



# Operating and configuration instructions

## UO-SPB-1 PROFIBUS module

### PROFIBUS-DP interface and PROFI-safe profile

## U-ONE<sup>®</sup>-SAFETY-LWL

### Universal encoder system – Generation II

Read the configuration manual before completing assembly,  
starting installation and carrying out other work.  
Store the manual for future use.

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Further current information on this product series is available online in our Service Point.

Just scan the QR code and open the link in the browser.



These instructions and the enclosed declaration of conformity can also be accessed via our Service Point. For this purpose, the QR code on the type plate of the corresponding device must be scanned.

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**Writing styles**

*Cursive* or **bold** texts indicate the title of a document, or are used for emphasis.

`Courier-New` font indicates text that is visible on the screen and software or software menu selections.

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## 1 General information

### 1.1 Information on the Operating and assembly manual

This operating and assembly manual provides important information for using the UO-SPB-1 electronic function module. It must be read carefully before beginning any work and observed. The UO-SPB-1 electronic function module is referred to in the following documentation as the SPB.

Furthermore, the local accident prevention regulations and general safety regulations applicable for the area where the device will be used must be observed.

### 1.2 Scope of delivery

The scope of delivery for the function module includes the declaration of conformity and the operating and configuration manual and the software & support CD.

### 1.3 Explanation of symbols

Warning information is designated using symbols. Information is preceded by signal words which express the extent of the danger involved. Always comply with these notices, and use caution to avoid accidents, personal injury and property damage.



**WARNING!**

Indicates a potentially hazardous situation that could lead to death or severe injury if it is not avoided.



**CAUTION!**

Indicates a potentially hazardous situation that could lead to minor or slight injuries if it is not avoided.



**CAUTION!**

Indicates a potentially hazardous situation that could lead to property damage if it is not avoided.



**NOTE!**

Emphasises useful tips and recommendations, and provides information useful for efficient, smooth operation.

## 1.4 Warranty and liability

Only the “General Terms and Conditions” of Johannes Hübner Fabrik elektrischer Maschinen GmbH apply. These will be provided to the operator at the latest when the order is confirmed or when the contract is concluded. All warranty and liability claims for personal injury and property damage are excluded, and the operator's operating permit will be null and void if one or more of the following apply:

- Failure to observe the operating and assembly manual.
- Improper use of the function module.
- Improper assembly, installation, commissioning and programming of the function module.
- Operating the function module despite technical defects.
- Independently carrying out mechanical or electrical modifications to function modules.
- Independently carrying out repairs.
- Catastrophes due to external interference or force majeure.
- Use of non-qualified personnel.
- Opening the function module.

## 1.5 Organisational measures

- The operating and assembly manual must always be stored easily within reach in the area where the function module is used.
- In addition to the operating and assembly manual, general statutory and other binding regulations on accident prevention and environmental protection must be observed. Operators must be trained on these regulations.
- Applicable national, local, and system-specific provisions and requirements must be observed.
- The operator is obligated to inform personnel of special operating considerations and requirements.
- The type plate and any prohibitions or notice signs adhered to the function modules must always be legible.
- Repairs may only be carried out by the manufacturer, or by an agency or individual authorised by the manufacturer.

## 1.6 Copyright protection



### **NOTE!**

Content information, texts, drawings, images, and other illustrations are copyright protected and subject to industrial property rights. Copying of any kind not associated with use of the function module is prohibited without a written declaration from the manufacturer. Violations will result in claims for damages.

## 1.7 Warranty provisions

Warranty provisions are outlined in the manufacturer's General Delivery Conditions.

## 1.8 Customer service

Contact persons are available by phone, fax, or e-mail for technical questions. See the manufacturer's address on page 2.

## 2 Basic safety information



### **CAUTION!**

This section provides an overview of all significant safety aspects necessary to protect personnel and ensure safe, fault-free operation of the function module. Failure to observe this information may result in significant danger.

### 2.1 Responsibility of the operator

The function modules are used in a commercial capacity. The operator of the function modules, therefore, is subject to statutory occupational safety requirements and the safety, accident prevention and environmental regulations applicable to the areas in which the function modules are used.

### 2.2 Selecting and qualifying personnel; basic obligations

- All work on function modules may be carried out only by qualified personnel. Qualified personnel are personnel with the training, experience, and instruction, as well as expertise on relevant standards, specifications, accident prevention regulations and operating circumstances necessary to carry out the required work, and who have been authorised to do so by the persons responsible for the safety of the system. They are able to identify and avoid potential hazards.
- In addition, please see standards VDE 0105-100 and IEC 60364 for the definition of “qualified personnel” (reference, e.g. Beuth Verlag GmbH, VDE-Verlag GmbH)
- Responsibilities for assembly, installation, commissioning and operation must be clearly defined. Personnel who are receiving instruction or training must be supervised.

### 2.3 Proper use

The SPB must be used in conjunction with the USL(H) 42 basic device and the UO-SCU.

The system manufacturer must review whether the properties of the function module fulfil the safety requirements in its specific application. The system manufacturer is responsible for use of the function module and for deciding whether to use the module. Function modules are designed for unsupervised, continuous operation.

#### **Proper use also includes:**

- observing all information in this operating and assembly manual,
- observing type plates and any prohibition or information signs,
- observing the operating manual of the machine or system manufacturer,
- operating the function module within the limits stipulated in the technical data,
- not engaging in improper use.

## 2.4 Improper use

	<p><b>WARNING!</b> Danger of death, physical injury and property damage due to improper use of the function module!</p> <p>In particular, the following uses are prohibited:</p> <ul style="list-style-type: none"> <li>• Use in environments with an explosive atmosphere,</li> <li>• Use in environments with radioactive radiation,</li> <li>• Use for medical purposes.</li> </ul>
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## 2.5 Safety information

  	<p><b>WARNING! CAUTION!</b> Destruction, damage or impact to the function of the function module.</p> <ul style="list-style-type: none"> <li>• Only complete wiring work and only connect or disconnect electrical connections when the module is powered down.</li> <li>• Review any potential hazards due to interactions with other systems and devices currently installed in the surrounding area, or which are to be installed. The user is responsible for taking relevant measures.</li> <li>• The power supply must be secured with a fuse appropriate for the diameter of the intake line.</li> <li>• Cables used must be suitable for the temperature range.</li> <li>• Defective function modules may not be operated.</li> <li>• Opening function modules is prohibited.</li> <li>• The type plates specify the technical properties of the function modules. If a type plate is no longer legible, or if a type plate is missing entirely, the function module may not be operated. Contact Hübner service (see page 2).</li> <li>• This module is not intended for use in residential areas and cannot provide adequate protection for radio reception in such areas. The device is classified in Group 1 and Class A according to EN 55011 and is intended for use in an industrial environment only.</li> </ul>
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	<p><b>NOTE!</b> <b>Disposal:</b> If the function module needs to be disposed after its service life, applicable national regulations must be observed.</p>
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### 3 Assembly

#### 3.1 Safety instructions

	<p><b>WARNING!</b></p> <ul style="list-style-type: none"> <li>• Installation and removal may only be carried out by qualified personnel.</li> <li>• In general, the requirements and acceptance conditions of the overall system must be taken into account for the installation.</li> <li>• Equipotential bonding measures must be provided for the entire processing chain of the system. Uninterrupted, low-resistance machine earthing must be ensured across all parts of the system. Ensure that connections have good electrical contact.</li> <li>• When laying the cables, ensure that there are no tripping hazards.</li> </ul>
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  	<p><b>WARNING! CAUTION!</b></p> <p><b>Risk of death, serious injury and/or damage to property due to overriding of the safety functions caused by an unsafe shaft drive!</b></p> <p>In general, the requirements and acceptance conditions of the entire system must be taken into account for the attachment.</p>
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#### 3.2 Basic rules

