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PROFINET IO – Diagnostics Processing in the User Program

Application with Code

SIEMENS

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Foreword

Objective of the application

This application was created to show the capabilities and variants of the PROFINET IO diagnostics from the user program. The application was designed in such a way that the different approaches to the solution are realized in two different user programs.

Main contents of this application

These applications deal with the following approaches:

- Application 1: Approach with SFC 51 “RDSYSST” and SFB 54 “RALARM”. (Status analysis during startup and error analysis in the error OBs)
- Application 2: Approach by means of the diagnostics expansion (FB_126_Dataset) based on Report System Error.

Delimitation

These applications do not include complete descriptions of all diagnostic capabilities offered by S7. In addition, the fully programmed code does not cover all possible errors. The extension of this code is thus possible and required by the user.

Basic knowledge of Microsoft Windows, STEP 7, the STEP 7 block architecture, PROFINET IO, programming in STL and WinCC flexible is required.

Structure of the document

The documentation of this application is divided into the following main parts.

Part	Description
Application Description	You are provided with a general overview of the contents. You are informed on the used components (standard hardware and software components and the specially created user software).
Principles of Operation and Program Structures	This part describes the detailed functional sequences of the involved hardware and software components, the solution structures and – where useful – the specific implementation of this application. It is only required to read this part if you want to familiarize with the interaction of the solution components to use these components, e.g., as a basis for own developments.
Structure, Configuration and Operation of the Application	This part takes you step by step through structure, important configuration steps, startup and operation of the application.
Appendix	This part of the document contains references and internet links.

Reference to Automation and Drives Service & Support

This entry is from the internet application portal of Automation and Drives Service & Support. Clicking the link below directly displays the download page of this document.

http://support.automation.siemens.com/WW/view/en/24000238

PROFINET IO Diag UP ID Number: 24000238

Table of Contents

Application Description

Contents

The following chapter provides information on the used components (standard hardware and software components) that are necessary for these applications. In addition, you are informed on the diagnostic capabilities of PROFINET IO networks via the user program.

1 Automation Problem

You are provided with information on…

the specific automation problem described in this documentation.

1.1 Overview

Description of the automation problem

The automation problem is to have a PROFINET I/O system with different components monitored by the control program. The option of manual operation and detailed diagnostics of the whole system is to be ensured. The focus is on the acquisition and representation of the diagnostic information.

1.2 Automation solution requirements

Automation problem requirements

In the automation solution, programming approaches are used to show possible solutions to the design of advisable diagnostics of PROFINET IO systems. The different options offered by STEP 7 are to be used. In addition, the connection of an HMI device which, among other things, is used for the display of the diagnostic data and of PROFINET IO will also be described.

Controller requirements

The control program processes

- the simulation of the demo process,
- the connection of the PROFINET IO system,
- the diagnostics of the I/O modules
  - during the CPU startup
  - in the event of a failure of I/O modules / I/O module (including station failure)
  - in the event of a recovery of I/O modules / I/O module (including station recovery)
- the preparation of the simulation and diagnostic data for the HMI device

HMI system requirements

The used HMI device is used as a graphical user interface for the display of the process or diagnostic data to the user.

2 Automation Solution

You are provided with information on…

the solution selected for the automation problem.

Diagnostic capabilities in the SIMATIC spectrum

SIMATIC S7 uses an integrated diagnostic concept for PROFINET IO. The overview in the following table shows all diagnostic capabilities in the SIMATIC S7 / STEP 7 spectrum.

The diagnostic capabilities in color will be described in greater detail in this document. Please note the chapters listed in “Further Information”.

Table 2-1

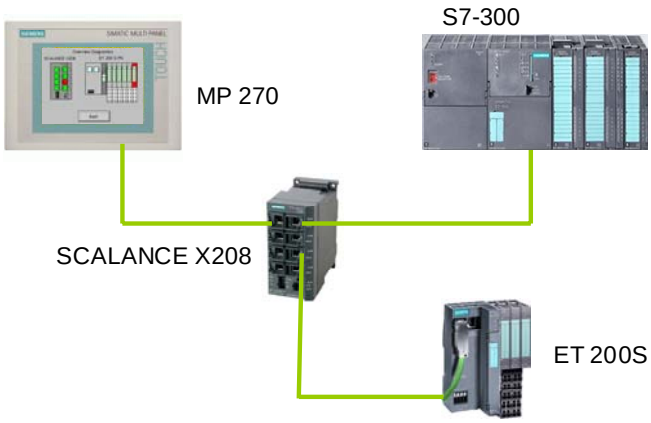
Diagnostic capabilities	Functionality	Field of application	Further information
Diagnostics via hardware display	Displays on the device hardware indicate statuses and error statuses. Moreover, modules with diagnostics capability facilitate error finding since they feature separate error displays.	Visual local hardware diagnostics by the operator.	Technical documentations of the used modules / systems.
General diagnostics with STEP 7 Basis	STEP 7 functions for diagnostics within the scope of the hardware or connection configuration.	Standard diagnostics with STEP 7 Basis.	PROFINET IO – Configuration & Diagnostics
Report System Error (diagnostics by the development environment)	Program blocks for SIMATIC S7, offered functions of the STEP 7 development environment. Integrated functions enable to process and display error statuses on HMI devices or in the STEP 7 environment.	Standard diagnostics with STEP 7 and in the SIMATIC HMI environment. (The FB_126_DATASET diagnostics expansion provides the option to diagnose PROFINET devices also with external devices)	Programming with STEP 7 V5.4 /3/ See chapter 3.2.4 and the following chapters in this document.
System diagnostics – PROFINET IO Device Diagnostics "FB 126"	Program blocks for the diagnostics of PROFINET systems for STEP 7. Libraries for the application and display for SIMATIC HMI systems such as WinCC and PCS 7.	Diagnostics expansion in complex SIMATIC S7, WinCC or PCS 7 HMI systems.	See also: German: Siemens I&S de English: Siemens I&S en
System functions / SIMATIC S7 system function blocks	• Reading system status / status partial lists (SFC 51) • Reading diagnostic data records (SFB 52) • Receiving diagnostic interrupts (SFB 54)	User program oriented diagnostics of system statuses or error diagnostics.	See chapter 3.2 and the following chapters in this document.

2.1 Overview of the overall solution

Diagrammatic representation

The following figure schematically shows the most important components of the solution:

Figure 2-1



Configuration

The system components are installed around the SCALANCE X208 Ethernet switch. The central control unit, a SIMATIC S7-300 station with a CPU 315-2 PN/DP and the PROFINET device, an ET 200S with IM 151-3 PN and the HMI device, an MP 270 6".

2.2 Description of the core functionality

Contents

The applications implemented here include the simulation of a simple automated process with input and output data as a demonstration basis.

The central points of these applications, however, are the different examples of solutions for the application of the diagnostic functionality in the running user program or for the display on the HMI.

Approaches

To solve the given diagnostic problem, two options were selected from the functional scope of SIMATIC S7:

- The approach using SFC 51 (RDSYSST) which compares the actual status of the I/O to the desired status during CPU startup and SFB 54 (RALARM) which analyzes the source of error in the event of an interrupt during continuous operation.
- The approach using the diagnostic support with “FB_126_Dataset” based on the Report System Error (SFM) function which monitors the entire program cycle and the involved interrupts.

2.2.1 Example of a solution with SFC 51 and SFB 54

User interface of the HMI device

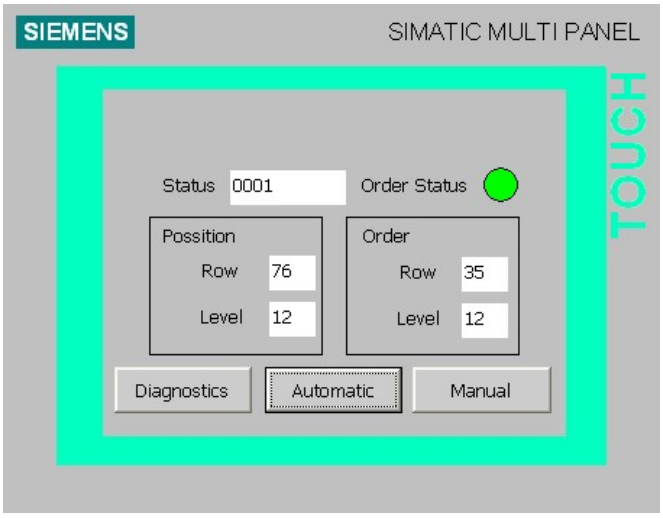
The used user interface consists of two screens.

- Simulation user interface
- Diagnostics user interface

The two screens will be briefly described in the following.

Simulation user interface

Figure 2-2



This user interface displays the status of the simulation application and enables to change between

- Manual mode,
- Automatic mode,
- and the Diagnostics section.

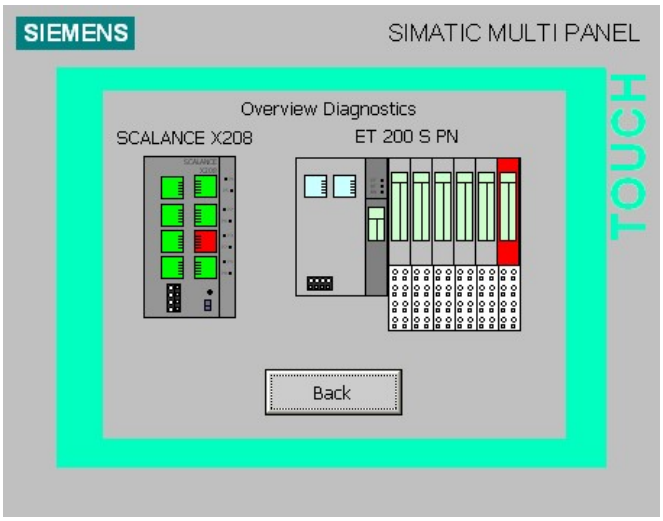
In Automatic mode the carriage of a high-bay racking system is simulated. Different positions with randomly determined target coordinates are approached and new jobs are generated. The job creation is represented by the “Order Status” display.

In Manual mode the simulated carriage can also be moved by touch control.

Use the “Diagnostics” button to open the Diagnostics user interface.

Diagnostics user interface

Figure 2-3



The Diagnostics user interface includes the Diagnostics view of the two modules that can be diagnosed via PROFINET. The current status errors of the two modules are displayed in red.

Unplugging or plugging in the corresponding modules or plugs is cyclically updated and displayed in the graphic representation, see chapter 8.2 “Diagnostics view of the solution with SFC 51 / SFB 54”.

Sequence of the core functionality

Several functions are implemented.

The general function, the simulation of the process, has to be seen independently of the diagnostic functions. It is the base load for the communication to the ET200S and for the visualization.

The startup diagnostics of the system or of the two PROFINET IO devices connected to the CPU are the first diagnostic step. This is realized by means of SFC 51 “RDSYSST” in OB 100 (restart). It is checked whether the device exists and whether it is complete. If information indicating an error is found, this information is prepared for the HMI device.

During operation the diagnostics of PROFINET IO will be performed via the interrupt OBs. SFB 54 “RALARM” is called in each of the three used interrupt OBs. The information determined by the block call is subsequently analyzed and prepared for the HMI device.

The following table illustrates the function steps of the individual diagnostic functions.

Table 2-2

	Action	Note
Diagnosing system status during startup (OB100)		
1	CPU and devices start up.	The CPU OS initializes the configured modules.
2	OB100 calls one instance of SFC 51 for each of the two configured devices to read out the system status.	The system status is read out as a data record and stored in a data block.
3	Subsequently, the two data blocks are analyzed and possibly existing error entries are stored in the DIAG_RALARM data block.	The DIAG_RALARM data block is thus the HMI for the diagnostic data of the I/O.
Error diagnostics from the error OBs (OB 82, OB 83, OB 86)		
1	By removing a module of the ET200S or by unplugging a plug on SCALANCE X 208, an interrupt OB is started.	In the S7-300, an I/O module can only be removed in PROFINET IO. PROFINET DP does not support this functionality.
2	The “RALARM” system function block is executed to obtain detailed information on the occurred errors.	The error information is divided into three sections, • the OB start information • the TINFO management information • the AINFO interrupt information
3	Subsequently, the interrupt information is analyzed and existing error entries are stored in the DIAG_RALARM data block.	

Advantages of this solution

The benefits of this procedure are the event-controlled diagnostics. When the event occurs, each status change is stored in a diagnostic data area that can be continuously read out and can be flexibly checked and evaluated by different components.

2.2.2 Example of a solution with PROFINET IO diagnostics expansion based on Report System Error

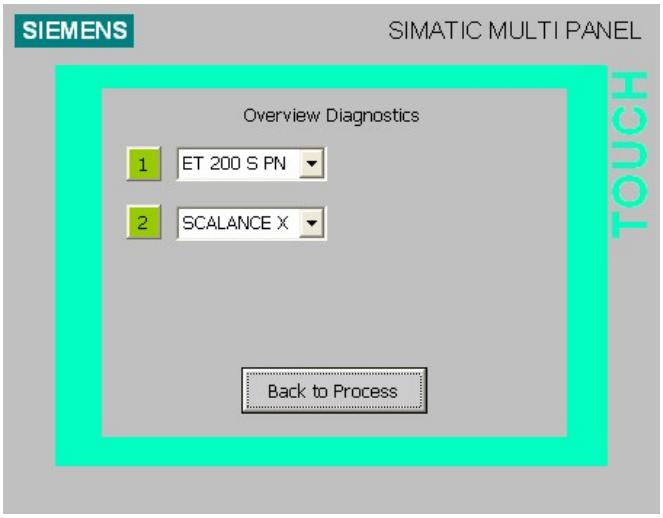
User interface of the HMI device

The used user interface consists of three screens.

- Simulation user interface (see chapter 2.2.1)
- Overview Diagnostics
- Device Diagnostics

Overview Diagnostics

Figure 2-4



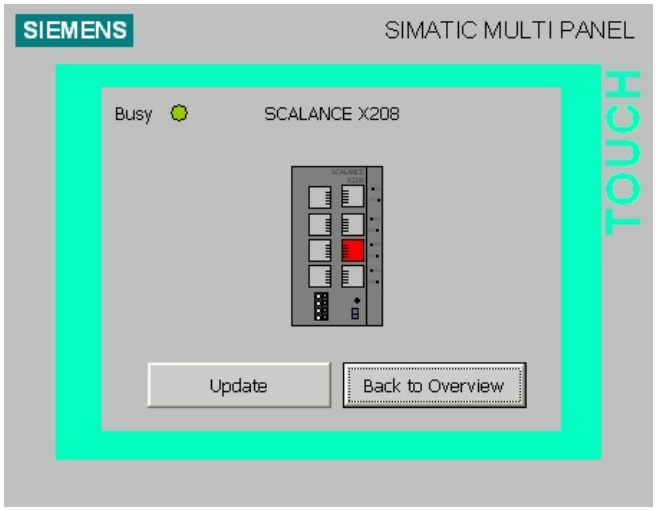
Overview Diagnostics dynamically display the configured PROFINET IO devices in the device number range 1 to 8 which are used in this example of a solution.

In the event of an error, the affected station is indicated by a flashing of the button with its device number. To select the suitable device, a select box of the available device types is added to the right of the address. ET200S or SCALANCE X can be selected. The FB_126_Dataset functionality does not allow the user to precisely identify the used device; for this reason, this configuration must be specified by the user or the program.

New device types can be inserted in WinCC flexible or the existing configurations can be adjusted to changed configurations as required. In this application, the data interface for device diagnostics is designed for devices with up to 9 modules.

Device Diagnostics

Figure 2-5



After selecting the device type in Overview Diagnostics, Device Diagnostics of the device address are opened for the corresponding device type by the selection of the device number.

Device Diagnostics include the visual representation of the corresponding device and display the current status at the instant when Device Diagnostics are opened. In the case of SCALANCE X, the representation corresponds to the online diagnostics from STEP 7.

Since the status of the modules within a device is not cyclically updated by this sample program, it is required to use the “Update” button to trigger a reevaluation in the cyclic program. The update status is indicated by the “Busy” display.

Sequence of the core functionality

Several functions are implemented.

