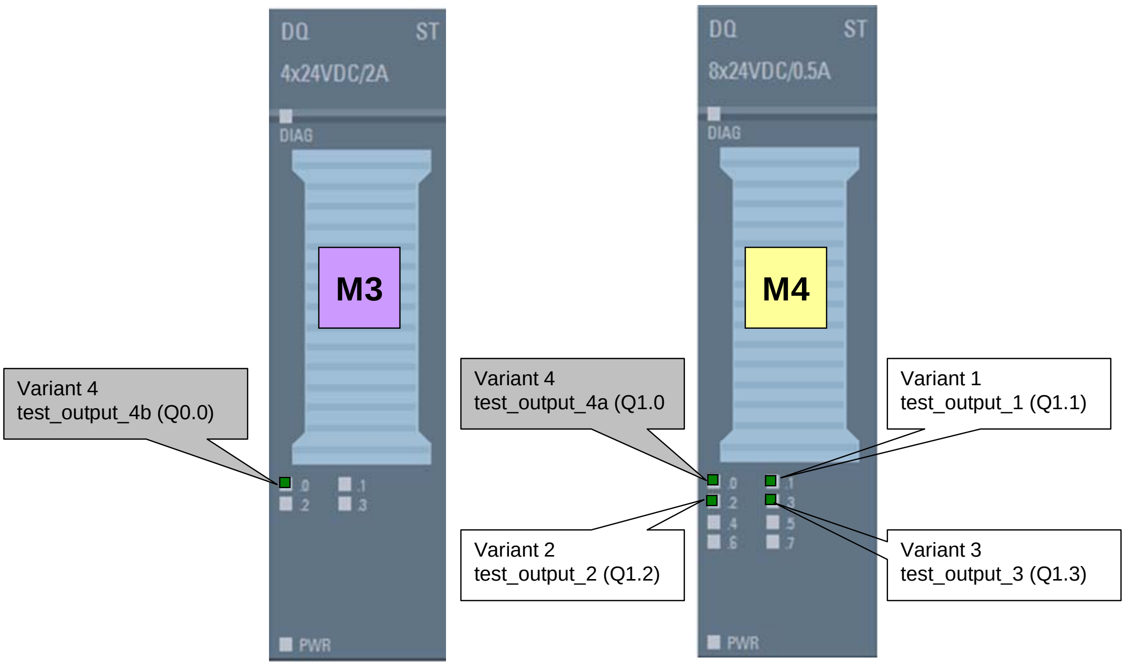
6.6 Display of enabled variant

The program for variant x is called cyclically for the enabled variant x. The outputs in ET 200SP are set for the variant x in the program.

Via the LEDs of the DQ modules of the ET 200SP it can therefore be easily detected which variant is enabled.

The figure shows the assignment of the LEDs for the variants.

Figure 6-6



7 Glossary

Table 7-1

Abbreviation / term in the document	Meaning
Actual configuration	The feedback data describes the actual configuration.
BaseUnit	BaseUnits ensure the electrical and mechanical connection of the ET 200SP modules.
BC	The BU cover (BC) is inserted in BaseUnits that are not used or are reserved for future configuration (empty slots).
BU_B	Dark BaseUnit
BU_D	Bright BaseUnit (opens a new potential group)
Code	STEP 7 project of the application
DI	Digital input module
DQ	Digital output module
Empty slot	A slot with BU cover is called an empty slot. Empts slot = BaseUnit + BU-Cover
Expected configuration	The control data describes the expected configuration.
IM	Interface module of the ET 200 station
LED BF	LED bus error
LED SF	LED collective error
Maximum configuration	Configuration that was configured in the STEP 7 basic project.
MMC	SIMNATIC Micro Memory Card
Modules	I/O modules of the ET 200SP
PG/PC	SIMATIC programming device / PC with STEP 7
Server module (SM)	The distributed I/O system ET 200SP is completed with the server module at the right end of the configuration.
Slot x	Slot x
STEP 7	Engineering tool for programming and configuration
STEP 7 basic project	STEP 7 project that covers all variants (maximum configuration)
STEP 7 project	Configuration and program (user program)

8 Literature

Table 8-1

	Topic	Link
/1/	SIMATIC Distributed I/O System ET 200SP System manual	http://support.automation.siemens.com/WW/view/en/58649293
/2/	S7-300, CPU 31xC and CPU 31x: Installation Operating instructions	http://support.automation.siemens.com/WW/view/en/13008499
/3/	PROFINET System manual	http://support.automation.siemens.com/WW/view/en/19292127
/4/	Collection of applications on the issue Configuration Control (Options Handling)	http://support.automation.siemens.com/WW/view/en/29430270
/5/	SIMATIC ET 200SP Interface Module IM 155-6 PN ST	http://support.automation.siemens.com/WW/view/en/59768173
/8/	STEP 7 Professional V11	http://support.automation.siemens.com/WW/view/en/57185407

9 History

Table 9-1

Version	Date	Revisions
V1.0	06/2012	First issue