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The supply cable of the base unit must be laid at a sufficient distance from power and high-voltage cables.</li> <li>• Shield the power cables between the frequency inverter and motor in accordance with the manufacturer's specifications.</li> <li>• Generous mounting distances must be maintained to actuators/systems with high energy density or electromagnetic emissions (e.g. contactors, relays, inverters, motors, solenoid valves, brakes).</li> <li>• Inductors (e.g. relays, contactors, solenoid valves, brakes) must be wired with interference suppressors to minimize both conducted and airborne interference.</li> <li>• Further information on good installation practice can be found in the USL installation instructions electronics.</li> </ul>
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#### 3.3 Connection

	<p><b>NOTE!</b></p> <ul style="list-style-type: none"> <li>• The DC power distribution for one or more USL systems should be designed in a star configuration for function modules, base units, and cabling. Ensure symmetrical wiring of the forward and return conductors as a twisted pair or cable.</li> <li>• Shielded cables must be used for all power and signal lines that are routed outside a cabinet. The cable shields must be connected to the machine ground at both ends.</li> <li>• Shield connection terminals must be used in the control cabinet to connect the cable shields over a large area.</li> </ul>
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### **3.4 Replacing function modules**

When replacing function modules, observe the following:

- The new function module must have the same item no. (ID) as the old one.
- When using a new measurement system, the operator must ensure that the PROFIBUS address set via hardware switches is the same as the previous PROFIBUS address.
- If there was previously bus termination for the measurement system to be replaced, then this should also be included for the new measurement system.
- Since the F parameter and iParameter of the SPB are saved in the security program for the controller, the new SPB is configured with the project-specific settings in the start-up phase.
- When recommissioning the replaced function module, a secure test run must be completed first to ensure it functions correctly.

## 4 Technical data and functions

### 4.1 Type plate

The following image shows an example of a type plate.

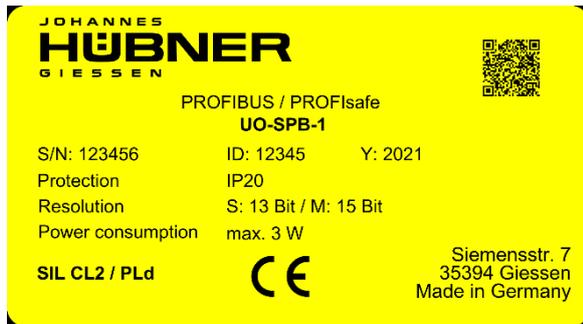
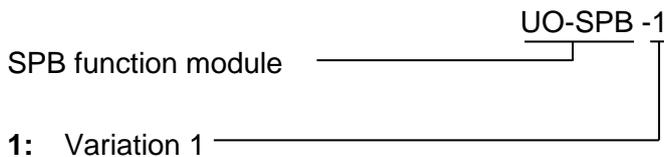


Fig. 4-1: Type plate (example)

The type plate is located on the outside of the housing, and includes the following information:

- Manufacturer
- Type, year of construction
- CE mark
- Serial number (S/N)
- Protective class
- Power consumption
- ID number
- Liquidation
- Certification information

### 4.2 Type designation



### 4.3 Electrical data

Information	Value
Supply voltage	Delivered to the SCU module via the bus connector
Additional UO-SPB-1 module power consumption	< 3 W
Protective class in accordance with DIN EN 60529	IP20 for cabinet installation Degree of protection of cabinet: ≥ IP54
Overall resolution	≤ 28 Bit
Singleturn functional	≤ 13 Bit (8192 steps/revolution)
Singleturn safety-specific	8 Bit (256 steps/revolution)
Multiturn	C 15 Bit (32768 revolutions)
PROFIBUS-DP V0 interface	in accordance with IEC 61158 and IEC 61784
PROFIsafe profile	3.192b in accordance with IEC 61784-3-3

Information	Value
Additional functions	Preset
Parameter	Configurable via PROFIBUS-DP
Integration time Safe	50 ms...500 ms
Integration time Unsafe	5 ms...500 ms
Monitoring window size	50...4000 increments
Idleness tolerance preset	1...5 increments/integration time Safe
Counting direction	Forward, reverse
Transmission	RS485, twisted and shielded copper cable with one pair of conductors (cable type A)
Output code	Binary
Addressing	1 – 99, adjustable via toggle switch
Baudrate	9.6 kbit/s...12 Mbit/s
JHG specific functions (configurable via the PROFIBUS-DP)	Speed output in increments/integration time Safe
<b>Cycle time</b>	
Not safety-related	0.5 ms, output via JHG-PROFIBUS module
Safety-related	5 ms, output via JHG-PROFIsafe module
Preset write cycles	≥ 4 000 000
Connection technology	M12 plug
Wiring diagram	PN165-412 (see section 14.2)
Elevation above sea level	≤ 3000 m

#### 4.3.1 PROFIBUS transmission technology, cable specification

All devices are connected in a bus structure (line). Up to 32 devices (masters or slaves) can be connected together in one segment.

The bus is terminated by an active bus termination at the start and end of each segment. To ensure trouble-free operation, it must be ensured that both bus terminations are always supplied with voltage. The bus termination must be completed externally using the connection plug.

If there are more than 32 system devices or to enlarge the network size, repeaters must be used to connect the individual bus segments.

All cables used must fulfil the following parameters according to the PROFIBUS specifications for copper data wires:

Parameter	Cable type A
Characteristic impedance in $\Omega$	135...165 at a frequency of 3...20 MHz
Operating capacity (pF/m)	30
Loop resistance ( $\Omega$ /km)	$\leq 110$
Wire diameter (mm)	$> 0.64$
Wire cross section (mm <sup>2</sup> )	$> 0.34$
Shielding	Generally foil shielding with shielding braid

The transmission speed for the PROFIBUS is selectable between 9.6 kBit/s and 12Mbit/s and is detected automatically by the USC 42-PROFIBUS module. The speed is set as the same for all devices on the bus during commissioning.

**Range depending on the transmission speed for cable type A:**

<b>Baudrate (kbits/s)</b>	9.6	19.2	93.75	187.5	500	1500	12000
<b>Range / segment (m)</b>	1200	1200	1200	1000	400	200	100

We recommend completing a visual acceptance procedure with protocol after assembly work is finished. If possible, suitable bus analysis tools should be used to assess the quality of the network: no duplicate bus addresses, no reflection, no telegram repetitions, etc.

	<p><b>NOTE!</b></p> <p>To ensure safe, trouble-free operation, the</p> <ul style="list-style-type: none"> <li>• PROFIBUS planning guidelines, PNO order no.: 8.011,</li> <li>• PROFIBUS assembly guidelines, PNO order no.: 8.021,</li> <li>• PROFIBUS commissioning guidelines, PNO order no.: 8.031,</li> <li>• PROFIsafe “Environmental Requirements”, PNO order no.: 2.232, and the standards and PNO documents referenced therein must be observed!</li> </ul> <p>In particular, the EMC guidelines must be observed in their current valid version.</p>
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**4.3.2 Bus termination**

If the SPB module is the last station in the PROFIBUS segment, then the bus must be terminated according to the PROFIBUS standard at the “PROFIBUS OUT” connection.



The bus termination can also be purchased from Johannes Hübner Gießen (see chapter 12)

## 4.4 Operating statuses and displays

### 4.4.1 Module status indicator (LED1)

Operating status	Status LED	Bus status
<b>Start</b>	flashing yellow/green 2 Hz	not ready for operation
<b>normal</b>	green	ready for operation
<b>bootloader</b>	flashing yellow/red 1 Hz	not ready for operation
<b>Warning</b>	flashing yellow 1 Hz	ready for operation
<b>Fault</b>	red	Fault



#### **Warning:**

A warning is generated when the SPB reaches the end of its service life (20 years).

### 4.4.2 Bus status indicator (LED2)

Flashes yellow briefly when the SPB starts up. Then the indicator depends on the operating status of the SPB.

LED2	Bus
green	ready for operation
off	No supply, hardware fault
flashing green 1 Hz	Incorrect configuration of F_Parameter
flashing green 3x with 5 Hz	PROFIsafe communication running, master requests operator acknowledgement
flashing yellow/red 1 Hz	SPB not addressed by the master, no cyclical data exchange
red	Internal error, bit 1 in PROFIsafe status byte set.