The general function, the simulation of the process, has to be seen independently of the diagnostic functions. It is the base load for the communication to the ET200S and for the visualization.

Except for one function block and the associated data blocks, the diagnostic functions are configured in the STEP7 software. The required “Report System Error” function is configured in HW Config. Aside from the “Report System Error” functionality, the diagnostic support for PROFINET IO was also configured in the form of DB 126 “FB_126_Dataset”.

The only individually created function block in this example is used to determine the diagnostic data of a device. The function block is selectively started as required. In this version, only one instance of this function is

implemented. The used data block is exclusively used for storing the diagnostic data.

The following table includes the function steps of the diagnostic function.

Table 2-3

	Action	Note
1	By unplugging a module or a plug, an interrupt OB is executed. Alternatively, an error during the initialization can be reported when starting the CPU. This is processed with SFM_FB FB 49.	
2	The detected error is subsequently stored in the data block of the diagnostic support, FB_126_Dataset.	The status visualization in Overview Diagnostics is also realized by the direct connection of the HMI device.
3	By selecting the corresponding device type and the address to be diagnosed on the HMI device, device diagnostics are started.	The HMI device assigns the job to successively read out the diagnostic information from the “FB_126_Dataset” data block to the HMI_DIAG_REQ function block.
4	The received detailed diagnostic data are stored in a standard data block designed for device diagnostics.	These diagnostic data are displayed by the HMI device.

Advantages of this solution

The special benefit of this procedure is the very lean programming within the controller. Furthermore, a wide range of possible errors is covered.

Another advantage is the constant communication requirement since the error information is only transferred upon request by the HMI device. The expansion of the PROFINET IO system by several devices ensures none or only insignificantly larger communication load in the overall system.

2.3 Required hardware and software components

Hardware components

Table 2-4

Component	No.	MLFB / order number	Note
Field PG or PC			
Programming device (PG) or PC with Ethernet network card, 100 Mbit/s full duplex	1	Depending on configuration	Installed software STEP 7, from version 5.4 SP1 and WinCC flexible Edition 2005 + SP 1
SIMATIC Multi Panel			
MP 270 6" TFT	1	6AV6545-0AH10-0AX0	
PROFINET IO – CPU315-2 PN/DP			
DIN rail	1	E.g. 6ES7390-1AE80-0AA0	
Power supply (PS307, 24V/5A DC)	1	E.g. 6ES7307-1EA00-0AA0	
CPU 315-2 PN/DP from V2.3	1	6ES7315-2EG10-0AB0	
Micro Memory Card (MMC)	1	E.g. 6ES7953-8LL11-0AA0	The MMC is mandatory for operating the CPU.
SCALANCE X208, network components			
Switch, e. g. SCALANCE X208	1	6GK5 208-0BA00-2AA3	
Industrial Ethernet twisted pair cable (Cat5) with RJ45 plugs (TP cord patch cable RJ45/RJ45, length 6 m)	4	E.g. 6XV1870-3QH60	
PROFINET IO – ET 200S			
Standard DIN rail 35 mm (e. g. length 483 mm)	1	6ES5710-8MA11	
IM151-3 PN interface module and terminating module	1	6ES7151-3BA20-0AB0	Head module with 2-port RJ45 switch.

Component	No.	MLFB / order number	Note
Micro Memory Card (MMC)	1	E.g. 6ES7953-8LF11-0AA0	The MMC is mandatory for ET 200S operation.
PM-E power module for ET 200S, 24V DC	1	6ES7 138-4CA01-0AA0	Mandatory for the power supply.
2DI 24V DC ST input module (5 ea.)	2	6ES7 131-4BB00-0AA0	
4 DI 24V DC HF input module (5 ea.)	1	6ES7 131-4BD01-0AB0	
4DO 24V/0.5A DC ST output module (5 ea.)	2	6ES7 132-4BD01-0AA0	
TM-P15S23-A1 Fast Connect terminal module (1 ea.)	1	6ES7 193-4CC20-0AA0	Necessary for the power module.
TM-E15S24-A1 Fast Connect terminal module (5 ea.)	5	6ES7 193-4CA20-0AA0	
Industrial Ethernet FC RJ45 plug 90 (10 ea.)	1	6GK1 901-1BB20-2AB0	
Industrial Ethernet FC stripping tool	1	6GK1 901-1GA00	

Standard software components

Table 2 -5

Component	No.	MLFB / order number	Note
STEP 7 V 5.4 SP 1	1	6ES7810-4CC08-0YA5	Floating license for STEP 7 V 5.4 or higher
WinCC flexible 2005 + SP 1	1	E.g. Advanced: 6AV6613-0AA01-1CA5	Floating license; WinCC flexible RT recommended

Example files and projects

The following list includes all files and projects used in this example.

Table 2-6

Component	Note
24000238_PROFINET_IO_Diag_CODE_V10.zip With the files: • PNDiag_conf1_V1.0.zip sample solution 1 • PNDiag_conf1_V1.0.zip sample solution 2	These zip files contain the two zip STEP 7 projects.
24000238_PROFINET_IO_Diag_V10_e.pdf	This document.

PROFINET IO Diag UP ID Number: 24000238

Principles of Operation and Program Structures

Contents

The following chapter provides you with an overview of the PROFINET IO diagnostic mechanisms and their realization in SIMATIC S7.

In addition, a diagnostics expansion is considered which allows diagnostics of the connected PROFINET IO via a data block interface. (FB_126_Dataset)

It is only required to read this part if you want to know how the individual solution components work together.

3 Diagnostic Mechanisms for PROFINET IO

You are provided with information on…

the specific diagnostic mechanisms realized in the SIMATIC S7 user program.

3.1 Diagnostics via the STEP 7 user program

Overview

For PROFINET IO, SIMATIC S7 offers the following diagnostic capabilities in the user program:

- Reading system status list
- Reading diagnostic data records
- Receiving diagnostic interrupts
- Reporting system errors with diagnostics expansion

3.1.1 Reading system status list

SFC 51 “RDSYSST” status information

The SFC 51 “RDSYSST” function provides an overview of the status of the PROFINET IO network or of individual devices on a PROFINET IO network.

PROFINET IO Diag UP ID Number: 24000238

Table 3-1

Block name	Execution level	Notes
SFC 51 “RDSYSST”	All OBs	Applicable SSL_ID: (Examples) • W#16#xy91 module status information • W#16#0x94 rack / station status information • W#16#0x96 module status information DP / PN IO

The letters “xy” are wildcards.

Note For further information on the mentioned SSL ID, please refer to the “System and Standard Functions for S7-300 / 400” /1/ manual, chapter 33.

Description

The SFC 51 “RDSYSST” system function is used to read out “system status lists” (abbreviated SSL), partial lists or SSL list excerpts of the CPU. In the case of PROFINET IO, these SSL include information on the status of the I/O module, the PROFINET IO master system or the actual controller.

When selecting the used SSL ID, particularly when used in an interrupt or the startup OB, it has to be observed that the SFC can only be executed synchronously. If the Busy bit is active after executing the SFC, which indicates an execution over several cycles, the data have not yet been completely read out and are thus invalid.

The received data record of the system status list includes overview information on the diagnosed PROFINET IO device. Further diagnostic steps provide further information.

The first of the two sample solutions described in the following sections includes an example of the application of this function.

Note For further information on the application of SFC 51 “RDSYSST” in conjunction with PROFINET IO, please refer to this manual: “PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

3.1.2 Reading diagnostic data records

SFB 52 “RDREC” diagnostic function block

The diagnostic data records of SIMATIC S7 offer a diagnostic capability with additional detailed information. System function block SFB 52 “RDREC” is used for reading out these data records. This block will not be considered in the following two examples.

Table 3-2

Block name	Execution level	Notes
SFB 52 “RDREC”	All cyclic OBs	Diagnostic data records of the ET 200S: (Excerpt) • 800x channel diagnostics of a submodule • C00x channel diagnostics of a slot • E00x channel diagnostics of assigned channels • F00x channel diagnostics of a device

The letter “x” is a wildcard.

Note Information on the usable diagnostic data records is available in the manual of the device to be diagnosed.

Description

When called, the system function block addresses the station to be diagnosed and indicates the data record to be read out as the INDEX parameter. If there is no diagnostic information, the system function block is executed without output.

Since SFB 52 “RDREC” is an SFB that works asynchronously, i.e., the execution spans several SFB calls, the block can only be used in cyclic operation. A use of the block in an interrupt OB or a timed interrupt OB is not advisable.

Aside from the exact position of the error, the diagnostic data records of SFB 52 also include information on the occurred error type. This information can be evaluated for further analysis purposes.

Note For information and examples on the application of SFC 52 “RDREC” in conjunction with PROFINET IO, please refer to this manual: “PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

3.1.3 Receiving diagnostic interrupts

SFB 54 “RALARM” diagnostic function block

The second diagnostic capability with additional detailed information is the evaluation of the diagnostic interrupts in SIMATIC S7. To evaluate the diagnostic information supplied with the interrupt, SFB 54 “RALARM” is used.

Table 3-3

Block name	Execution level	Notes
SFB 54 “RALARM”	Interrupt OBs, as required: • OB82 • OB83 • OB85 • OB86	When operating SFB 54, the Mode parameter has to be observed; here • Mode = 1 has to be used.

Description

Within the scope of the SIMATIC S7 interrupt processing, SFB 54 “RALARM” evaluates received interrupt data. The received information is provided to the output parameters as two data records. The two data records include both the information of the starting interrupt OB and the information of the interrupt source.

The addressing of the interrupt source can be taken directly from the calling interrupt OB. The call of SFB 54 “RALARM” outside an interrupt OB is not advisable since important information on the interrupt status are not included here.

The first of the two sample solutions described in the following sections includes an example of the application of this function.

Note For further information and examples on the application of SFC 54 “RALARM” in conjunction with PROFINET IO, please refer to this manual: “PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

3.1.4 “Report System Error” STEP 7 functionality

“Report System Error”

As a native diagnostic capability for the S7 program, STEP 7 provides the “Report System Error” functionality. It comprises blocks generated by STEP 7 in HW Config on a configuration-dependent basis which, depending on the user-configured execution level, are automatically placed in the user program by STEP 7.

Table 3-4

Block name	Execution level	Notes
Report System Error “SFM_FB”, “SFM_FC”, “SFM_DB” (Default: FB 49, FC 50, DB 49, DB 50) optional: Diagnostics expansion for PROFINET IO (Default: DB 126 “FB_126_Dataset”)	OB100 (startup OB) + OB35 (timed interrupt OB general) + Interrupt OBs (e.g.: OB82, OB83, OB85, OB86)	The application of the “Report System Error” functionality is limited to the two described execution levels. Additional parameterizations such as CPU Stop are selectively possible. However, it is not required that the blocks are called in all OBs, it is possible to use only a selection of the interrupt OBs.
	Alternatively: OB 1 + Interrupt OBs (e.g.: OB82, OB83, OB85, OB86)	

Description

The “Report System Error” mechanism is a convenient and very user-friendly option to display the diagnostic information provided by the CPU of an IO device or IO controller as messages in STEP 7 or on a SIMATIC HMI device.

The blocks and message texts required for this purpose are generated by STEP 7 according to user specifications. The user only has to load the changed blocks and the calls at the execution levels into the CPU and to transfer the generated texts to the connected HMI devices.

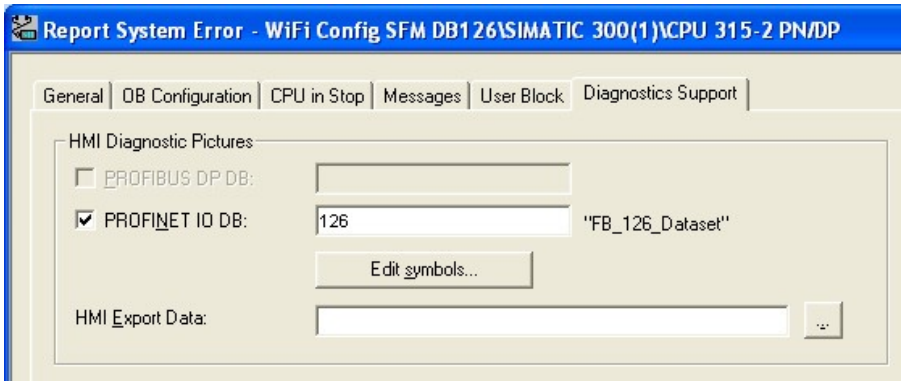
Note For further information on “Report System Error”, please refer to the “Programming with STEP 7 V5.4” manual or to this manual: “PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

3.1.5 The DB 126 “FB_126_Dataset” diagnostics expansion

Configuration

Further development of STEP 7 also included the innovation of the “Report System Error” functionality. STEP 7 V 5.4 + SP 1 and higher enables the user program or an HMI panel to query diagnostic data of a PROFINET IO device from the controller.

Figure 3-1



Description

The diagnostics expansion is configured within the scope of the “Report System Error” functionality and is available as a DB. It is set up by the system with the number 126. The used DB number can be freely selected by the user.

This diagnostics expansion is available for both PROFINET IO and PROFIBUS DP.

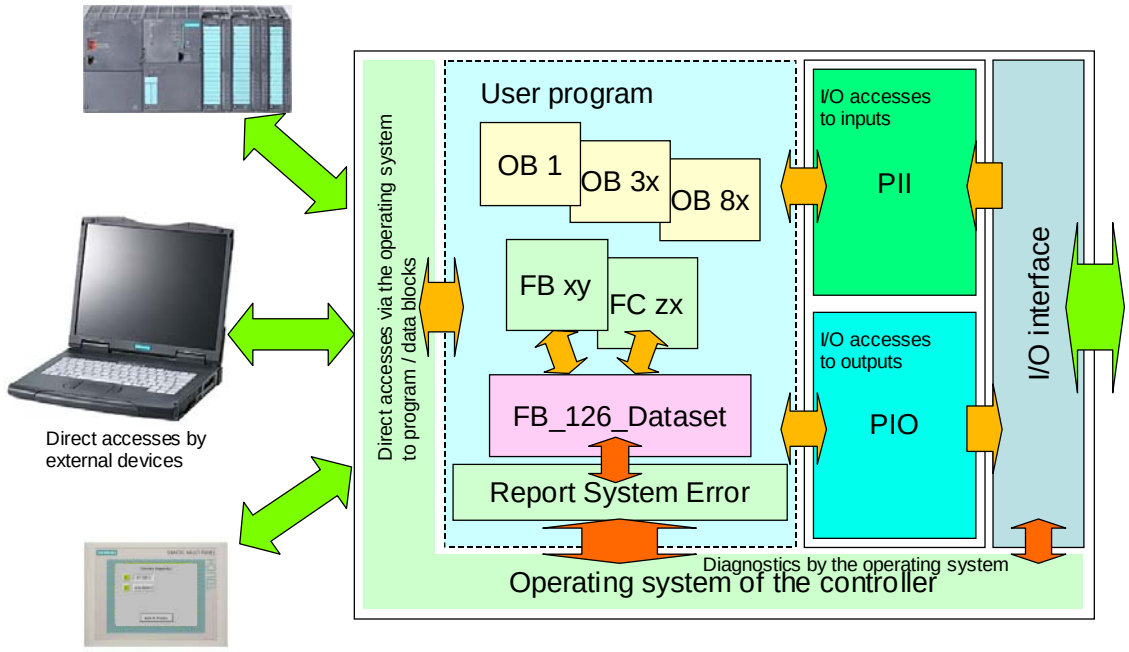
Note Please also observe this FAQ: Simultaneous Use of “Signal System Error”, FB125, FB128 and SFC13 /4/

PROFINET IO Diag UP ID Number: 24000238

Function diagram

The principle of operation of the diagnostics expansion is shown in the figure below:

Figure 3-2



The actual diagnostics expansion, i.e. “FB_126_Dataset”, is located in the main memory of the CPU. The data block can thus be accessed from both user program (FBs, FCs) and external devices (PGs/ HMI devices, etc.) which can access the controller via communication functions and display or further process this diagnostic information.

The principle of operation and the interface of the diagnostics expansion are explained in detail in chapter 6.2.