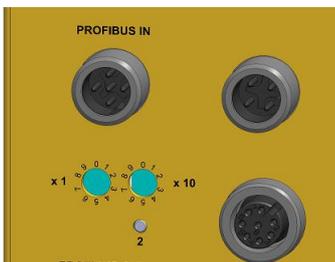
For appropriate measures in case of a fault, see chapter 10.1.

## 5 PROFIBUS / PROFIsafe – Commissioning

### 5.1 PROFIBUS

PROFIBUS is a consistent, open, digital communication system with a broad range of applications, particularly in manufacturing and process automation. PROFIBUS is suitable for fast, time-critical and complex communication tasks.

Communication via PROFIBUS is governed by international standards IEC 61158 and IEC 61784. Application and engineering aspects are defined in the guidelines of the PROFIBUS user organization. This ensures that user requirements for manufacturer-independence and openness are fulfilled, and guarantees communication between devices made by different manufacturers, without adjustments to the devices themselves.



Valid PROFIBUS addresses: 1 – 99

x1: Setting the 1st position

x10: Setting the 10th position

**The device will not start up if an invalid station address is set.**

The set PROFIBUS address automatically indicates the PROFIsafe target address, see chapter 5.6.1.6.

**For important information, see the PROFIBUS guidelines:**

- PROFIBUS guidelines: PROFIsafe – Environmental Requirements order no.: 2.232
- PROFIBUS assembly guidelines, order no.: 8.021
- PROFIBUS commissioning guidelines, order no.: 8.031

This and further information on the PROFIBUS or PROFIsafe is available from the office of the PROFIBUS user organisation:

**PROFIBUS Nutzerorganisation e.V.**

Haid-und-Neu-Str. 7

D-76131 Karlsruhe

[www.profibus.com](http://www.profibus.com)

[www.profisafe.net](http://www.profisafe.net)

Phone: + 49 721 96 58 590

Fax: + 49 721 96 58 589

E-mail: [germany@profibus.com](mailto:germany@profibus.com)

#### 5.1.1 DP communication protocol

SPB's support the communication protocol **DP**, which is designed for fast data exchange on the field level. The basic function is defined by the **VO** performance level. This includes cyclical data exchange and station and module-specific diagnostics.

### 5.1.2 Device master data file (DMD)

The characteristic communication features of PROFIBUS devices have been defined in the form of an electronic device data sheet (device master data file, DMD file) to create a simple plug-and-play configuration for PROFIBUS.

The defined file format allows the project management system to easily read in the PROFIBUS SPB's device master data and take it into consideration automatically when configuring the bus system.

The DSD file is part of the SPB and uses the file name **HUEB0E3F.GSD** (German). The SPB also includes three bitmap files named **HUEB\_BDE.bmp**, **HUEB\_BDI.bmp** and **HUEB\_BSF.bmp**, which the SPB shows in normal operation, diagnostic operation and special operating modes.

The files are saved on the Software and Support CD (see the "Accessories" section in the operating and assembly manual). This is part of the delivery.

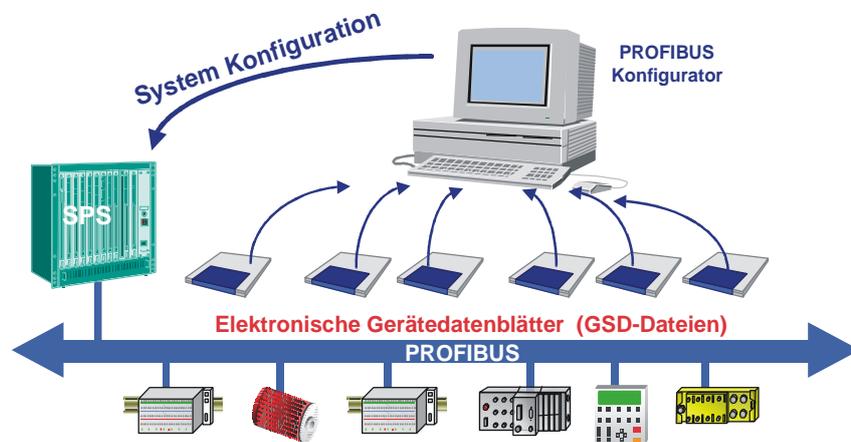


Fig. 5-1: DSD for the configuration

### 5.1.3 PNO ID number

Each PROFIBUS slave and each master class 1 must have an ID number. This is already entered into the enclosed DSD file.

It is required so that a master can identify types of the connected devices without significant protocol overhead. The master compares the ID numbers of the connected devices with the ID numbers in the project management data specified by the project management tool. The user data transfer only starts once the correct device types have been connected with the correct station address. This provides a high level of security against project management errors.

The SPB has the PNO ID number **0x0E3F** (Hex). This number is reserved and saved in the PNO.

## 5.2 PROFIsafe

PROFIsafe is the profile for transmitting safety-related data via the PROFIBUS and PROFINET and is standardised internationally in IEC 61784-3-3.

PROFIsafe is a functional extension of PROFIBUS-DP, and was the first communication standard in accordance with safety standard IEC 61508 that permits failsafe communication fulfilling the standard on one and the same bus line. PROFIsafe devices, therefore, do not require any changes to the existing hardware components, and integrate into existing systems without issue.

These properties are due to the “black channel” principle:

- No impact on standard bus protocols
- Independent of the respective transmission channel, whether copper cables, fibre optic cables, backplane bus or wireless
- Neither the transmission rates nor respective error recognition play a role.
- The transmission channels for PROFIsafe are all “black channels”.

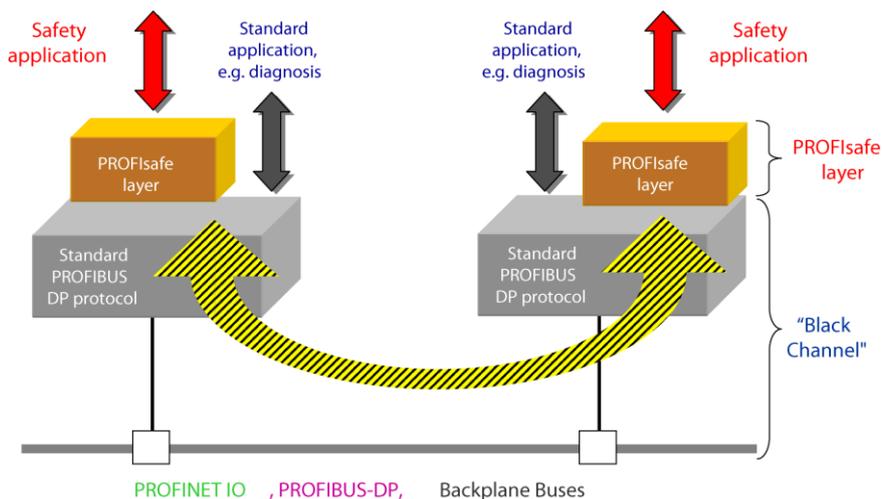


Fig. 5-2: “Black channel” principle [source: PROFIsafe system description]

### 5.3 SPB ↔ PROFIBUS / PROFIsafe communication

The actual values for position and speed are transmitted in two slots:

- The actual position values of both SPBs are compared for secure transmission. If the difference is less than the set monitoring window, then the value is considered secure. The secured actual position value and the secured speed value calculated on this basis are transmitted via the PROFIsafe profile. The part of the controller that handles safety-related tasks can then process these values.
- The actual position value and calculated speed value for the first SPB are transmitted directly in the non-secured process data channel. Generally, this channel is processed more frequently by the controller. Normal automation processes can, therefore, access the more frequently updated position value.