PROFINET IO Diag UP ID Number: 24000238

4 Functional Mechanisms – Process Simulator

4.1 Process simulator

Cross-solution

A process simulation is used as a basis in both sample solutions. This process simulator is exclusively used for supplying the HMI and the I/O ranges of the used ET200S device with data or for querying data.

Simulated process

The task of the simulation is to simulate a carriage of a high-bay racking system. Positions are dynamically approached in a virtual high-bay racking system and new positions are selected and approached after a defined time. A two-dimensional grid of rows and levels is used. The simulation can also be used in Manual mode to approach individual rows and levels.

The simulation is limited to 120 rows and 20 levels. The travel paths are determined in the block and limited to several ranges due to the system attribute of SIMATIC.

Note The process simulator will not be considered in greater detail since the two examples of solutions focus on the diagnostics of the PROFINET IO components.

5 Functional Mechanisms – Solution with SFC 51 and SFB 54

5.1 Overview of the approach

Introduction

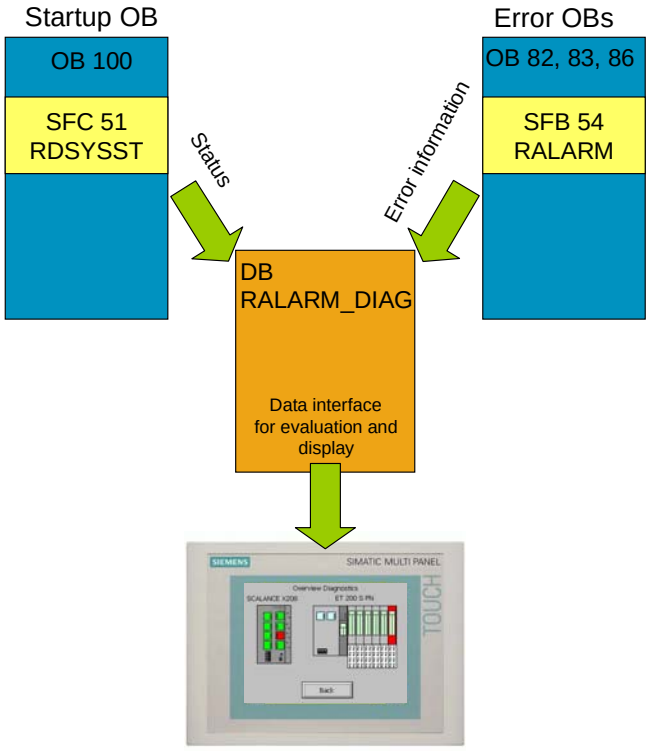
The structure of the first approach using SFC 51 “RDSYSST” and SFB 54 “RALARM” has to be considered at two execution levels.

- Startup: The status of the two configured devices (actual status) is compared to the configured configuration (desired status) via SFC 51 “RDSYSST”.
- Behavior in the event of an error: The diagnostic information of the diagnostic / error interrupt, which includes both the triggering component and the detailed information, is determined by means of SFB 54 “RALARM” and subsequently evaluated.

Overview

The figure below shows the data flow of this approach.

Figure 5-1



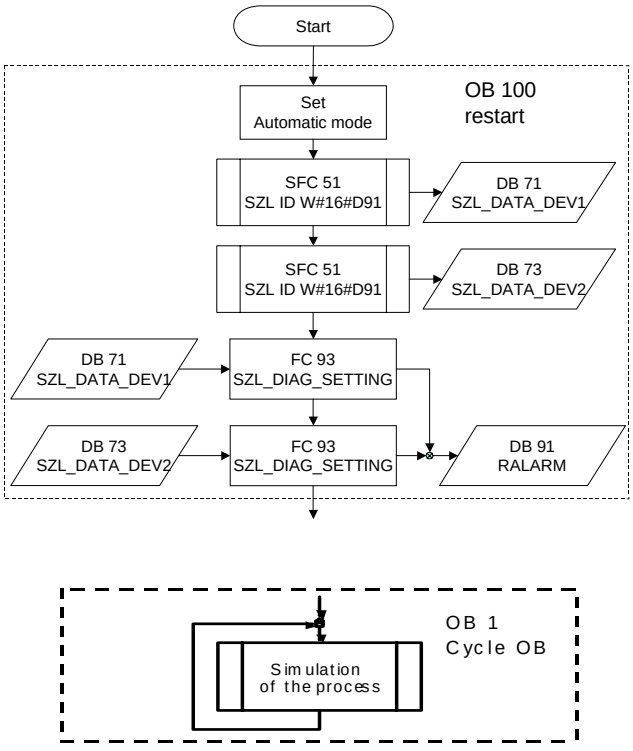
The program structures will be described in detail in the following sections.

5.1.1 Cyclic operation, including program startup

Program flow chart

The program flow chart shown below provides an overview of the controller's program flow from turning on to cyclic operation.

Table 5-1

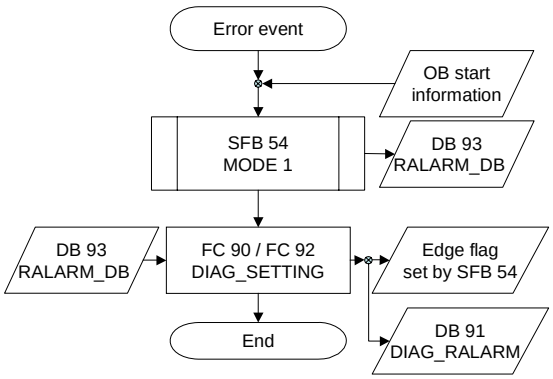
Program flow chart	Description
	During startup of the controller the statuses of the two connected PROFINET IO devices are determined by means of the RDSYSST system function and stored in corresponding data blocks. The status information of the devices is then analyzed and the information on defective modules is entered in the RALARM data block.
	<u>Cyclic operation</u> Cyclic operation consists exclusively of the process simulation.

5.1.2 Behavior in the event of an interrupt

Program flow chart

The program flow chart below shows an overview of the controller's program flow in the event of an interrupt.

Table 5-2

Program flow chart	Description
	In the event of an alarm message of the PROFINET IO device, an interrupt OB is started depending on the interrupt. To read out the detailed information of the interrupt, the call of SFB 54 RALARM is integrated in each interrupt OB. The read out data records AINFO and TINFO are evaluated and the relevant information is stored in the DIAG_RALARM data block.

5.1.3 HMI

Introduction

The individual approaches ensure that interfaces in the form of data blocks are used for the connection to the used HMI device. These data blocks are described below.

Used blocks

To connect the visualization in the first approach, the following two data blocks are used:

Table 5-3

Data block	Contents
DB 91 "DIAG_RALARM"	The data block contains two arrays with 10 words each that represent the modules (slot 0 to 9) of a device. The data are evaluated directly in the HMI Device Diagnostics and displayed in the diagnostic picture.
DB 100 "VISU_DB"	The data block includes all inputs / outputs of the process simulator.

5.2 Explanations on the program

The following sections provide you with...

…detailed information on the blocks used in the example of a solution with SFC 51 and SFB 54.

5.2.1 SFC 51 “RDSYSST” system function

Introduction

The STEP 7 documentation includes a very comprehensive description of the SFC 51 “RDSYSST” system function and the possible SSL ID. For this reason, the explanations on this block are limited to the points necessary in this application.

Note

Further information on this block is available in these manuals:

“System and Standard Functions for S7-300 and S7400” /1/ or

“PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

SSL ID W#16#xy91

Partial lists with status information on modules assigned to the CPU can be read out by means of SSL ID W#16#xy91.

W#16#0D91

The used SSL ID reads out module status information of all modules in the specified rack / in the specified station (DP or PROFINET IO).

Note

For further information on the diagnostic data structure, please refer to the “System and Standard Functions for S7-300 / 400” /1/ manual.

Block call in the user program

SFC 51 is called in OB 100 individually for each used device. The figure below shows the calls for the two devices 1 and 2 of the sample solution:

Figure 5-2

```
Network 2 : Title:
Get Configsituation by the use of SFC 51 RDSYSST.

CALL  "RDSYSST"
 REQ       :=TRUE
 SZL_ID    :=W#16#D91
 INDEX     :=W#16#8001            // Number of the used HW Carrier (HW Config)
 RET_VAL   :="WORKING_DB".RET_VAL_SFC51_DEV1
 BUSY      :="WORKING_DB".BUSY_SFC51_DEV1
 SZL_HEADER:="SZL_HEADER_DEV1".SZL_HEADER
 DR        :=P#DB71.DBX0.0 BYTE 256

CALL  "RDSYSST"
 REQ       :=TRUE
 SZL_ID    :=W#16#D91
 INDEX     :=W#16#8002            // Number of the used HW Carrier (HW Config)
 RET_VAL   :="WORKING_DB".RET_VAL_SFC51_DEV2
 BUSY      :="WORKING_DB".BUSY_SFC51_DEV2
 SZL_HEADER:="SZL_HEADER_DEV2".SZL_HEADER
 DR        :=P#DB73.DBX0.0 BYTE 256
```

Structure of the received data records

The data records generated by the system function call have the following structure for each module, including the head module:

Figure 5-3

+0.0	Dataset1	STRUCT		
+0.0	ADDR1	WORD	W#16#0	IO System ID and Stationnumber
+2.0	ADDR2	WORD	W#16#0	Slotnumber
+4.0	Logaddr	WORD	W#16#0	Baseaddress
+6.0	STyp	WORD	W#16#0	Configured Type
+8.0	CTyp	WORD	W#16#0	Current Type plugged
+10.0	Reserved	WORD	W#16#0	Number of Submodules without Submodule 0
+12.0	EAState	WORD	W#16#0	IO State
+14.0	AID_UnW	WORD	W#16#0	Area ID and Unit size

Note The output structure of SSL ID W#16#xy91 used in the current project is explained to a large extent in the “System and Standard Functions for S7-300 / 400” /1/ manual.

Application of SFC 51 RDSYSST in the user program

Block FC 93 SZL_DIAG_SETTING used in the approach with SFC 51 and SFB 54 evaluates the SFC 51 RDSYSST outputs and prepares the data for the visualization.

PROFINET IO Diag UP ID Number: 24000238

Realization of the data evaluation in the program (FC 93)

The following table shows the core component of the FC 93 SLZ_DIAG_SETTING function.

Table 5-4

Program code	Comment

`// Check the Head information about a fault in the Device`
 	
`UN DBX 13.4 // If the Head Bit`
`BEB`
 	
`// Otherwise find out which Slot is faulty and Indicate th:`
 	
`L P#13.0 // Bit indicator f`
`T #SZ_Point`
`L 0 // Preset the Loop`
`T #i`
`L #N_DR // with the value`
`lop: T #i`
 	
`L DBB [#SZ_Point] // If the lower nil`
`L B#16#D // ... without car:`
`UW`
`L 0`
`==I // ... larger than`
`SPB nxt`
`AUF DB [#D_DB] // So open the DIA`
`L #D_DB2 // ... use the cur:`
`SLD 3`
`T #DR_Point`
`L #ERR_CODE // ... Read the Er:`
`T DBB [#DR_Point] // ... and store it`
`AUF DB [#S_DB] // Reopen the SZL I`
 	
`nxt: L #D_DB2 // Increment the S:`
`+ 1`
`T #D_DB2`
 	
`L W#16#10 // Sift about 16 B`
`SLW 3`
`L #SZ_Point // ... and store t`
`+I`
`T #SZ_Point`
 	
`L #i`
`LOOP lop`
	Whether the actual module reports an error is determined at the beginning of the examination. If a fault of the station is displayed, the individual modules are examined.
	
	All data records transferred in the data record are examined, starting with the head module; they are checked for
	• module fault (bit 13.0)
	• module not available (bit 13.2)
	• module deactivated (bit 13.3).
	If one of these errors has occurred, an error code conforming to SFB 54 is stored in DIAG_RALARM DB. (This is necessary to ensure a uniform diagnostic language for the HMI device.)

Note The functional scope of the described sample block is very small and the block cannot be used in a system without extensions.

Result of the data evaluation

The information resulting from the FC 93 SZL_DIAG_SETTING function is stored in the DIAG_RALAM data block and saved in the form of two arrays. Each of the two devices receives an array with up to 9 modules plus module head. This information is stored individually for each module and displayed via the HMI device.

5.2.2 System function block SFB 54 “RALARM”

Introduction

The STEP 7 documentation describes system function block SFB 54 “RALARM” in great detail. For this reason, the explanations on this block are limited to the points necessary in this application.

Used mode

SFB 54 “RALARM” offers 3 different modes. In conjunction with PROFINET IO, mode 1 can be used most effectively. Mode 1 writes to all output parameters, independently of the component triggering the interrupt.

Note

Further information on this block is available in these manuals:

“System and Standard Functions for S7-300 and S7400” /1/ or

“PROFINET IO From PROFIBUS DP to PROFINET IO” /2/

Application in different interrupt OBs

In conjunction with PROFINET IO, the use of block SFB 54 “RALARM” is effective in three interrupt OBs. These OBs are:

- OB 82 diagnostic interrupt
- OB 83 insert / remove
- OB 86 rack failure OB

Parameter from the local data of the OBs

The only necessary data from the local data of the OBs is the F_ID parameter of SFB 54 RALARM. The parameter includes the logical start address of the component that triggered the interrupt.

The following table lists the local data areas / header information of the OBs which include this parameter.

Table 5-5

Organization block	Parameter
OB 82	OB82_MDL_ADDR
OB 83	OB83_MDL_ADDR
OB 86	Bit 16 – 30 of the OB86_Z23 parameter

Call of the block in the sample program

SFB 54 is called once in OB 82, OB 83 or OB 86. The figure below shows the call in OB 82 of the sample solution as an example:

Figure 5-4

```
Network 1: Title:
Diagnosis with SFB 54 RALARM

      L     #OB82_MDL_ADDR
      T     #TEMP


      CALL  "RALRM" , "IDB_SFB54"
       MODE  :=1
       F_ID  :=#TEMP
       MLEN  :="WORKING_DB".RALARM_MLEN
       NEW   :="WORKING_DB".RALARM_NEW
       STATUS:="WORKING_DB".RALARM_STATUS
       ID    :="WORKING_DB".RALARM_ID
       LEN   :="WORKING_DB".RALARM_LEN
       TINFO :=P#DB93.DBX0.0 BYTE 200
       AINFO :=P#DB93.DBX200.0 BYTE 8192
```

Note The TINFO and AINFO data resulting from the function block depend on the case of application and are listed in the “System and Standard Functions for S7-300 / 400” /1/ manual, chapter 8.3.

Evaluation of the interrupt information in the user program

In this sample solution, the received diagnostic data are handled similarly; however, a changed procedure for error recovery is necessary for OB 86 which requires a slightly modified block for evaluating the data. But this is adequately described in the FC 92 “OB86_DIAG_SETTING” documentation.

The evaluation of the SFB 54 diagnostic data by means of the FC 90 “DIAG_RALARM_SETTING” function will be considered in greater detail in the following sections.

Realization of the diagnostics evaluation in the program

The following table shows the core component of the FC 90 DIAG_RALARM_SETTING function called in OB 82 or OB 83.

Table 5-6

Program code	Comment
Network 2 : Title: Identify the used Device and set up the Ar L #STATION_ADDR L W#16#EFFF // UW L 1 // -I L 10 // *I L #SLOT_PORT_NO // +I T #D_DB //	The station address is used to identify the specific area of the DIAG_RALARM data block the block has to write to. The exact position is calculated by adding the defective module slot.
Network 3 : Title: Calculate the DB Pointer and set the Value L #D_DB // SLD 3 T #Point L #ALARM_TYPE // T DBB [#Point]	After conversion into a pointer the interrupt information is read out and stored at the calculated position in the DIAG_RALARM data block. The HMI device uses this block as a data source.
Network 4 : Title: Setup a Timer for the Reset function for t SET U(L #ALARM_TYPE // L W#16#4 // ==I) O(L #ALARM_TYPE L W#16#C // ==I) NOT BEB SET L 0 // T DBB [#Point]	If the interrupt is detected as a recovery of the module, the value in the DIAG_RALARM data block is set to 0 and consequently also the HMI display is corrected.

Result of the data evaluation

The information resulting from the FC 90 DIAG_RALARM_SETTING function is stored in the DIAG_RALAM data block and saved in the form of two arrays. Each of the two devices receives an array with up to 9 modules plus module head. This information is stored individually for each module and displayed via the HMI device.

5.3 The application in the WinCC flexible configuration

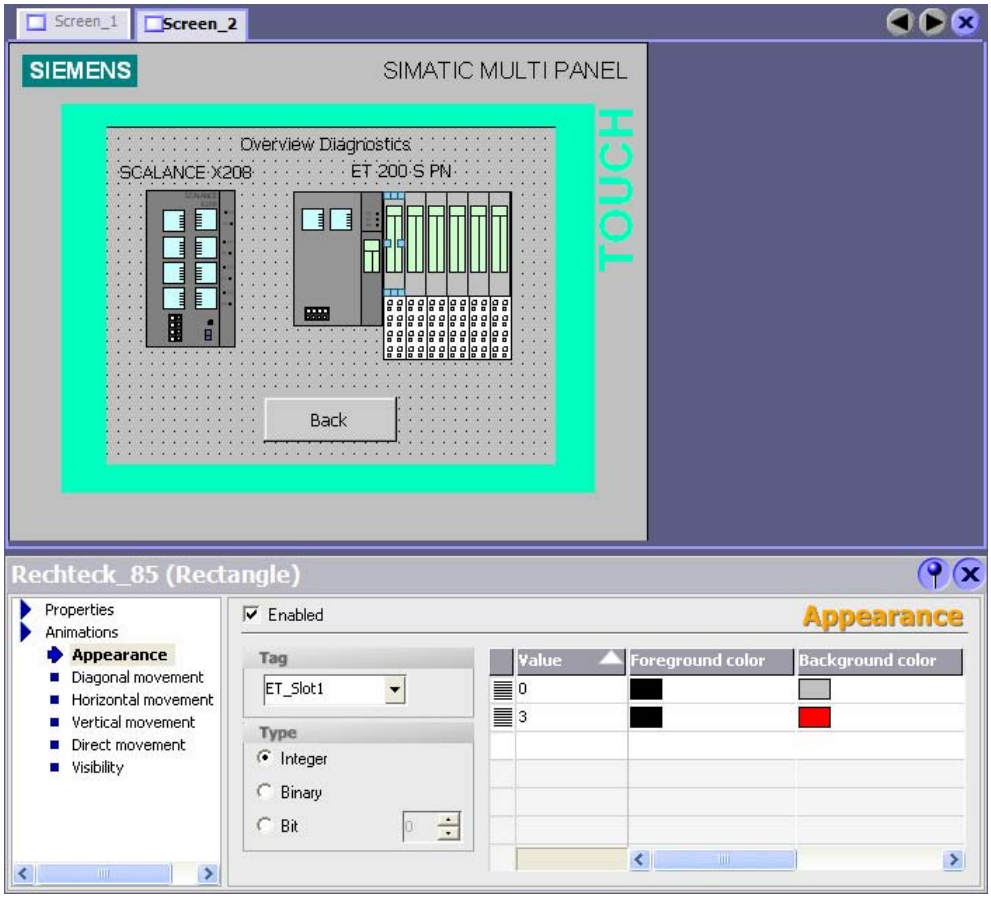
Application of the diagnostic data

The information of DB 91 “DIAG_RALARM” is applied on the Diagnostics user interface already described in chapter 2.2.1.

5.3.1 Configuration for the ET200S module in WinCC flexible

As an example, we consider the configuration of a module with regard to the error behavior.

Figure 5-5



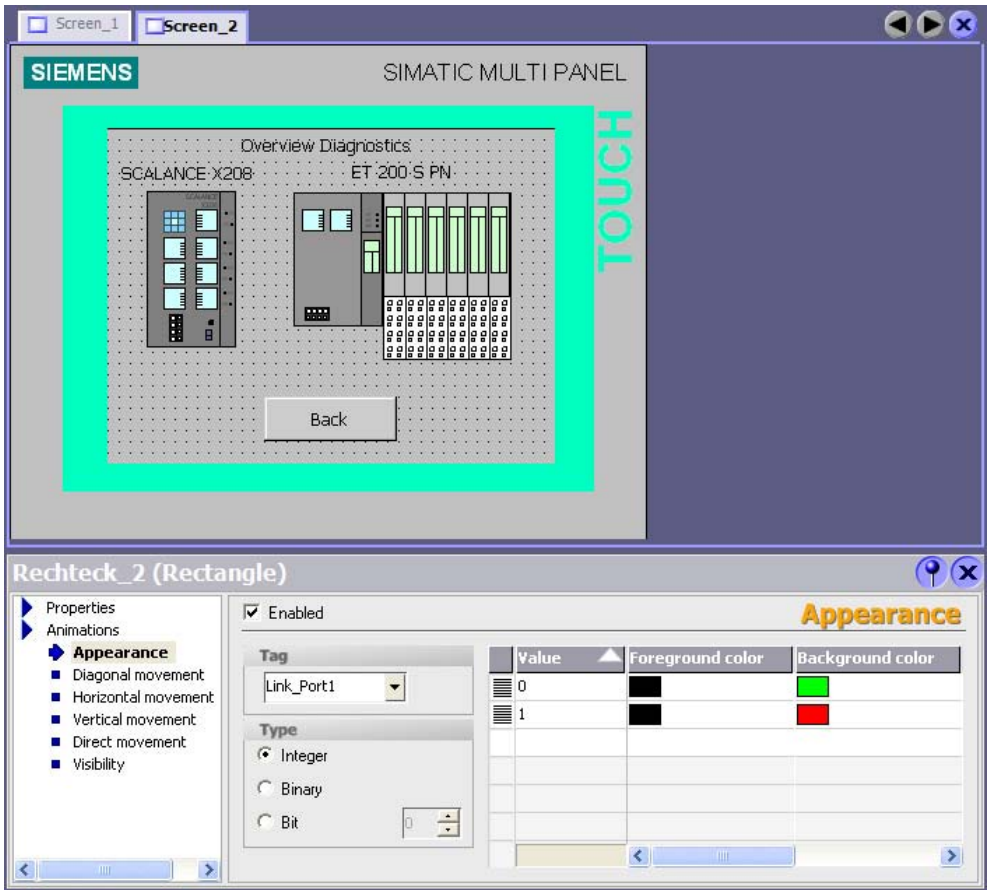
In the above display, the PM of the ET 200S is considered. When an event occurs here, an error code is read out by the STEP 7 program in DB 91 “DIAG_RALARM” in byte 1, see TAG configuration. These values correspond to the SFB 54 error designations

- 0 Module OK
- 3 Module withdrawn

5.3.2 Configuration for the SCALANCE X208 module in WinCC flexible

As an example, we consider the configuration of a port with regard to the error behavior.

Figure 5-6



In the above display, port 1 of SCALANCE X208 is considered. When an event occurs here, an error code is read out by the STEP 7 program in the DB 91 “DIAG_RALARM” byte 11, see TAG configuration. These values correspond to the SFB 54 error designations.

Other error designations apply to SCALANCE X208 since the errors are different, the values used here are:

- 0 Port OK
- 1 Linkdown

5.4 Modification options for this sample solution

STEP7 configuration

The configuration overhead is limited to inserting the PROFINET IO device into HW Config of STEP7. If further modules are to be configured, they have to be inserted here.

STEP7 programming

Data block DB 91 “DIAG_RALARM”, the block size has to be adjusted to the PROFINET IO ID, must be adapted:

If more than 9 modules are used per device, these changes also have to made in the following blocks:

- FC 90 “DIAG_RALARM_SETTING”
- FC 92 “OB86_RALARM_SETTING”
- FC 93 “SZL_DIAG_SETTING”

If additional errors are to be considered or if system status changes are to be made, they also have to be programmed in the listed blocks.

WinCC flexible configuration

With regard to the WinCC flexible configuration, a **separate graphical display** and the assignment of the modules to the data block areas in DB 91 “DIAG_RALARM” have to be provided for each additional device. When using new PROFINET IO device types, these types have to be entered individually for each module at a later time.

6 Funct. Mech. – Solution with Diagnostics Expansion Based on RSE

6.1 Overview of the approach

Introduction

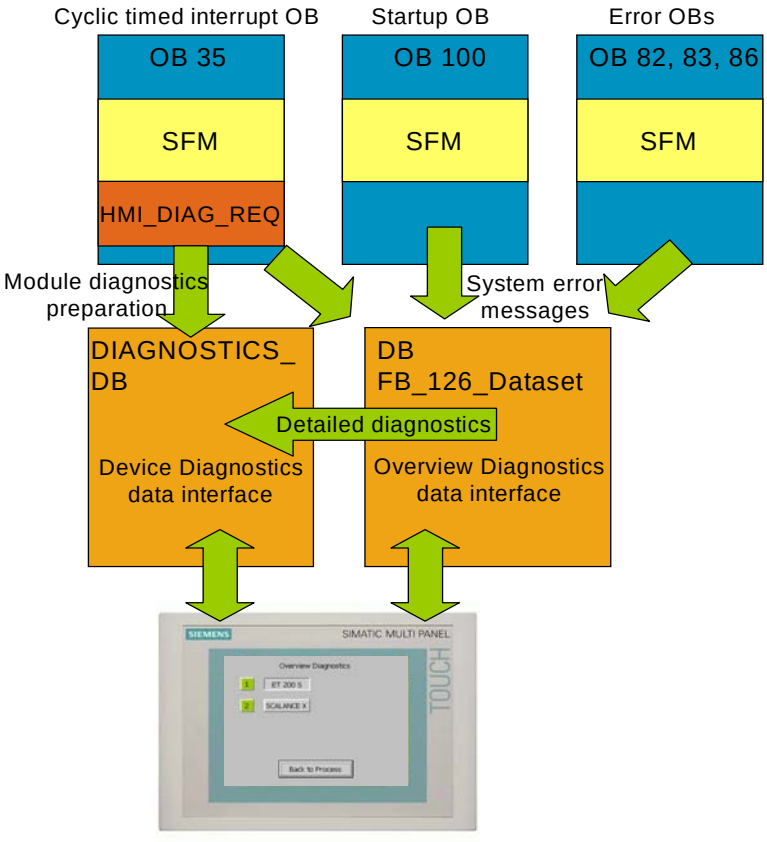
Considered from the user program, the extent of work of the approach using “Report System Error” and the diagnostics expansion is less. However, a system property of system error becomes noticeable which requires the use of up to three operating levels.

- Cyclic operation
- Behavior in timed interrupt OB-triggered operation
- Behavior in the event of an interrupt

Overview

The figure below shows the data flow of this approach.

Figure 6-1



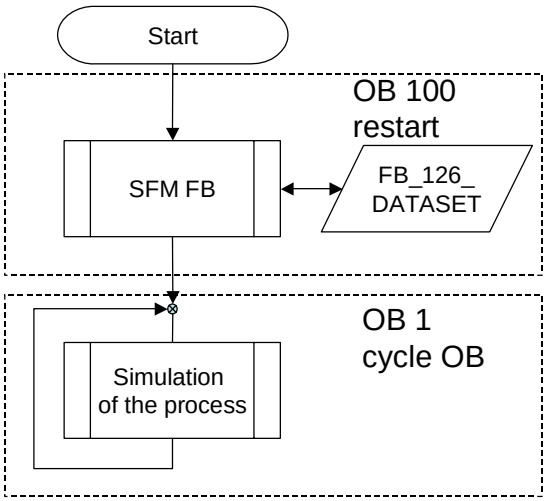
The program structures will be described in detail in the following sections.

6.1.1 Cyclic operation, including program startup

Program flow chart

The following program flow chart provides an overview of the controller's program flow of this approach in program startup and cyclic operation.

Table 6-1

Program flow chart	Description
	Startup OB 100 During startup the SFM FB is entered by the configuration and processed. Additional program components are not required. The cyclic program is not influenced, no further program calls are required in OB 1 or in a program part subordinate to the OB.

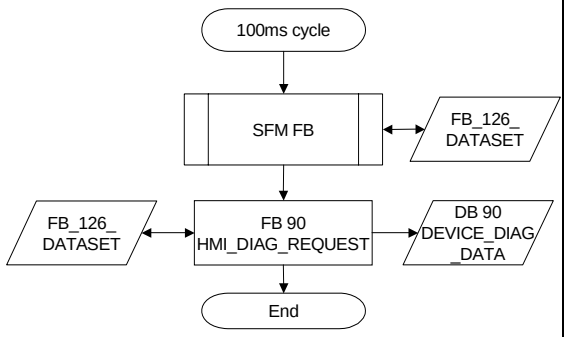
Note Please note the possible alternatives when configuring "Report System Error", see chapter 3.2.4.

6.1.2 Behavior in timed interrupt OB-triggered operation

Program flow chart

The program flow chart below shows an overview of the controller's program flow considered in the 100ms cycle.

Table 6-2

Program flow chart	Description
	The function call of the "Report System Error" FB was inserted in the timed interrupt OB (in the example OB 35) by the configuration. Subsequently, function block FB 90 "HMI_DIAG_REQUEST" was inserted for handling the FB_126_DATASET interface. This block queries and evaluates the diagnostic information. The results are stored in DB 90 "DEVICE_DIAG_DATA" and can be displayed, e.g. via the HMI device, or evaluated from there.

Note

By using block FB 90 "HMI_DIAG_REQUEST", the data evaluation function from DB 126 "FB_126_Dataset" was automated and encapsulated. A parallel use of this data block by other devices is possible.

Attention

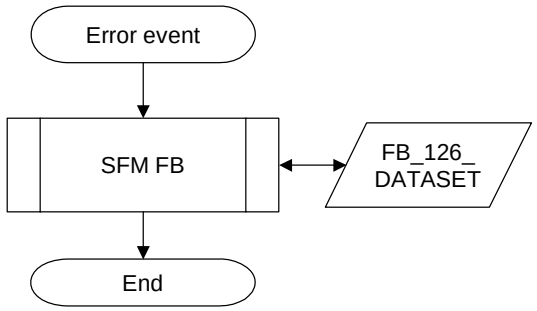
The overview diagnostic data of DB 126 "FB_126_Dataset" are only updated in the event of an error; if data in the DB are overwritten by the user program, the data are only corrected during the next diagnostics.

6.1.3 Behavior in the event of an interrupt

Program flow chart

The program flow chart below shows an overview of the controller's program flow considered in the event of an interrupt.

Table 6-3

Program flow chart	Description
	The "Report System Error" function block is entered in the interrupt OB selected by the configuration. Additional program components are not required.

Note Only the blocks selected in the configuration are considered by the function, a subsequent change or adjustment requires a regeneration in the Wizard and a new download.

6.1.4 HMI

Introduction

The individual approaches ensure that interfaces in the form of data blocks are offered for the connection to the used HMI device. These data blocks are described below.

Used blocks

To connect the visualization in the second approach, the following four data blocks are used:

Table 6-4

Data block	Contents
DB 90 “DEVICE_DIAG_DATA”	This data block includes an ARRAY of 11 words and each word represents one module. The data are updated by the control program upon request by the HMI device and can be read out.
DB 99 “DIAGNOSTICS_DB”	This data block supports the HMI device in the Device Diagnostics configuration. The device configuration of the Overview Diagnostics, see chapter 2.2.2, is stored here.
DB 100 “VISU_DB”	This data block includes all necessary information on the process simulator.
DB 126 “FB_126_Dataset”	Among other things, this data block includes overview diagnostics of the PROFINET IO line that is evaluated in the Overview Diagnostics of the HMI device.

6.2 Explanations on the program

The following sections provide you with...

...details on the blocks used in the approach with the diagnostics expansion based on Report System Error.

6.2.1 The DB 126 “FB_126_Dataset” diagnostics expansion

Introduction

The DB 126 “FB_126_Dataset” diagnostics expansion is an expansion of the “Report System Error” functionality. The diagnostics expansion is available as a data block.

Together with the “Report System Error” functionality, the diagnostics expansion forms the core of approach 2.

Block structure

The created data block is divided into three areas:

- User interface
- Detailed diagnostics
- Overview diagnostics

User interface and detailed diagnostics have to be considered separately.