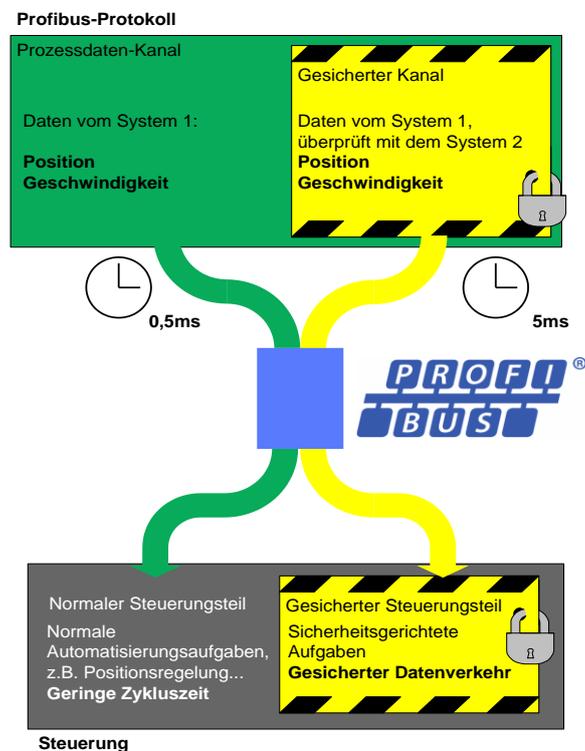


Fig. 5-3: SPB – PROFIsafe communication

### 5.4 PROFIBUS start-up

Before the SPB can be integrated into user data traffic (Data\_Exchange), the master must first initialise during SPB start-up. The data traffic this generates between the master and the SPB (slave) is divided into the parameterisation, configuration and data transfer phases.

During these phases, the system checks whether the projected target configuration matches the actual device configuration. The device type, format and length information and the number of inputs and outputs must match during this check. This provides the user with reliable protection against data format errors.

If the check was completed without errors, the system switches to DDLM\_Data\_Exchange mode. The SPB transmits its actual position, for instance, in this mode.

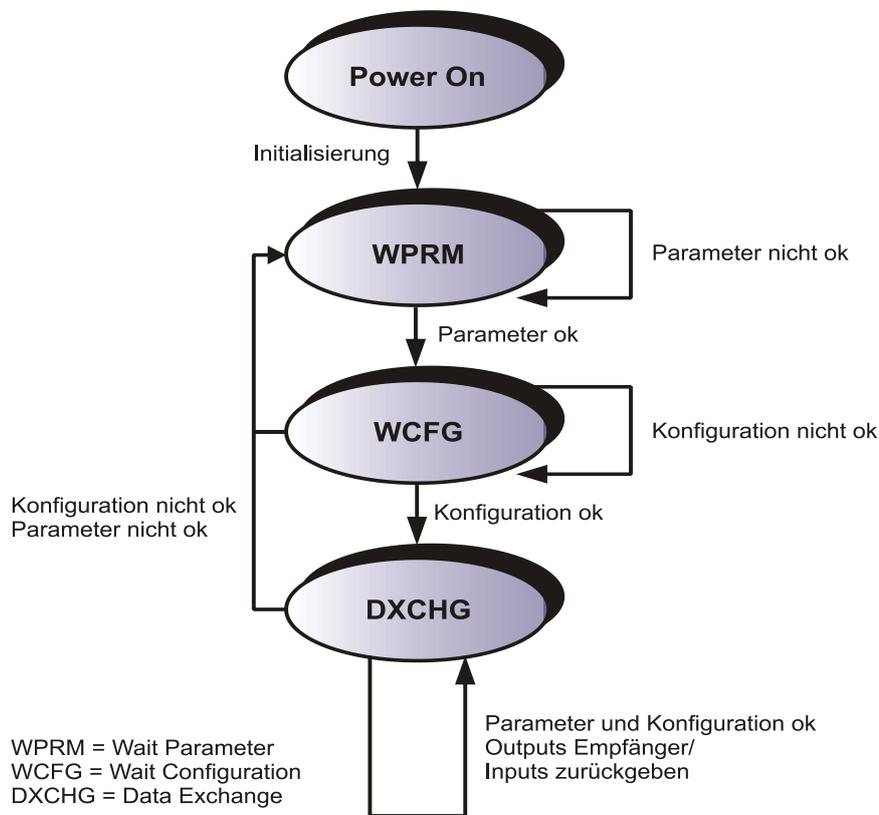


Fig. 5-4:DP slave initialisation

## 5.5 Configuration

Configuration means that information must be provided on the length and type of the process data, and how it should be handled.

The SPB stores a certain number of input and output words on the PROFIBUS depending on the configuration. This structural information is already entered into the GSD file both for the safety-related and for the non-safety related data and is described in the following.

The following applies:

- Flow of input data: F-Device → F-Host
- Flow of output data: F-Host → F-Device

### 5.5.1 Safety-related data, JHG-PROFIsafe module

The module stores five input words for the user data and four input bytes for the PROFIsafe parameter block.

Byte	Bit	Input data	
X+0	$2^8-2^{15}$	Cam	Unsigned16
X+1	$2^0-2^7$		
X+2	$2^8-2^{15}$	Status	Unsigned16
X+3	$2^0-2^7$		
X+4	$2^8-2^{15}$	Speed	Integer16
X+5	$2^0-2^7$		
X+6	$2^8-2^{15}$	Actual value, Multiturn, 15 bit	Integer16
X+7	$2^0-2^7$		
X+8	$2^8-2^{15}$	Actual value, Single turn, 13 bit	Integer16
X+9	$2^0-2^7$		
X+10	$2^0-2^7$	Safe Status	Unsigned8
X+11	$2^{16}-2^{23}$	CRC2	3 Bytes
X+12	$2^8-2^{15}$		
X+13	$2^0-2^7$		

The module stores four output words for the user data and four output bytes for the PROFIsafe parameter block. It is only possible to access the Safe-Control register indirectly via the safety program from an F runtime group.

Byte	Bit	Output data	
X+0	$2^8-2^{15}$	Control1	Unsigned16
X+1	$2^0-2^7$		
X+2	$2^8-2^{15}$	Control2	Unsigned16
X+3	$2^0-2^7$		
X+4	$2^8-2^{15}$	Preset, Multi-Turn	Integer16
X+5	$2^0-2^7$		
X+6	$2^8-2^{15}$	Preset, Single-Turn	Integer16
X+7	$2^0-2^7$		
X+8	$2^0-2^7$	Safe Control	Unsigned8
X+9	$2^{16}-2^{23}$	CRC2	3 Bytes
X+10	$2^8-2^{15}$		
X+11	$2^0-2^7$		

## 5.5.2 Register structure of safety-related data

### 5.5.2.1 Input data

#### Cam: Unsigned16

Byte	X+0	X+1
Bit	15 – 8	7 – 0
Data	$2^{15} – 2^8$	$2^7 – 2^0$

Bit	Description
$2^0$	<b>Speed overrun</b> This bit is set when the speed value is outside a range of – 32768...+32767.
$2^1...2^{15}$	reserved

**Status: Unsigned16**

Byte	X+2	X+3
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

Bit	Description
$2^0$	<b>Preset_Status</b> — This bit is set when the F-Host triggers a Preset request via the variable <code>IPAR_EN</code> of the F-peripheral DBs or the bit <code>Preset_Request</code> in the <code>Control1</code> register. The bit is reset automatically after the end of Preset execution.
$2^1 \dots 2^{14}$	reserved
$2^{15}$	<b>Error</b> — This bit is set when a Preset query could not be executed due to excessive speed. The current speed must be within the range of the speed set in the lower <code>standstill tolerance preset</code> . The bit is reset after the F-Host deletes the variable <code>IPAR_EN</code> , <b>see also from page 60</b> .

**Speed: Integer16**

Byte	X+4	X+5
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

The speed is output as a signed two's complement value.

Setting the direction of rotation = **Forward**

- In light of the flange mounting, turning the shaft clockwise:  
→ positive speed output

Setting the direction of rotation = **Reverse**

- In light of the flange mounting, turning the shaft clockwise:  
→ negative speed output

If the measured speed exceeds the display range of  $-32768 \dots +32767$ , this will cause an overrun reported in the cam register via Bit  $2^0$ . At the time of the overrun, the speed will remain stopped at the respective +/- maximum value until it is back in the display range. In this case, the message will also be deleted from the cam register. The speed is indicated in `increments per integration time Safe`.

**Multi-Turn / Single-Turn: Multi-Turn, Integer16**

Byte	X+6	X+7
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

**Single-Turn, Integer16**

Byte	X+8	X+9
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

Since up to now only 16 bit registers have been possible on the controller side, the position value must be calculated first. The number of revolutions is noted in the `Multi-Turn` tab, while the current Single-Turn position in steps is noted in the `Single-Turn` tab. The actual position can be calculated alongside the resolution of the SPB, max. number of steps per revolution according to the type plate:

Position in steps = steps/revolution * number of revolutions + Single-Turn position
---

Steps per revolution:           **8192**      $\triangleq$  **13 Bit**

Number of revolutions: **0...32767**  $\triangleq$  **15 Bit**

The output position is not signed.

**Safe-Status: Unsigned8**

Byte	X+10
Bit	7 – 0
Data	$2^7 - 2^0$

Bit	Description
2 <sup>0</sup>	<b>iPar_OK:</b> New iParameter values have been assigned to the F-Device. This bit is set when a Preset query has been successfully completed via the F-Host (Bit <code>iPar_EN</code> ), see chapter 9.
2 <sup>1</sup>	<b>Device_Fault:</b> Error in the F-Device or F-module This bit is set when the value set under the iParameters for <code>window increments</code> has been exceeded, and/or the internally calculated PROFIsafe telegram is faulty. The SPB is then transitioned to a failsafe state, and outputs its passivated data. This state can only be exited by correcting the error and supply voltage OFF/ON.

Bit	Description
2 <sup>2</sup>	<p><b>CE_CRC:</b> Checksum error in communication</p> <p>This bit is set when the F-Device detects an F communication error, for instance a missing serial number (detected via a CRC2 error in V2 mode) or if data integrity has been violated (CRC error). The F-Host is then requested to count all faulty messages within a certain time T and, if the maximum permitted number of faulty messages has been exceeded, to enter a configured safe state.</p> <p>This error can also be triggered by incorrect CRC values in the iParameters (F_iPar_CRC) or F-Parameters (F_Par_CRC) in the configuration sequence. The SPB reports a parameter error via PROFIBUS standard diagnosis, and does not start up.</p>
2 <sup>3</sup>	<p><b>WD_timeout:</b> Watchdog timeout in communication</p> <p>This bit is set when the set Watchdog time F_WD_Time in the F-parameters has been exceeded. A valid, current security telegram must be received from the F-Host within this time; otherwise, the SPB is transitioned to a failsafe state and outputs its passivated data. This state can only be exited by correcting the error and supply voltage OFF/ON. see chapter 5.6.1.7.</p>
2 <sup>4</sup>	<p><b>FV_activated:</b> Failsafe values activated</p> <p>This bit is set when the SPB is in a failsafe state and outputs its passivated data.</p>
2 <sup>5</sup>	<p><b>Toggle_d:</b> Toggle bit</p> <p>The toggle bit is device-based, and initiates incrementation of the virtual serial number within the F host. The toggle bit is used to synchronise the counters in the SPB/F host to generate the virtual serial number.</p>
2 <sup>6</sup>	<p><b>cons_nr_R:</b> Virtual serial number was reset.</p> <p>The counter is reset when the F host detects an F communication error (CE_CRC).</p>
2 <sup>7</sup>	reserved

	<p><b>NOTE!</b></p> <p>The Safe-Status can only be accessed indirectly with the help of variables of the F-periphery DB via the safety program from an F-runtime group, see chapter 8.</p>
---	--

### 5.5.2.2 Output data

#### Control1: Unsigned16

Byte	X+0	X+1
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

Bit	Description
2 <sup>0</sup>	<b>Preset_Request</b> This bit is used to control the preset function. When this function is executed, the SPB is set to the position value saved in the tabs <code>Preset Multi-Turn/Preset Single-Turn</code> . An exact process must be observed to execute the function, see chapter 9.
2 <sup>1</sup> ...2 <sup>15</sup>	reserved

#### Control2:

reserved

#### Preset Multi-Turn / Preset Single-Turn: Preset Multi-Turn, Integer16

Byte	X+4	X+5
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

#### Preset Single-Turn, Integer16

Byte	X+6	X+7
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

Since up to now only 16 bit registers have been possible on the controller side, the preset value to be written must be calculated first. The desired preset value must be in the range of 0 to 268 435 455 (28 Bit). The relevant values for `Preset Multi-Turn/Preset Single-Turn` can be calculated alongside the resolution of the SPB, max. number of steps per revolution according to the type plate (8192):

$$\text{Number of revolutions} = \text{desired preset value} / \text{steps per revolution}$$

The integer portion of this division indicates the number of revolutions, and must be entered in the `Preset Multi-Turn` tab.

$$\text{Single-Turn-Position} = \text{desired preset value} - (\text{steps per revolution} * \text{number of revolutions})$$

The results of this calculation are entered into the `Preset Single-Turn` tab.

The preset value is set as a new position when the preset function is executed, see chapter 9.

**Safe-Control: Unsigned8**

Byte	X+8
Bit	7 – 0
Data	$2^7 - 2^0$

Bit	Description
$2^0$	<b>iPar_EN:</b> iParameter assignment unlocked This bit must be set indirectly by the F host via a variable in order to be able to execute the preset function, <b>see chapter 9“Preset function” on page 60.</b>
$2^1$	<b>OA_Req:</b> Operator confirmation query requested This bit is set via the F host driver if an error has been detected in safety-related communication and it has been corrected. The bit is also set if the SPB/F host could not be integrated synchronously into bus operation during start-up of the F-system. In relation to the SPB, an operator confirmation query is indicated via the green LED (3x with 5 Hz). In this case, an operator acknowledgement is required of the function modules in the security program. This allows the counter in the F host and F device to be synchronised for the virtual serial number. The SPB is then transferred from safe status, output passivated data, to normal status, output cyclical data.
$2^2$	<b>R_cons_nr:</b> Reset the counter for the virtual serial no. This bit is set when the F host detects an F communication error, either via the status byte or through itself.
$2^3$	reserved
$2^4$	<b>activate_FV:</b> Activate failsafe values This bit is set internally within the device via the firmware if the SPB cannot output any more failsafe data due to a device error, errors in safety-related communication, or when starting up the F system. Instead, the SPB outputs its passivated data.
$2^5$	<b>Toggle_h:</b> Toggle bit The toggle bit is host-based, and initiates incrementation of the virtual serial number within the F host. The toggle bit is used to synchronise the counters in the SPB/F host to generate the virtual serial number.
$2^6-2^7$	reserved

	<b>NOTE!</b> The Safe-Control register can only be accessed indirectly with the help of variables of the F-periphery DB via the safety program from an F-runtime group, see chapter 8.
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### 5.5.3 Process data, JHG-PROFIBUS module

The module stores four input words for simple usage data that is not safety-related.

Byte	Bit	Input data	
X+0	$2^8-2^{15}$	Cam	Unsigned16
X+1	$2^0-2^7$		
X+2	$2^8-2^{15}$	Speed	Integer16
X+3	$2^0-2^7$		
X+4	$2^8-2^{15}$	Actual value, Multiturn, 15 bit	Integer16
X+5	$2^0-2^7$		
X+6	$2^8-2^{15}$	Actual value, Single turn, 13 bit	Integer16
X+7	$2^0-2^7$		

### 5.5.4 Register structure of process data

#### 5.5.4.1 Input data

##### Cams: Unsigned16

Byte	X+0	X+1
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

Bit	Description
$2^0$	<b>Speed overrun</b> This bit is set when the speed value is outside a range of $-32768...+32767$ .
$2^1...2^{15}$	reserved

**Speed: Integer16**

Byte	X+2	X+3
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$

The speed is output as a signed two's complement value.

Setting the direction of rotation = **Forward**

- In light of the flange mounting, turning the shaft clockwise:  
→ positive speed output.

Setting the direction of rotation = **Reverse**

- In light of the flange mounting, turning the shaft clockwise:  
→ negative speed output.

If the measured speed exceeds the display range of -32768...+32767, this will cause an overrun reported in the cam register via Bit  $2^0$ . At the time of the overrun, the speed will remain stopped at the respective +/- maximum value until it is back in the display range. In this case, the message will also be deleted from the cam register. The speed is indicated in increments per integration time Unsafe.