The overview diagnostics area is event-controlled and updated depending on error or error recovery. In contrast, the user interface and the output via the detailed diagnostics are program- or system-triggered.

The three sections of the diagnostics expansion will be considered in greater detail in the following sections.

User interface

The figure below shows the structure of the user interface:

Figure 6-2

// Common Interface Information for DB 126

DB126.DBW 0	"FB_126_Dataset".HMI_ID	HEX	W#16#0000
DB126.DBW 2	"FB_126_Dataset".System_No	HEX	W#16#0064
DB126.DBW 4	"FB_126_Dataset".Device_No	HEX	W#16#0001
DB126.DBX 6.0	"FB_126_Dataset".Enable	BIN	2#0
DB126.DBX 6.1	"FB_126_Dataset".Next_Error	BIN	2#0
DB126.DBX 6.2	"FB_126_Dataset".Busy	BIN	2#0
DB126.DBX 6.3	"FB_126_Dataset".More_Errors	BIN	2#0
DB126.DBB 7	"FB_126_Dataset".Device_Status	HEX	B#16#00
DB126.DBW 8	"FB_126_Dataset".Offset_System_Header	HEX	W#16#002C
DB126.DBW 10	"FB_126_Dataset".Offset_System_Array	HEX	W#16#0036
DB126.DBW 12	"FB_126_Dataset".Vendor_ID	HEX	W#16#0000
DB126.DBW 14	"FB_126_Dataset".Device_ID	HEX	W#16#0000
DB126.DBB 16	"FB_126_Dataset".Error_Level	HEX	B#16#00

Important parameters

The following table lists an excerpt of the input parameters important for the application:

Table 6-5

Parameter	Range of values	Note
FB_126_Dataset.HMI_ID	0 - …	Number of the OP that uses the block. If the value 0 is set, the DB is available. (In this application, the value remains 0)
FB_126_Dataset.System_No	100 - …	Address of the PROFINET network. Here 64h = 100d.
FB_126_Dataset.Device_No	1 - …	Address of the device to be diagnosed.
FB_126_Dataset.Enable	True / False	Start of the query.
FB_126_Dataset.Next_Error	True / False	If More_Errors is present, the next error can be read out by setting this bit.
FB_126_Dataset.Busy	True / False	The job is being processed
FB_126_Dataset.More_Errors	True / False	If open errors are still present in the system, this bit is set.

Detailed diagnostics

In the event of an error, the detailed diagnostics show the position and the code of the error.

Figure 6-3

// Diagnostics Information's

DB126.DBW 18	"FB_126_Dataset".Module_No	HEX	W#16#0000
DB126.DBW 20	"FB_126_Dataset".Submodule_No	HEX	W#16#0000
DB126.DBW 22	"FB_126_Dataset".Channel_No	HEX	W#16#0000
DB126.DBD 24	"FB_126_Dataset".Error_Cat	HEX	DW#16#00000000
DB126.DBD 28	"FB_126_Dataset".Help_Cat	HEX	DW#16#00000000
DB126.DBD 32	"FB_126_Dataset".Error_No	HEX	DW#16#00000000
DB126.DBW 36	"FB_126_Dataset".Map_ErrorNo	HEX	W#16#0000
DB126.DBW 38	"FB_126_Dataset".Map_HelpNo	HEX	W#16#4000
DB126.DBW 40	"FB_126_Dataset".Number_IO_Sys	HEX	W#16#0001
DB126.DBW 42	"FB_126_Dataset".Systems_Status	HEX	W#16#0000

Important parameters

The following table lists an excerpt of the output parameters important for the application:

Table 6-6

Parameter	Range of values	Note
FB_126_Dataset.Module_No	1 - …	Address parameter module number of the error source in the PROFINET IO device model
FB_126_Dataset.Submodule_No	1 - …	Address parameter submodule number of the error source in the PROFINET IO device model
FB_126_Dataset.Channel_No	1 - …	Address parameter channel number of the error source in the PROFINET IO device model
FB_126_Dataset.Error_No	1 - …	Error number reported by the PROFINET IO device.

Overview diagnostics

The overview diagnostics show an overview of the devices on the master system. In this example, the devices 1 and 2 are configured and OK.

Figure 6-4

// Overview Diagnostics

DB126.DBW 44	"FB_126_Dataset".Detail_IO_Sys[0].System_No	HEX	W#16#0064
DB126.DBW 46	"FB_126_Dataset".Detail_IO_Sys[0].Max_Num_Dev	HEX	W#16#0002
DB126.DBW 48	"FB_126_Dataset".Detail_IO_Sys[0].Offset	HEX	W#16#0036
DB126.DBW 50	"FB_126_Dataset".Detail_IO_Sys[0].Devices_Affect	HEX	W#16#0000
DB126.DBW 52	"FB_126_Dataset".Detail_IO_Sys[0].Offset_Status	HEX	W#16#0038
DB126.DBW 54		BIN	2#1111_0000_1111_1111
DB126.DBW 56		BIN	2#0000_0000_0000_0000

Important parameters

The following table lists an excerpt of the output parameters important for the application:

Table 6-7

Parameter	Range of values	Note
FB_126_Dataset.Devices_Affected	1 - …	Number of devices affected in the master system.
IO_SYS_0 (In this application: DB126.DBW 54)	Structure of two bytes with 2 BOOLS for each device	Overview of the configured devices and their current status. (See structure) If more than 8 devices are used, additional words are used correspondingly.
IO_SYS_Status0 (In this application: DB126.DBW 56)	Structure	Overview of the status of the individual device groups on the PROFINET IO system.

Structure of IO_SYS_0

The following table includes the possible status values of an IO device in the IO_SYS_0 structure. In the structure, 2 BOOLS representing the device status are assigned to each possible device. The possible values are:

Table 6-8

Value / BOOL	Status
00	IO device configured and OK.
01	IO device configured, but an error has occurred.
11	IO device not configured.

Attention

The system overwrites changes in the data area of the overview diagnostics of DB 126 “FB_126_Dataset” with the actual values only after an interrupt event has occurred.

Application of the user interface

The application of the user interface is divided into two areas.

- Selection of bus system and device number
- Triggering of the query.

Selection of bus system and device number

The number of the bus system is listed in the configuration. The number is configured in HW Config. When programmed correspondingly, the “System_No” parameter can also be taken out of the “Detail_IO_Sys[X].System_No” area.

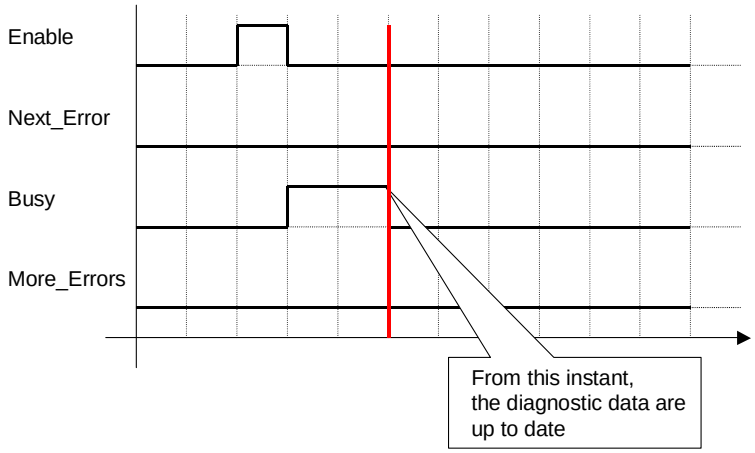
You obtain the device number either from the system specification or by evaluating the IO_SYS_0 values.

Triggering of the query

The job request can be interconnected as follows.

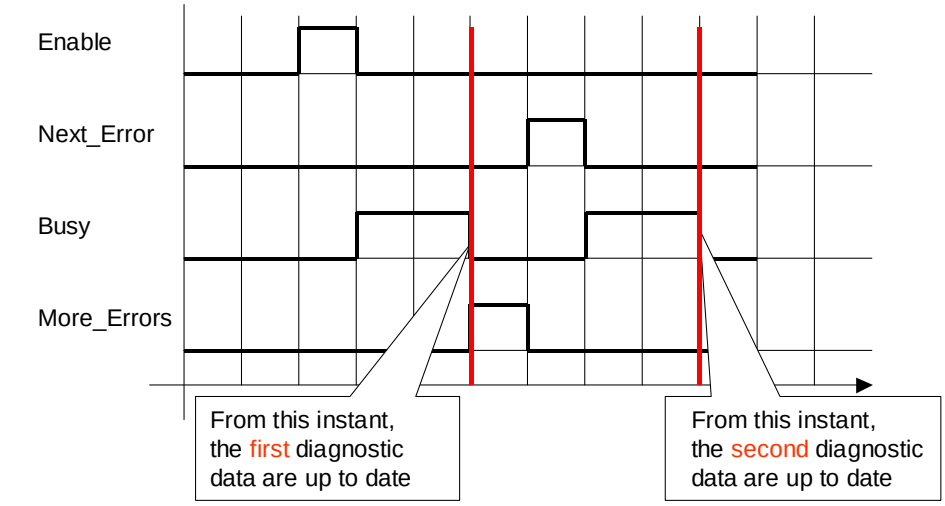
If there is only one error per device:

Figure 6-5



If there are several errors per device:

Figure 6-6



Triggered by the HMI, this sequence can be repeated as required.

Note The trigger steps described here are realized in function block FB 90 “HMI_DIAG_REQ”.

6.2.2 Application in block FB 90 HMI_DIAG_REQ

Introduction

Block FB 90 HMI_DIAG_REQ used in the “FB 126 Dataset diagnostics expansion based on Report System Error” sample solution is based on the user interface described above.

Realization in the program

The table below shows the core code lines of this function block.

Table 6-9

Program code	Comment
run: U "FB_126_Dataset".Busy // BEB L "FB_126_Dataset".Module_No // L 0 ==I SPB End //	If, after the activation of the function and after the Busy display by the FB_126_Datset data block, the value for Module_No in the data block equals 0, no error has occurred.
L "FB_126_Dataset".Module_No // L 2 // *I SLW 3 T #POINT L "FB_126_Dataset".Map_ErrorNo T #ERROR_NO // L #Diag_DB T #TEMP AUF DB [#TEMP] L #ERROR_NO // T DBW [#POINT] //	If an error has occurred, the position of the error message in DB 90 DEVICE_DIAG_DATA is calculated with the position of the error and the error information is stored at this location.
UN "FB_126_Dataset".More_Errors SPB End	If no further errors have occurred in the device, the block can be terminated.
SET U "FB_126_Dataset".More_Errors S "FB_126_Dataset".Next_Error // BEA	If errors still exist, the Next_Error parameter is set.

Data storage in data block DB 90 DEVICE_DIAG_DATA

The data received by means of function block FB 90 HMI_DIAG_REQ are stored in the DIAG_RALAM data block. They are stored in the form of two arrays. An array with up to 9 modules plus module head is structured for each of the two devices. This information is stored individually for each module and displayed via the HMI device.

6.3 The application in the WinCC flexible configuration

Application of the diagnostic data

In this approach, the diagnostic data are divided into two areas:

- Overview Diagnostics
- Device Diagnostics.

Both areas will be considered in the following sections.

6.3.1 Overview Diagnostics

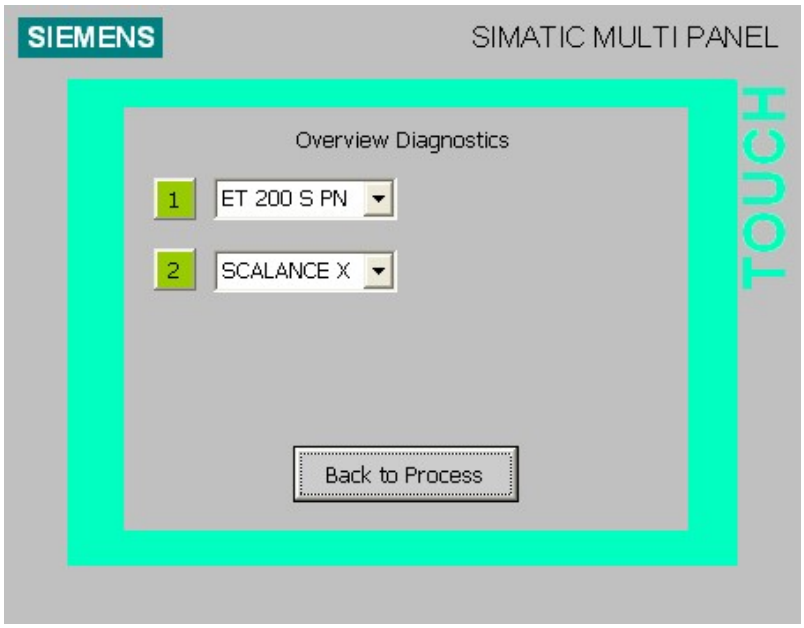
Introduction

Two data blocks of the CPU are used within the scope of the overview diagnostics.

Data block 99 “DIAGNOSTICS_DB” supports the user in storing the configuration for the overview diagnostics. The settings of the symbolic I/O fields are stored here and backed up for later displays. Presettings for configurations are possible in the data block.

Data block 126 “FB_126_Dataset” contains the current status of the PROFINET IO segment in its overview diagnostics. These data are decisive for the HMI Overview Diagnostics view.

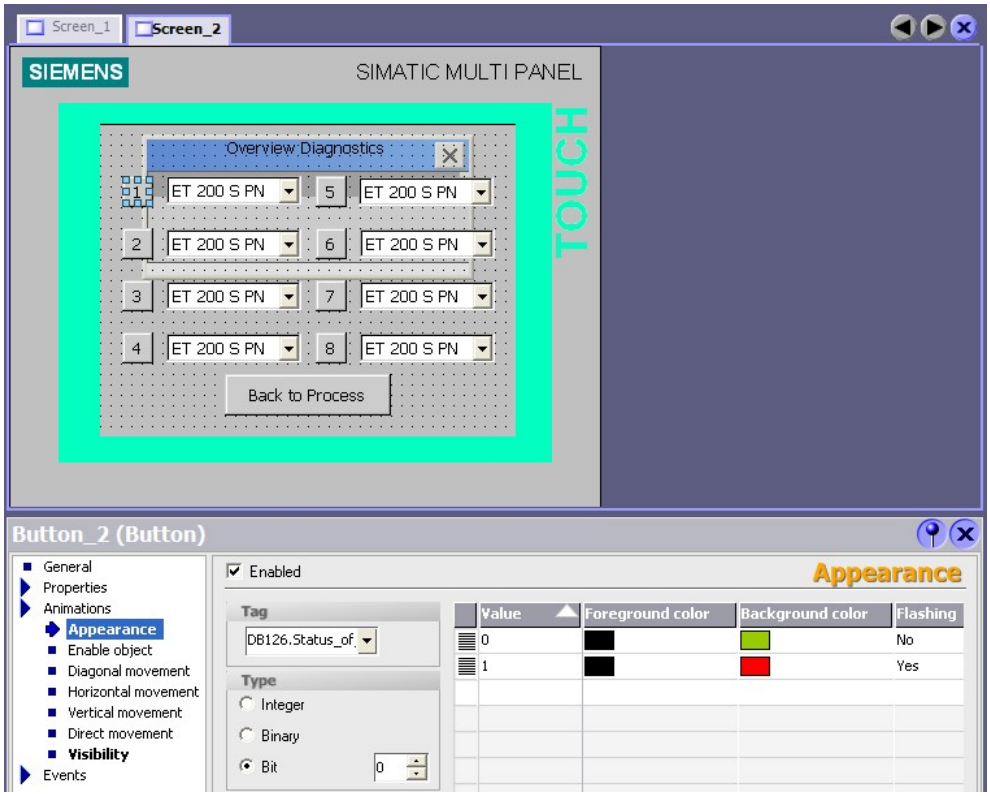
Figure 6-7



Configuration of the Overview Diagnostics in WinCC flexible

The two described data blocks are responsible for each of the eight possible devices. We now consider this view:

Figure 6-8



The figure shows that one Address button and one symbolic I/O field are available for each device. Depending on the device status, the Address button is displayed either with

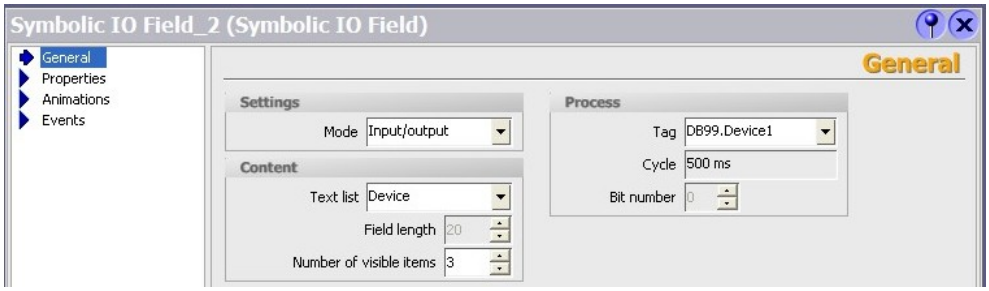
Table 6-10

Status	Color / visibility
Module status OK	Green / visible
Module fault	Flashing red / visible
Module not configured	Invisible

The required data are taken out of DB 126 “FB_126_Dataset”, here bit 54.0.