**Multi-Turn / Single-Turn**

	Multi- Turn, Integer16		Single- Turn, Integer16	
Byte	X+4	X+5	X+6	X+7
Bit	15 – 8	7 – 0	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$	$2^{15} - 2^8$	$2^7 - 2^0$

Since up to now only 16 bit registers have been possible on the controller side, the position value must be calculated first. The number of revolutions is noted in the `Multi-Turn` tab, while the current `Single-Turn` position in steps is noted in the `Single-Turn` tab. The actual position can be calculated alongside the resolution of the SPB, max. number of steps per revolution according to the type plate:

Position in steps = (steps per revolution * number of revolutions) + Single-Turn position
---

Steps per revolution:     **8192  $\triangleq$  13 Bit**

Number of revolutions:   **0...32767  $\triangleq$  15 Bit**

The output position is not signed.

## 5.6 Parameterisation

Parameterisation means providing specific information to a PROFIBUS-DP slave that it needs for operation before it enters the cyclical exchange of process data. The SPB requires data, for instance, on the integration time, counting direction, etc.

Typically, the configuration program provides an input screen for the PROFIBUS-DP master where the user can enter the parameter data or select it from a list. The structure of the input screen is provided in the device master file. The number and type of parameters to be entered by the user depend on the configuration.

 	<p><b>WARNING! CAUTION!</b>  <i>Danger of death, severe physical injury and/or property damage due to a malfunction, caused by incorrect configuration.</i></p> <p>The system manufacturer must ensure proper function through a secured test run during commissioning and each time the parameters are changed.</p>
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### 5.6.1 F-Parameter (F\_Par)

The F-Parameters contain information to adapt the PROFIsafe layer to certain applications and check the configuration in a separate, independent manner. The following is a list of F parameters supported by the SPB.

**Byte-Order = Big Endian**

Byte	Parameter	Type	Description
X+0	F_Check_SeqNr	Bit	Bit 0 = 0: no review
	-	Bit	Bit 1 = 0: not used
	F_SIL	Bit range	Bit 3-2 00: SIL1 01: SIL2 10: SIL3 [default] 11: no SIL
	F_CRC_Length	Bit range	Bit 5-4 00: 3-Byte-CRC
X+1	F_Block_ID	Bit range	Bit 5-3 001: 1
	F_Par_Version	Bit range	Bit 7-6 01: V2-Mode
X+2	F_Source_Add	Unsigned16	Source address, Default = 1 Range: 1-65534
X+4	F_Dest_Add	Unsigned16	Target address, Default = 503 Range: 1-65534
X+6	F_WD_Time	Unsigned16	Watchdog time, Default = 125 Range: 125-10000
X+8	F_iPar_CRC	Unsigned32	CRC of the i parameter, Default = 1132081116 Range: 0-4294967295
X+12	F_Par_CRC	Unsigned16	CRC of the F parameter, Default = 46906 Range: 0-65535

#### 5.6.1.1 F\_Check\_SeqNr

The parameter determines whether the sequence number in the consistency check (CRC2 calculation) of the F user data telegram should be integrated. This parameter is set to “NoCheck” and cannot be changed. This means only failsafe DP standard slaves are supported if they behave in this manner.

#### 5.6.1.2 F\_SIL

F\_SIL indicates the SIL the user expects from the specific F device. It is compared to the manufacturer information stored locally. The SPB supports the safety classes no SIL and SIL 1 to SIL3, SIL3 = standard value.

#### 5.6.1.3 F\_CRC\_Length

Depending on the length of the F input/output data (12 or 123 bytes) and the SIL level a CRC of 2, 3 or 4 bytes is required. To check the data, this parameter transmits the expected length of the CRC2 signature in the safety protocol for F components during start-up. The SPB supports the CRC length of 3 bytes. This value is preset and cannot be changed.

#### 5.6.1.4 F\_Block\_ID

This parameter is used to set whether a CRC should also be formed via the device-specific safety parameter “F\_iPar”. Since the SPB supports device-specific safety parameters such as “Safe integration time”, this parameter is pre-set to a value of “1 = form F\_iPar\_CRC” and cannot be changed.

#### 5.6.1.5 F\_Par\_Version

This parameter identifies the PROFIsafe version “V2 Mode” implemented in the SPB. This value is preset and cannot be changed.

#### 5.6.1.6 F\_Source\_Add / F\_Dest\_Add

The parameter `F_Source_Add` defines a unique source address within a PROFIsafe island.

The parameter `F_Dest_Add` defines a unique target address within a PROFIsafe island.

The device-specific part of the F-device compares the value with the address switch on site or an assigned F address to check the authenticity of the connection.

The PROFIsafe target address must match the PROFIBUS address set using the address switch implemented in the SPB + 500 (see also the “Bus addressing” section in the operating and assembly manual)

Standard value `F_Source_Add = 1`, Standard value `F_Dest_Add = 503`,

`F_Source_Add ≠ F_Dest_Add`.

#### 5.6.1.7 F\_WD\_Time

This parameter stipulates the monitoring time [ms] in the SPB. A valid, current security telegram must be received from the F-Host within this time; otherwise, the SPB is transitioned to a safe state.

The default value is 125 ms.

In general, the watchdog time should be high enough that the communication tolerates telegram run times, but that the error reaction function can be executed quickly enough in case of an error.

### 5.6.1.8 F\_iPar\_CRC

This parameter represents the checksum value (CRC3) calculated from all iParameters for the device-specific part of the SPB, and ensures secure transmission of the iParameters. It is calculated in a program "JHG\_iParameter" provided by Johannes Hübner Gießen. The checksum value calculated there must then be entered manually into the engineering tool of the F-Host, see also section 6.

The SPB generates a checksum itself from the iParameters transmitted by the F-Host. This checksum is compared with the checksum transmitted by the F-Host in the SPB. If the two F\_iPar\_CRC are identical, the SPB is transferred into data exchange during start-up; otherwise the SPB does not start up.

The 32-bit CRC polynomial 0x04C11DB7 is used to calculate the F\_iPar\_CRC in the SPB as well as in the program JHG\_iParameter.

Standard value = 1132081116, valid for all iParameter with standard setting.

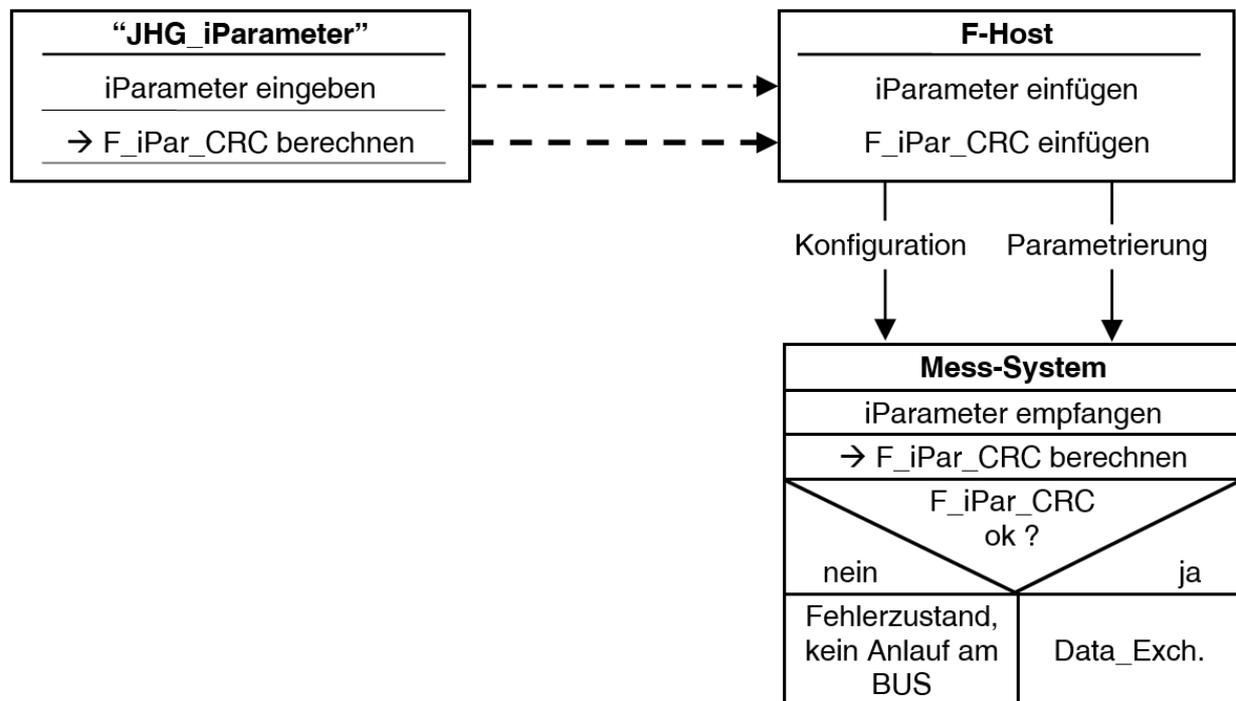


Fig. 5-5: Diagram of F\_iPar\_CRC calculation

### 5.6.1.9 F\_Par\_CRC

This parameter represents the checksum value (CRC1) calculated from all F-parameters for the SPB, and ensures secure transmission of the iParameters. It is calculated externally in the engineering tool of the F-Host and must then be entered here under this parameter, or is automatically generated.

The CRC1 checksum value is also the starting value for the cyclical CRC2 calculation.

The 16-bit CRC polynomial 0x4EAB is used to calculate the F\_Par\_CRC.

Standard value = 46906, valid for all F-parameters with standard setting.

### 5.6.2 iParameter (F\_iPar)

Application-specific device properties are stipulated in the iParameters. A CRC calculation is required to securely transmit the iParameters, **see chapter 6.1 “iParameter” on page 34.**

The following is a list of iParameters supported by the SPB.

#### Byte-Order = Big Endian

Byte	Parameter	Type	Description
X+0	Integration time Safe (Integration Time Safe)	Unsigned16	Default = 2 Range: 1-10
X+2	Integration time Unsafe (Integration Time Unsafe)	Unsigned16	Default = 20 Range: 1-100
X+4	Window increments (Window Increments)	Unsigned16	Default = 1000 Range: 50-4000
X+6	Idleness tolerance preset (Idleness Tolerance Preset)	Unsigned8	Default = 1 Range: 1-5
X+7	Direction (Direction)	Bit	0: Counting direction decreasing 1: Counting direction increasing [default]

#### 5.6.2.1 Integration Time Safe

This parameter is used to calculate the safe speed output via the cyclical data of the PROFIsafe module. Long integration times facilitate high-resolution measurements at low speeds. Short integration times indicate speed changes faster, and are well suited for high speeds and a high level of dynamism. The time base is set to 50 ms. Therefore, 50 ... 500 ms can be set over the value range of 1 ... 10. Standard value = 100 ms.

#### 5.6.2.2 Integration Time Unsafe

This parameter is used to calculate the unsafe speed output via the process data of the PROFIBUS module. Long integration times facilitate high-resolution measurements at low speeds. Short integration times indicate speed changes faster, and are well suited for high speeds and a high level of dynamism. The time base is set to 5 ms. Therefore, 5 ... 500 ms can be set over the value range of 1 ... 100. Standard value = 100 ms.

#### 5.6.2.3 Window Increments

This parameter defines the maximum permitted position deviation in increments for the Master/Slave scanning system integrated into the SPB. The permitted tolerance window depends primarily on the maximum speed in the system, and must first be calculated by the system operator. Higher speeds require a larger tolerance window. The value range is 50...4000 increments.

Standard value = 1000 increments.

#### 5.6.2.4 Idleness Tolerance Preset

This parameter defines the maximum permitted speed in increments per Integration time Safe for carrying out the preset function. The permitted speed depends on the bus behaviour and system speed, and must be calculated first by the system operator. The value range is from 1 increment per integration time Safe up to 5 increments per Integration Safe. Standard value = 1 increment per standard value Integration time Safe.

#### 5.6.2.5 Direction

This parameter defines the current counting direction for the position value in light of the flange connection when the shaft is turning clockwise.

**Forward** = counting direction increasing

**Reverse** = counting direction decreasing

**Standard value** = Forward

## 6 Determining the parameters / CRC calculation

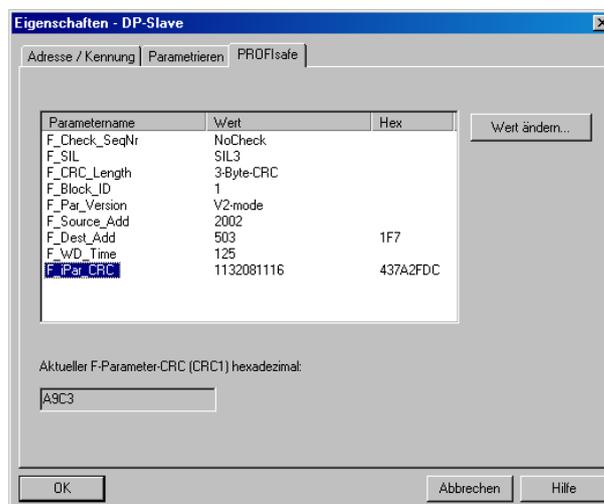
It is useful to stipulate the known parameters in the F-Host even before project planning, so that they can be taken into consideration in the project plan.

The following section describes the process in conjunction with SIEMENS project management software SIMATIC Manager and the option package S7 Distributed Safety.

The software JHG\_iParameter required to calculate the CRC is included in the Software and Support CD.

### 6.1 iParameter

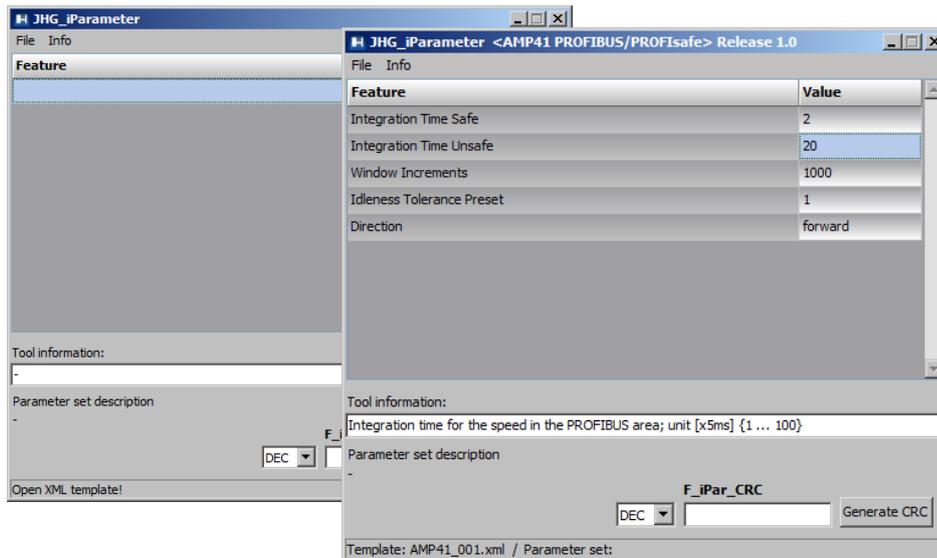
The iParameter are set with feasible default values in the standard settings, and should only be changed if the automation task expressly requires this. A CRC calculation is required to securely transmit the individual set iParameters. This must be completed when changing the default iParameters using the JHG program "JHG\_iParameter". The calculated checksum corresponds to the F-Parameter F\_iPar\_CRC. This must be entered during project planning for the SPB with the hardware configurator in the window Properties - DP Slave in the field of the same name, see chapter 7.3.1.