Data block DB 99 “DIAGNOSTICS_DB” is responsible for storing the information in the symbolic I/O field:

Figure 6-9



The value of the “Device” text list is stored in the data block. The following values are stored here:

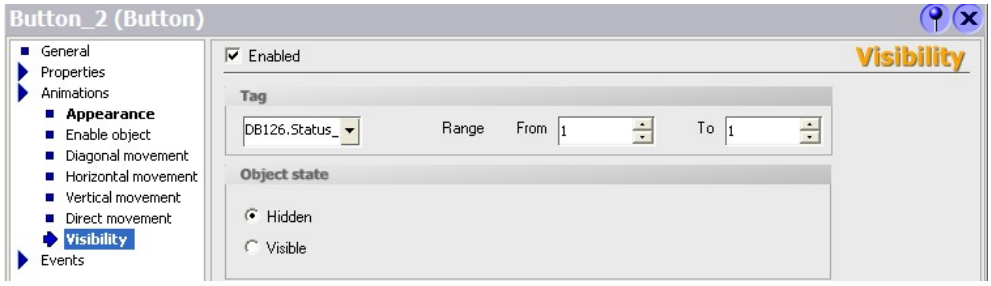
Table 6-11

Number	Device type
3	ET 200 S PN
4	SCALANCE X208

Display of the different devices

To ensure that “only” those devices are displayed that are configured, the configuration information of DB 126 “FB_126_Dataset” is evaluated via the “Visibility” parameter.

Figure 6-10



If the second bit of the two Overview Diagnostics bits is set, the module is not configured. In this case, this is bit 54.1. This function is used for both the button and the symbolic I/O field. Thus, only the devices that are configured are visible.

6.3.2 Device Diagnostics

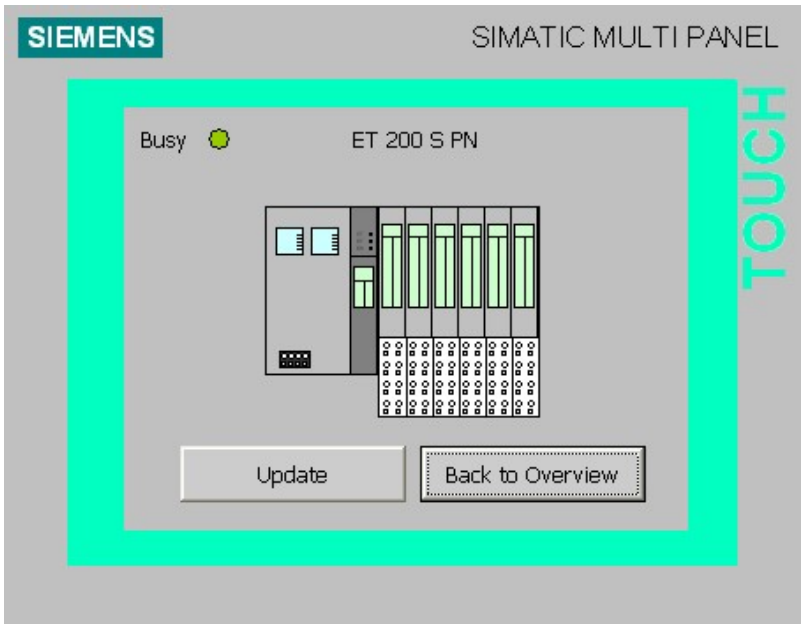
Introduction

Depending on the overview diagnostics information, a Diagnostics screen is started for the selected device within the scope of the device diagnostics.

The evaluation of the diagnostic information is triggered by opening the HMI screen by the user; the diagnostic data are generated by FB 90 HMI_DIAG_REQ and stored as a general data block (DB 90 DEVICE_DIAG_DATA). This data block is read out by the HMI device and displayed in a device-specific graphic representation.

This enables to use one identical Diagnostics user interface for several devices.

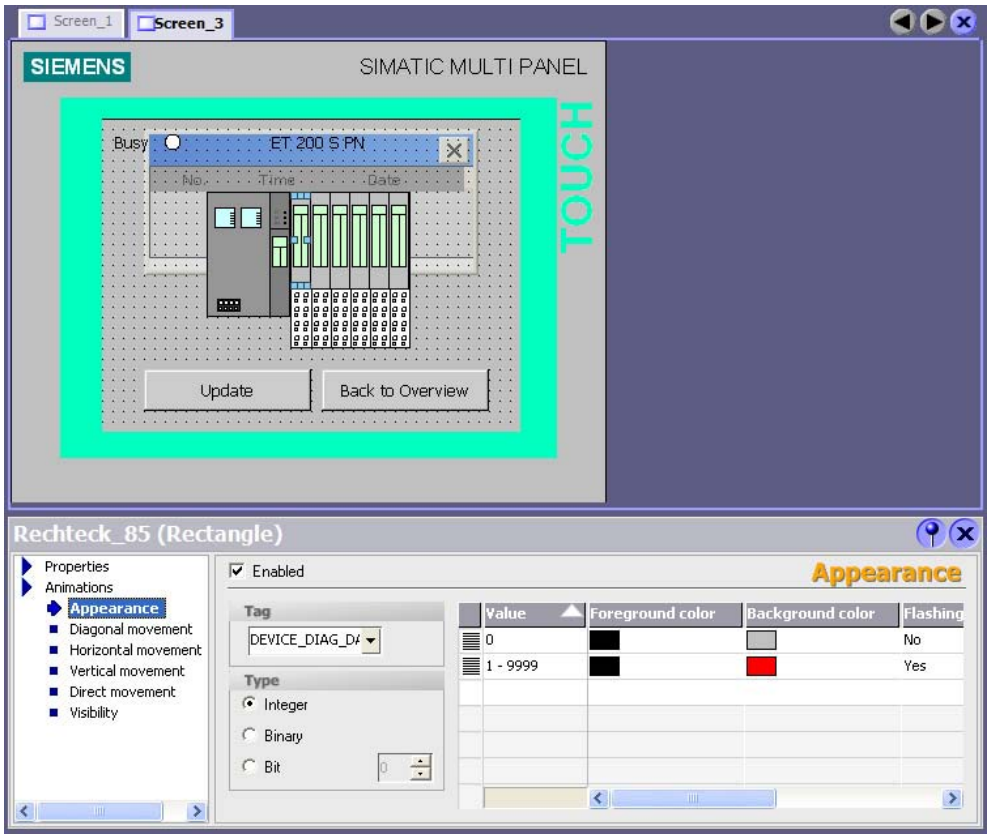
Figure 6-11



Configuration of the Device Diagnostics in WinCC flexible

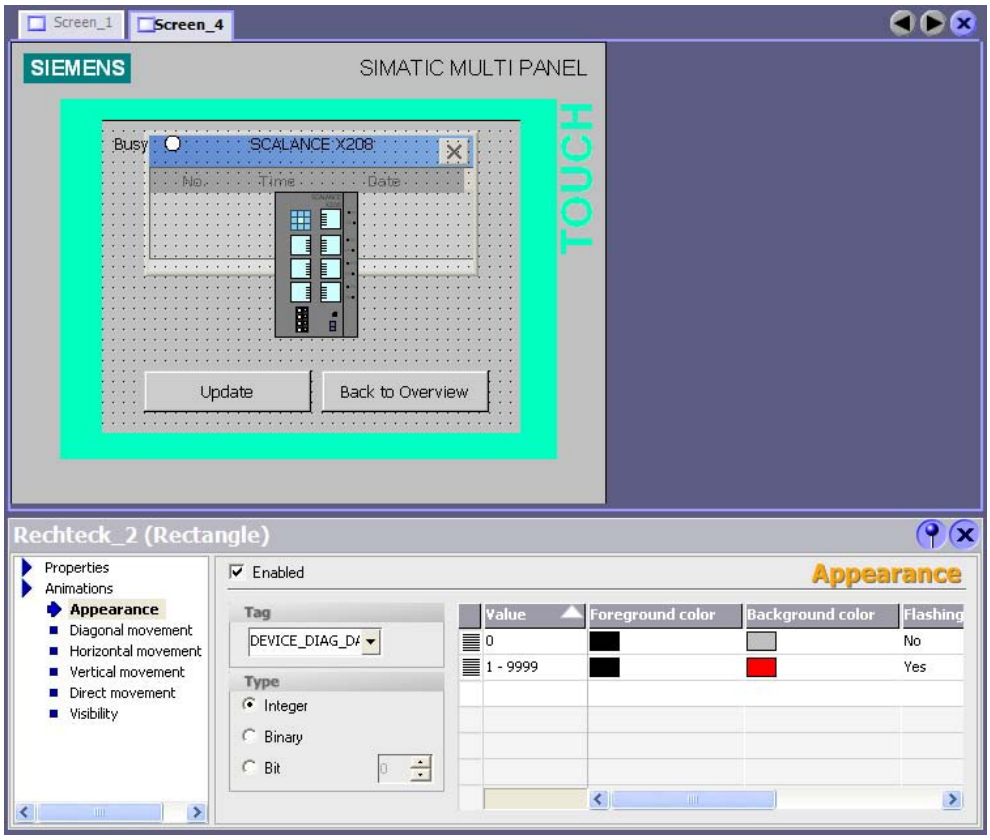
The Device Diagnostics interface is the standard DB 90 DEVICE_DIAG_DATA interface which is updated by opening a Diagnostics window or by using the “Update” button.

Figure 6-12



If DB 90 DEVICE_DIAG_DATA includes an entry for the corresponding module, the display is switched to flashing red. If the error is corrected, the data will be reset during the next update. The interface is identical for both possible device types, see display with SCALANCE X-208.

Figure 6-13



A more precise specification of the error classes is provided by extensions of the display options.

6.4 Modification options for this sample solution

STEP7 configuration

The configuration overhead is limited to inserting the PROFINET IO device into HW Config of STEP7. If further modules are to be configured, they have to be inserted here.

In addition, the configuration of the “Report System Error” functionality can also be adjusted in HW Config. When inserting new PROFINET IO components, the blocks have to be regenerated to ensure that the changes are also applied to block DB 126 “FB_126_Dataset”.

STEP7 programming

Changes in the STEP7 program are only required when more than 9 modules are used in one PROFINET IO device. Then data block

- DB 90 “DEVICE_DIAG_DATA”

has to be adjusted.

When a PROFINET IO address configuration is larger than eight or when more than eight PROFINET IO devices are used, also block

- DB 99 “DIAGNOSTICS_DB”

has to be adjusted.

Further adjustments are not required.

WinCC flexible configuration

With regard to the WinCC flexible configuration, an extension is only required when a new device type or more than 8 devices are used.

A **separate graphical display in a separate screen** and the assignment of the modules to the general data block areas in DB 90 “DEVICE_DIAG_DATA” have to be provided for each additional device type.

When using more than 8 devices, an additional Overview Diagnostics screen must be configured.

Structure, Configuration and Operation of the Application

Contents

This part takes you step by step through structure, important configuration steps, startup and operation of the application.

7 Installation and Startup

You are provided with information on…

the hardware and software you have to install and the steps necessary to start up the example.

7.1 Installation of hardware and software

This chapter describes which hardware and software components have to be installed. The descriptions and manuals as well as delivery information included in the delivery of the respective products should be observed in any case.

Hardware installation

For details on the hardware components, please refer to chapter 2.3. For the hardware configuration, please follow the instructions listed in the table below:

Attention

Switch on the power supply only after the last step.

Installation of the PC module

Table 7-1

No.	Instruction	Comment
1	Install the Ethernet card in the PG/PC.	When using a field PG, it exists already.

Installation of the control components

Table 7-2

No.	Instruction	Comment
2	Mount switch, CPU and power supply of the S7-300 on the S7-300 DIN rail.	
3	Mount the ET200S PN on the 35 mm top-hat rail.	
4	Attach the following modules with the corresponding terminal modules to the ET200S PN head module in the following order: • PM 24V DC • 2 DI 24V DC • 2 DI 24V DC • 4 DI 24V DC HF • 4 DO 24V 0.5A DC • 4 DO 24V 0.5A DC	Make sure that the following cabling of the inputs and outputs is correct: • Connect output pin 2 of the last DO module to input pin 1 of the first DI module. • Connect output pin 6 of the last DO module to input pin 5 of the first DI module.
5	Attach the MP 270 panel.	
6	Ensure the power supply of the SCALANCE X208 switch, the CPU, the ET200S PN and the MP 270 panel with 24 V DC.	The power supply of the PM module of the ET200S PN additionally requires that the following litz wires are connected from the head module: • 2 L+ -> pin 2 • 2 M -> pin 3 Use litz wires with cable lugs for the power supply.
7	Supply the power supply unit with 230 V AC.	An inlet connector for non-heating apparatus with ground wire and cable lugs has to be used.
8	Use the Ethernet cables to network CPU, ET200S PN and MP270 to the SCALANCE X208 switch.	Alternatively, you can also use other RJ45 network cables.

Note The installation guidelines for SIMATIC S7 and SIMATIC NET always have to be observed.

Installation of the standard software

For the used software components, please refer to chapter 2.3 of this document.

Note If possible, install all Microsoft updates and service packs offered for your operating system.

Table 7-3

No.	Instruction	Comment
1	Install STEP7 V 5.4 + SP 1	Download see \1\
2	Install WinCC flexible 2005 + SP 1 (optionally HF 5)	Download see \2\

7.2 Initialization of the MP270 6"

Necessity

To use the MP270 6" with these sample projects, the settings and adjustments described in the following sections have to be made. The factory settings of the MP270 without the listed adjustments do not allow the intended operation.

Preparations

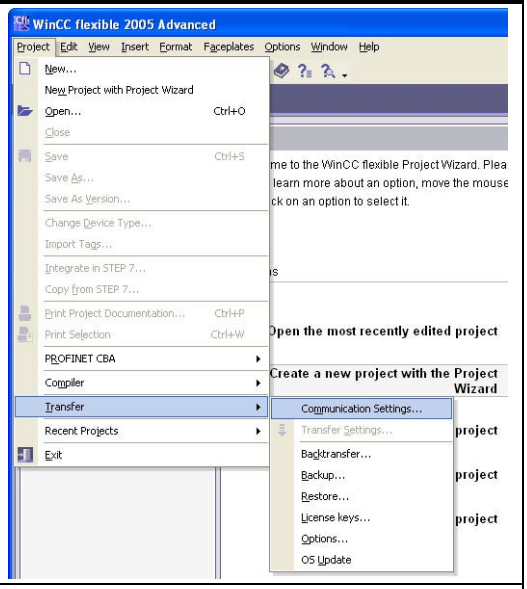
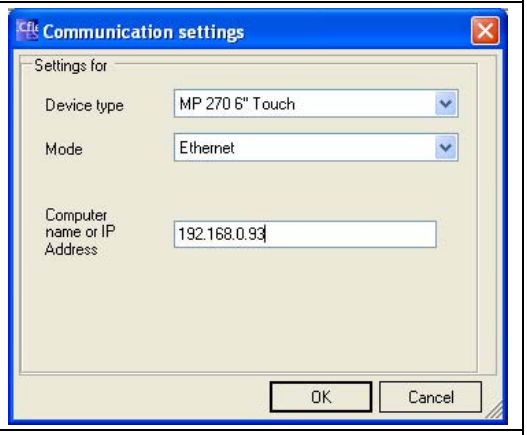
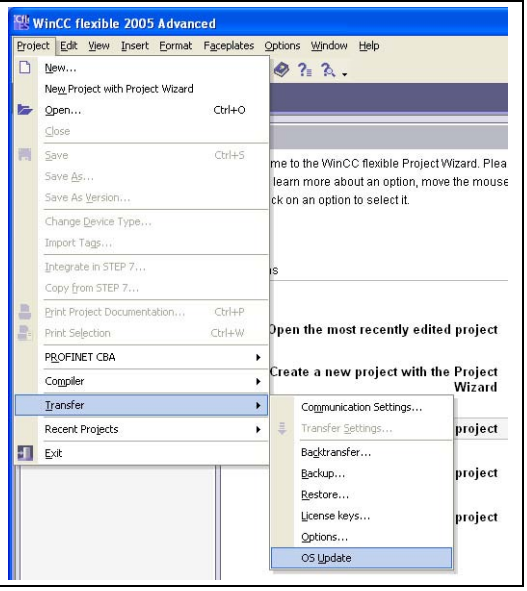
The preparation of the MP270 6" for operation with the application consists of two steps.

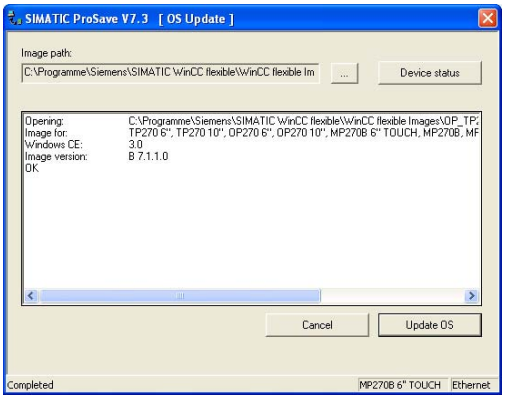
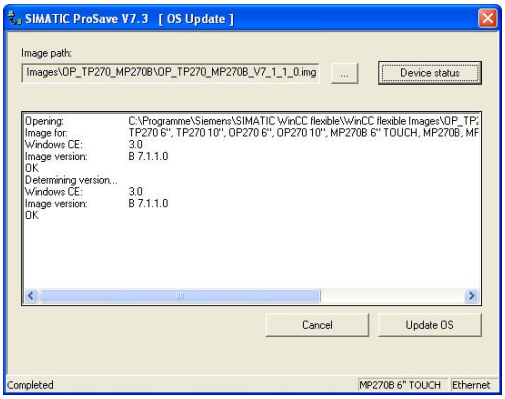
- Assigning the IP address
- Checking the used OS version

Both steps will be described in the following sections.

Table 7-4

No.	Instruction	Comment
1	If not yet done, turn on the MP270 6" and wait until you see the Loader window. Select *Control Panel*.	
2	In the Control Panel, double-click the *Network* menu option to open it.	
3	Select “Onboard LAN Ethernet Driver” and use the “*Properties*” button to open the properties.	If other network cards are entered here, they will not be considered since the onboard interface will be used.
4	In the “IP Address” tab, select “Specify an IP Address” and specify the following parameters: IP Address: 192.168.0.93 Subnet Mask: 255.255.255.0 Default Gateway: 192.168.0.1	If you select a different IP address for the MP, this address must be changed in the S7 projects in HW Config.
5	On the PG/PC used by you, start WinCC flexible 2005 + SP 1.	

No.	Instruction	Comment
6	Open the Communication Settings by selecting *Project > Transfer > Communication Settings* and adjust the settings to the MP270 6" with Ethernet interface as follows.	
7	Device type: MP270 6" Touch Mode: Ethernet IP Address: 192.168.0.93 Please observe that changed addresses also have to be entered here. Close the dialog boxes with OK.	
8	Select *Project > Transfer > OS Update* to open the “OS Update” window.	

No.	Instruction	Comment
9	The current image version of the MP270 in this WinCC flexible version is displayed. (Here version B 7.1.1.0) To check the version, Device status can be used to check the online version in the MP270.	
10	If the MP270 version corresponds to the current version, this step is completed. If the version is older, an update must be performed using *Update OS*. After the update or the check of the version OS Update can be exited by selecting Cancel. You can now also close WinCC flexible.	

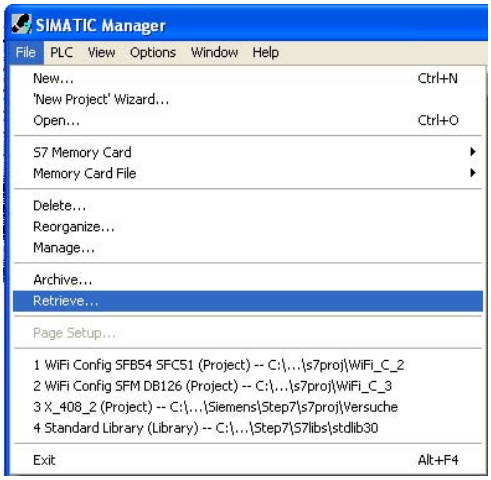
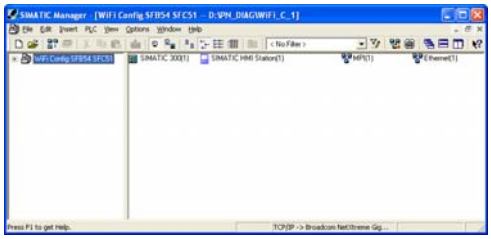
7.3 Downloading the application software to the controller

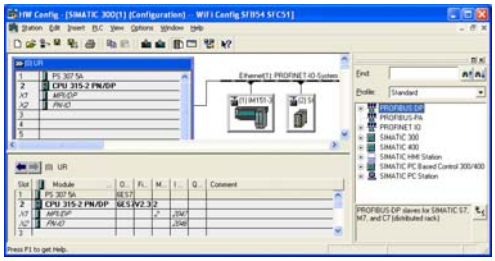
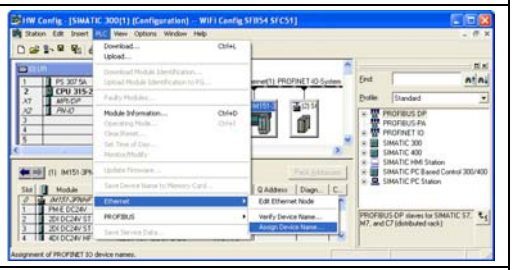
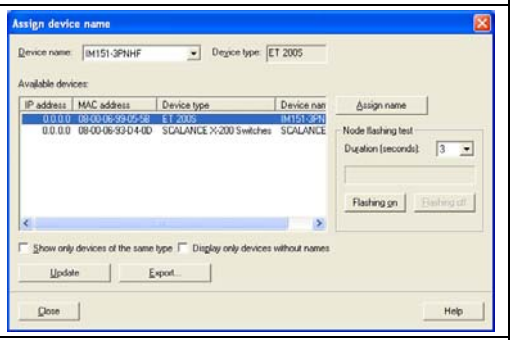
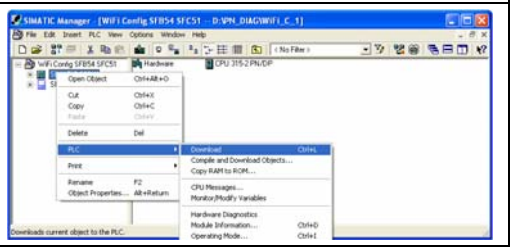
Procedure

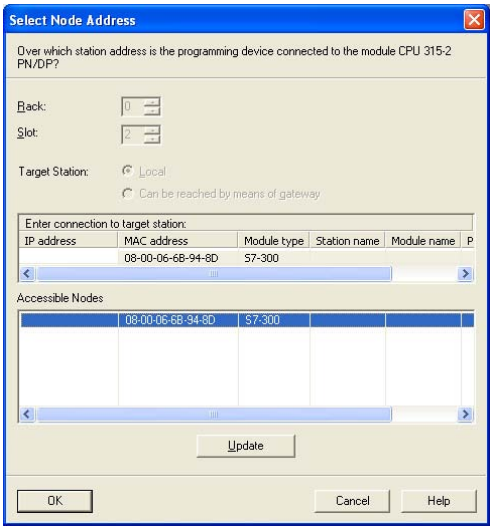
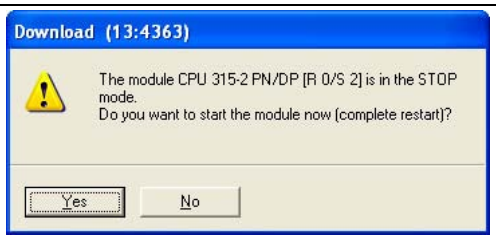
The overview provided below describes what has to be done to download the sample code to the controller.

The download of the solution with SFC 51 / SFB 54 is shown as an example to illustrate the installation.

Table 7-5

No.	Instruction	Comment
1	Reopen STEP 7.	
2	Open the dialog box for retrieving projects via: File > Retrieve…	
3	Search for the archive of the project. Select the PNDiag_conf1_V1.0.zip project (included in the code archive, see chapter 2.3). Select “Open” to unzip the file.	
4	After unzipping, please expand the project tree and select the SIMATIC S7300(1) controller.	

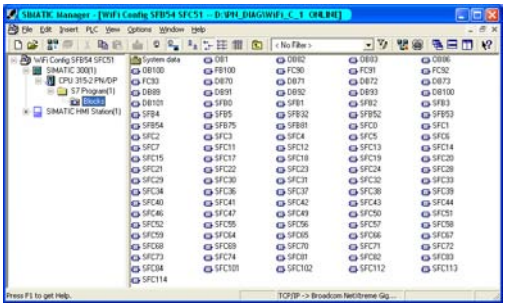
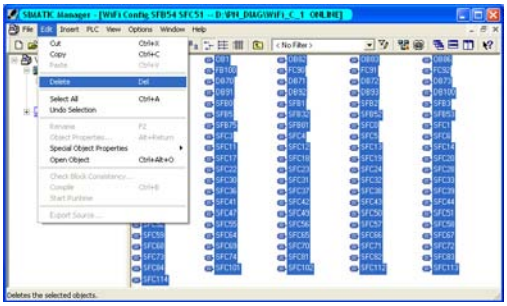
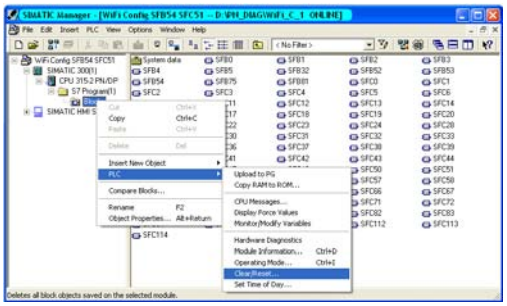
No.	Instruction	Comment
5	Use the hardware icon in the Project window to open HW Config of the S7300.	
6	Select the IM151-3 PN I/O module and subsequently *PLC > Ethernet > Assign Device Name...*	
7	From the existing devices, select the MAC address for the IM151-3 PN known to you or select the module of the ET200S type and click the “Assign name” button.	
8	After transferring, close the dialog box and repeat the same procedure with SCALANCE X208.	
9	To define the SCALANCE X208 “Fault Mask”, it is advisable to determine the currently active nodes on the network. To define the “Fault Mask”, press the SET button of SCALANCE X208 for approx. 5 seconds; in this status, the Link LEDs of the switch should have stopped flashing.	For a description of the SCALANCE X208 functions, please refer to this manual: “Industrial Ethernet SCALANCE X-100 and SCALANCE X-200 Product Line” /5/
10	Now close HW Config and return to the SIMATIC Manager.	
11	In the project tree, select SIMATIC S7300(1) and use the right mouse button to select the menu: *PLC > Download*	

No.	Instruction	Comment
12	After you have confirmed that the complete control is to be downloaded, the Select Node Address dialog box opens. Use the “Update” button to enable the selection of the module. Subsequently, an S7-300 module with MAC but without IP address is displayed. Select this address and confirm the selection with “OK”.	
13	The following dialog boxes with queries, e.g. whether the IP address of the module was to be assigned, have to be confirmed with “OK”. To complete the download process, confirm the STEP 7 restart request with “Yes”.	

Resetting the controller / the MMC

The following steps are required for a successful general reset of a CPU 315-2 PN/DP without field PG or without external MMC card reader.

Table 7-6

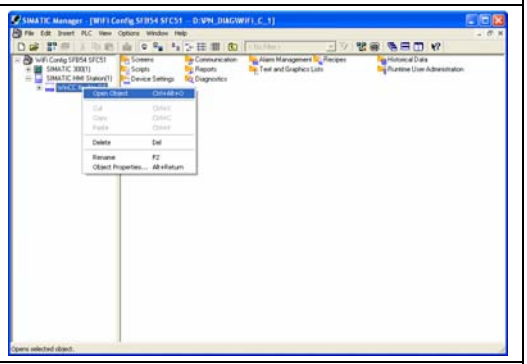
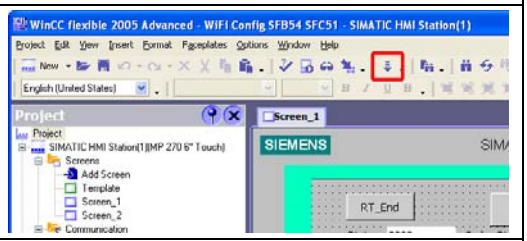
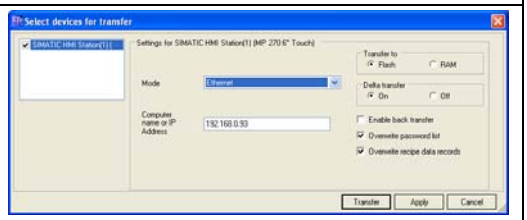
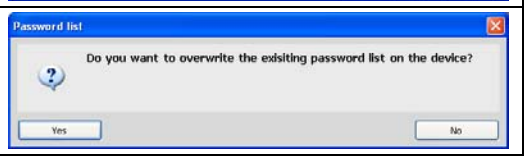
No.	Instruction	Comment
1	Either open the project online or go online to the controller via “accessible nodes”.	
2	Go to the block folder and select all blocks. Delete the blocks, including the system data blocks, from this view.	
3	In the project tree, select the block container and use the right mouse button to select the *PLC > Clear/Reset...* function. After confirming the query, both RAM and MMC flash memory are cleared and you can restart.	

7.4 Downloading the application software to the MP270 6"

Procedure

The panel configuration can be downloaded directly after downloading the control program.

Table 7-7

No.	Instruction	Comment
1	In the project tree of the SIMATIC Manager, select SIMATIC HMI Station(1). Use the plus symbol to the left of SIMATIC HMI Station(1) to open the next level.	
2	Select WinCC flexible RT and use the right mouse button to select *Open Object*	
3	As soon as WinCC flexible is started, the download of the configuration can be started by selecting *Project > Transfer > Transfer Settings...* or by using the arrow displayed on the screen.	
4	If the mode is set to “Ethernet” and if the address of the module corresponds, the download can be started via “Transfer”. Please observe that the MP270 module has to be operated in Runtime or Transfer mode to be able to perform the transfer.	
5	After confirming the query whether the password list was to be overwritten, the download is completed and WinCC flexible can be closed.	

Download completed

All necessary downloads of the software components have been completed.

PROFINET IO Diag UP ID Number: 24000238

8 Operation of the Application

You are provided with information on…

how you can operate the functions of the simulation application and the individual diagnostic capabilities.

8.1 Simulation application

Overview

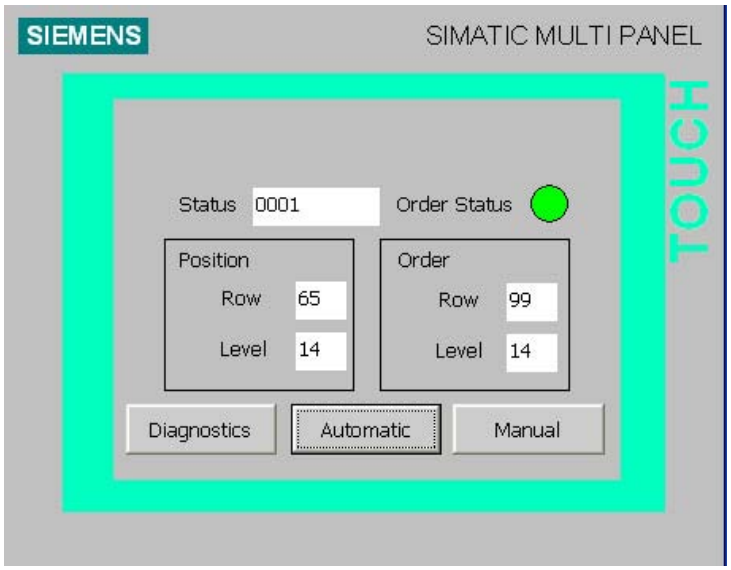
The simulation application is identical in both solutions. It is based on the simulation of a carriage performing free three-dimensional motions. Positions are approached in a two-dimensional grid and started.

The actual simulation can be executed in

- Automatic mode
- Manual mode.

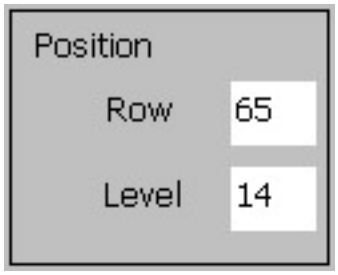
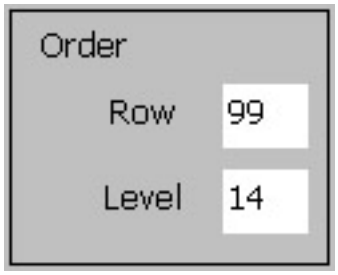
Automatic mode

Figure 8-1



In Automatic mode the following display elements are available:

Table 8-1

Display element	Description
	The status display displays the following information: • Operating mode - 0001 Automatic- - 0002 Manual mode • Reaching the travel limits - F201 left end position - F202 right end position - F301 bottom end position - F302 top end position
	The “Order Status” display indicates the current status of the job. When the display is green, the job is currently being processed; a yellow display indicates that a new job is currently being determined.
	The two fields in “Position” indicate the current position of the carriage.
	The two fields in “Order” indicate the current target position of the current job.

To control the process or the display, the following function elements are applicable:

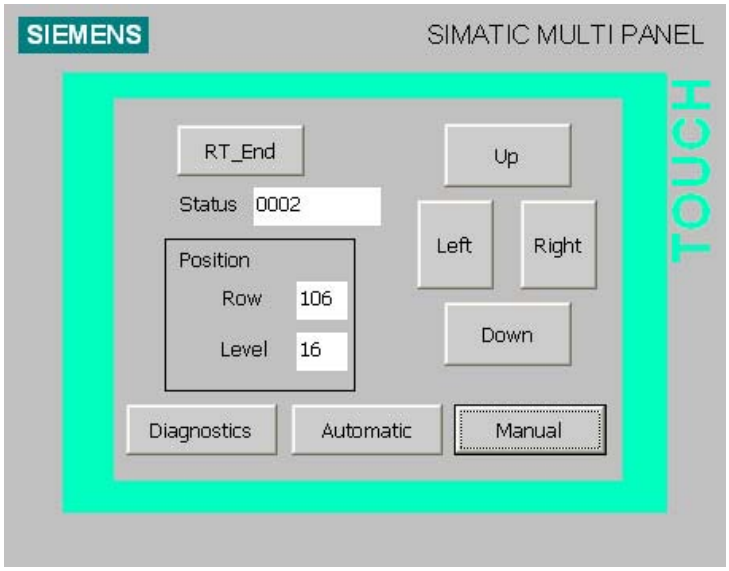
Table 8-2

Function element	Description
	The “Diagnostics” button allows the user to change the display to Diagnostics.
	The “Automatic” button switches the simulation to Automatic mode.

Function element	Description
	The “Manual” button switches the simulation to Manual mode.

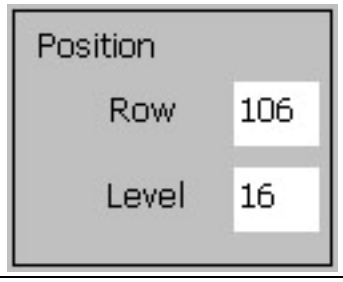
Manual mode

Figure 8-2



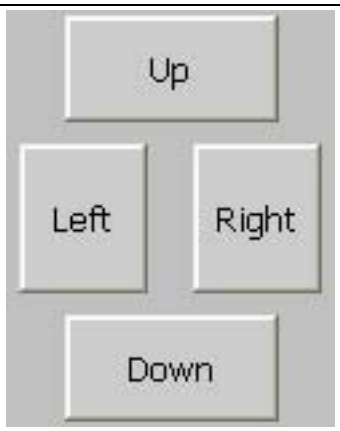
In Manual mode the following display elements are available:

Table 8-3

Display element	Description
	The status display displays the following information: • Operating mode - 0001 Automatic- - 0002 Manual mode Reaching the travel limits - F201 left end position - F202 right end position - F301 bottom end position - F302 top end position
	The two fields in “Position” indicate the current position of the carriage.

To control the carriage or the display, the following function elements are applicable:

Table 8-4

Function element	Description
	The “RT_End” button allows the user to stop Runtime. WinCC flexible RT is exited on the panel.
	The direction buttons allow the user to manually change the position in the two-dimensional grid.
	The “Diagnostics” button allows the user to change the display to Diagnostics.

	The “Automatic” button switches the simulation to Automatic mode.
	The “Manual” button switches the simulation to Manual mode.

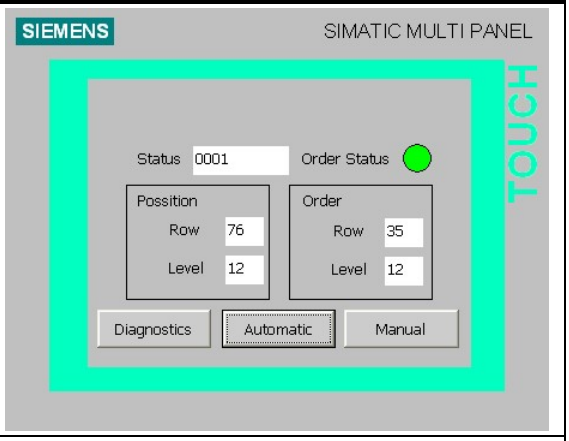
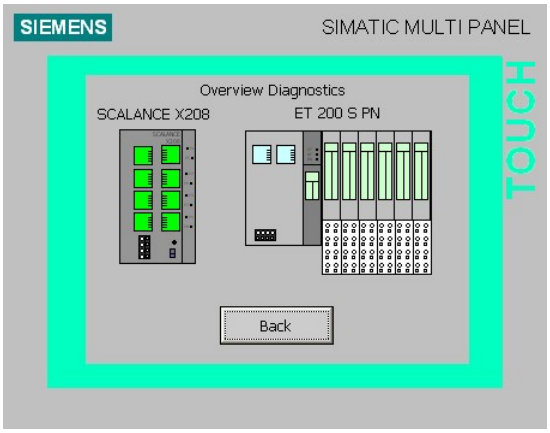
8.2 Diagnostics view of the solution with SFC51 / SFB 54

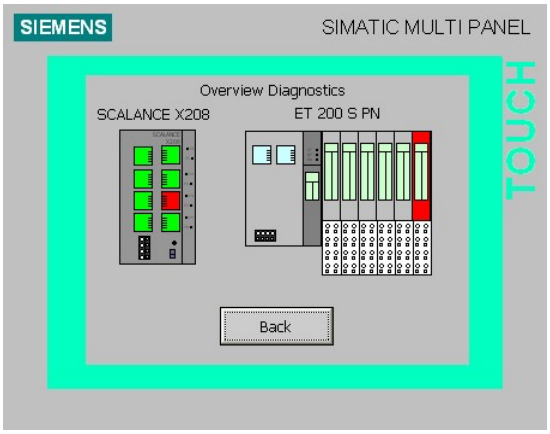
Diagnostics view

The Diagnostics view consists of the detailed view of the two involved PROFINET IO devices.

The “Back” button can be used to return to the simulator display.

Table 8-5

Action	Comment
After loading the system, it is in Automatic mode.	
Use the “Diagnostics” button to go to the Overview Diagnostics of the application with the two available PROFINET IO devices.	

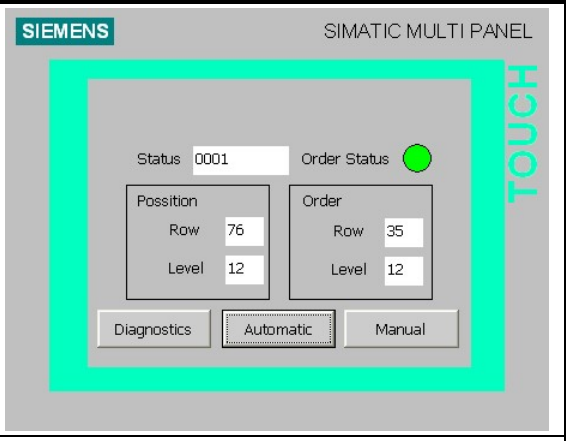
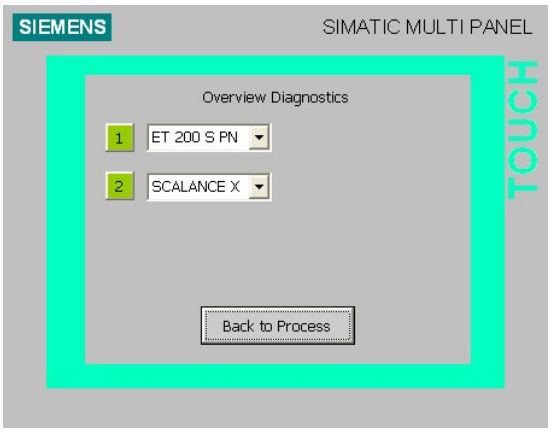
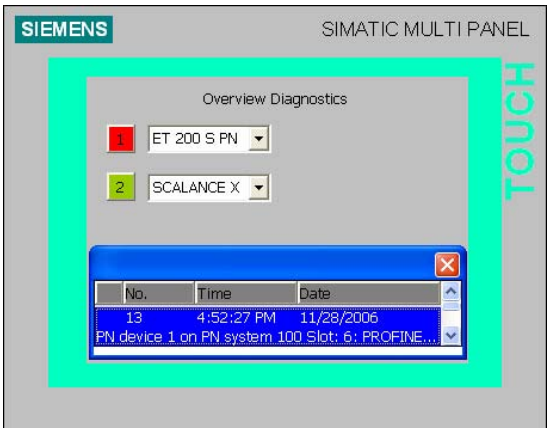
Action	Comment
Diagnostic interrupts which are displayed on the HMI device are triggered by withdrawing a module or removing a LAN connection on SCALANCE X208.	

8.3 Diagnostics view of the solution with “Report System Error” and FB_126_Dataset

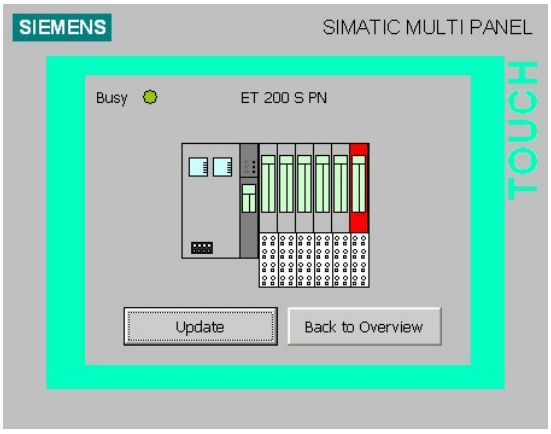
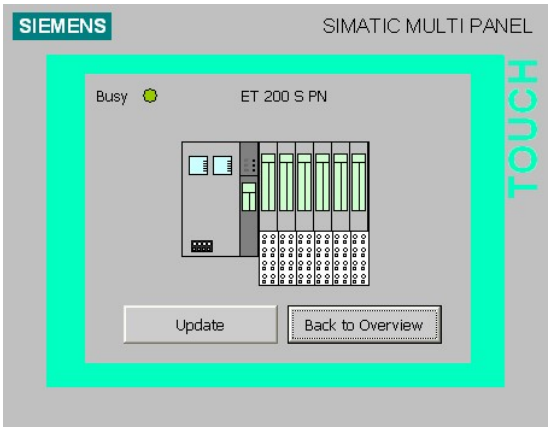
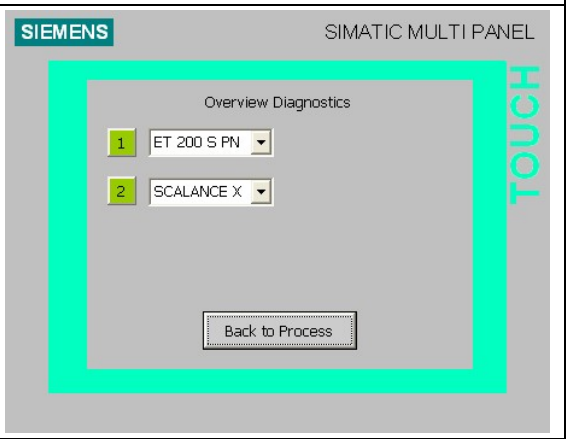
Diagnostics view

The diagnostics of this solution consist of two parts, Overview Diagnostics and Device Diagnostics. Overview Diagnostics are the first step. The “Back to Process” button enables to return to the process display.

Table 8-6

Instruction	Comment
After loading the system, it is in Automatic mode.	
Use the “Diagnostics” button to go to the Overview Diagnostics of the application with all configured PROFINET IO devices.	
In the event of an error, here module no.6 of the ET 200S withdrawn, the address of the ET 200S module flashes red. Via the message window, the “Report System Error” function automatically reports the detailed error as a text.	

PROFINET IO Diag UP ID Number: 24000238

Instruction	Comment
Use the Address button to open the Device Diagnostics window of the defined module, in this case the ET 200S. In the Diagnostics window, the defective module flashes red.	
If the error is corrected, the corrected display can be displayed by selecting the “Update” button to update the display.	
“Back to Overview” takes you back to the Overview Diagnostics. Use “Back to Process” to return to the process simulation.	

Appendix and Literature

9 Literature

9.1 Bibliographic references

This list is by no means complete and only provides a selection of appropriate sources.

Table 9-1

	Topic	Title
/1/	STEP 7	System Software for S7-300/400 System and Standard Functions http://support.automation.siemens.com/WW/view/en/11214574
/2/	STEP 7	PROFINET IO From PROFIBUS DP to PROFINET IO Programming Manual http://support.automation.siemens.com/WW/view/en/19289930
/3/	STEP 7	Programming with STEP 7 V5.4 http://support.automation.siemens.com/WW/view/en/18652056
/4/	STEP 7 FAQ	Simultaneous Use of “Signal System Error”, FB125, FB128 and SFC13 http://support.automation.siemens.com/WW/view/en/17858394
/5/	SIMATIC NET	Industrial Ethernet SCALANCE X-100 and SCALANCE X-200 Product Line http://support.automation.siemens.com/WW/view/en/19348646
/6/	SIMATIC S7	PROFINET IO – Configuration & Diagnostics http://support.automation.siemens.com/WW/view/en/22981197

9.2 Internet links

This list is by no means complete and only provides a selection of appropriate software downloads.

Table 9-2

	Topic	Title
\1\	STEP 7 V 5.4 SP 1	Download of Service Pack 1 for STEP 7 V5.4 http://support.automation.siemens.com/WW/view/en/23849953
\2\	WinCC flexible Edition 2005 SP1 HF5	Download of HF 5 for WinCC flexible Edition 2005 SP 1 http://support.automation.siemens.com/WW/view/en/24104401

History

Table 0-1 History

Version	Date	Modification
V1.0	01/24/07	First edition