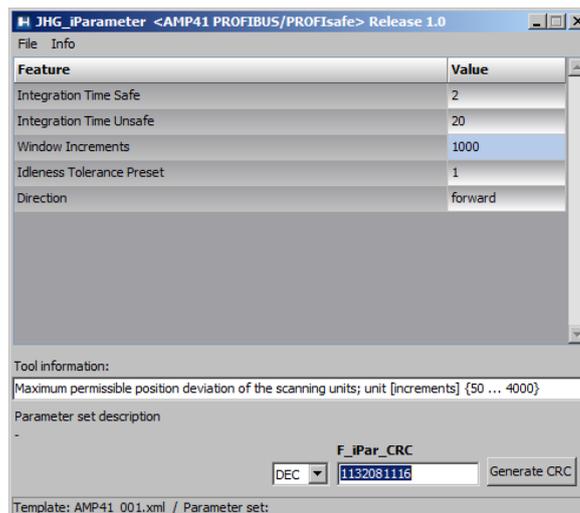
### 6.1.1 CRC calculation via the iParameter

The default standard values are used for the following example CRC calculation. These can be loaded via an XML template file in the program `JHG_iParameter`. If deviating values are required, these can be overwritten by double clicking the relevant entry. The changed parameters can be saved as a complete parameter set or opened as a template.

- Install `JHG_iParameter` using the installation file “`JHG_iParameter_Setup.exe`”.
- Start `JHG_iParameter` using the start file “`JHG_iParameter.exe`”, then use the menu `File` -> `Open XML template` to open the template file included with the SPB (here, the example: `AMP41_001.xml`).



If necessary, adjust the relevant parameters, then - to calculate the `F_iPar_CRC`- click the `Generate CRC` button.

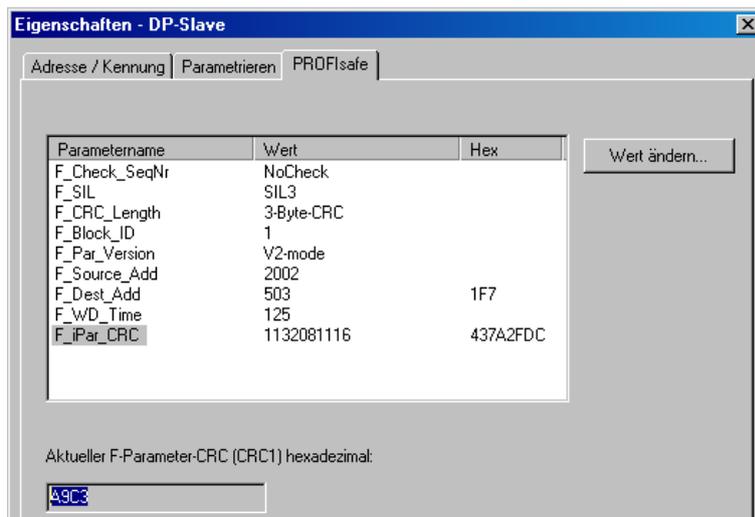


Each time the parameters are changed, `F_iPar_CRC` must be calculated once again. This must be taken into consideration in the project planning. If there is already a security program, it must be regenerated.

Further information on handling `JHG_iParameter` is used in the help file in the menu `Info` -> `Help`.

## 6.2 F-Parameter

The F-Parameters are set with feasible default values in the standard settings, and should only be changed if the automation task expressly requires this. A CRC is required to securely transmit the individual set F-Parameters, and is calculated automatically by the SIMATIC Manager. This checksum corresponds to the F-Parameter `F_Par_CRC`, which is displayed during project management of the SPB with the hardware configurator in the window `Properties - DP Slave` under the heading `Current F-Parameter-CRC (CRC1)` as a hexadecimal value: The value entered in the example below `A9C3` is valid for the standard setting shown here, see chapter 7.3.2.



### 6.2.1 Non-adjustable F-Parameters

The following F-Parameters are managed either by the SPB or the F-Host and therefore cannot be changed manually:

- `F_Check_SeqNr`: NoCheck
- `F_CRC_Length`: 3-Byte-CRC
- `F_Block_ID`: 1
- `F_Par_Version`: V2-mode
- `F_Source_Add`: 2002 (example value, specified by the F-Host)

### 6.2.2 Adjustable F-Parameters

It is assumed that the following parameters are set to their standard values:

- `F_SIL`: SIL3
- `F_Dest_Add`: 503 (corresponds to the set PROFIBUS address +500)
- `F_WD_Time`: 125
- `F_iPar_CRC`: 1132081116 (calculated via the JHG-Tool "JHG\_iParameter")

Any change in parameters will result in a new `F_Par_CRC` value, which is displayed as shown above. If there is already a security program, it must be regenerated.

## 7 Create security program - Example configuration

This section describes the process for creating the security program using SIEMENS project manager `SIMATIC Manager` and the option package `S7 Distributed Safety`.

The security program is created using the `FUP/KOP-Editor` in `STEP 7`. Failsafe FBs and FCs are programmed in the programming language `F-FUP` or `F-KOP`, while failsafe DBs are created in the `F-DB` language. Failsafe application modules that can be used in the security program are available to the user in the `F-library Distributed Safety`, which is available to the user.

Security tests are completed automatically when generating the security program, and additional failsafe modules for error recognition and error reaction are integrated. This ensures that outages and errors are detected and that appropriate reactions are triggered which keep the `F`-system in a safe state or transfer it to a safe state.

A standard user program can run in the `F-CPU` in addition to the security program. The standard and security program can coexist in an `F-CPU`, since the safety-related data of the security program is protected against accidental influence by data in the standard user program.

Data can be exchanged between the security and standard user programs in the `F-CPU` via markers and through access to the process map of inputs and outputs.

### Access protection

Access to the `F-System S7 Distributed Safety` is secured by two password queries, the password for the `F-CPU` and the password for the security program. The online and offline passwords for the security program are differentiated:

- The offline password is part of the security program in the offline project on the programming device.
- The online password is part of the security program in the `F-CPU`.

### 7.1 Requirements

	<p><b>WARNING!</b> <b><i>Danger of deactivating the failsafe function through improper security program project planning!</i></b></p> <ul style="list-style-type: none"> <li>• The security program may only be created in conjunction with the system documentation provided by SIEMENS for the software and hardware.</li> <li>• Full documentation on the topic of “Project planning and programming” a secure controller is available from SIEMENS in the handbook <b><i>S7 Distributed Safety - Project Planning and Programming</i></b>, document order number: <b><i>A5E00109536-04</i></b>. This documentation is part of the option package <code>S7 Distributed Safety</code>.</li> <li>• The following descriptions refer to the process itself, without including information from the SIEMENS handbook. The information and notices provided in the SIEMENS handbook, in particular the safety information and warnings, must therefore be observed and complied with.</li> <li>• The project planning should be considered an example. The user is obligated to review and adjust the project planning to determine whether it is useful in their application. The use must also choose appropriate safety-related hardware components, and must select the necessary software requirements.</li> </ul>
---	---

Software components used for the S7 Distributed Safety example configuration:

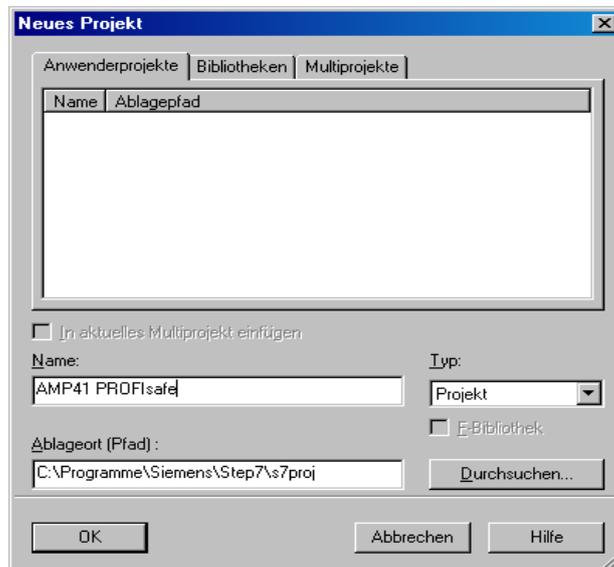
- STEP 7 V5.5 + SP2
- S7 Distributed Safety Programming V5.4 + SP5
- S7 F ConfigurationPack V5.5 + SP9

Hardware components of the SIMATIC 300 series used for the S7 Distributed Safety example configuration:

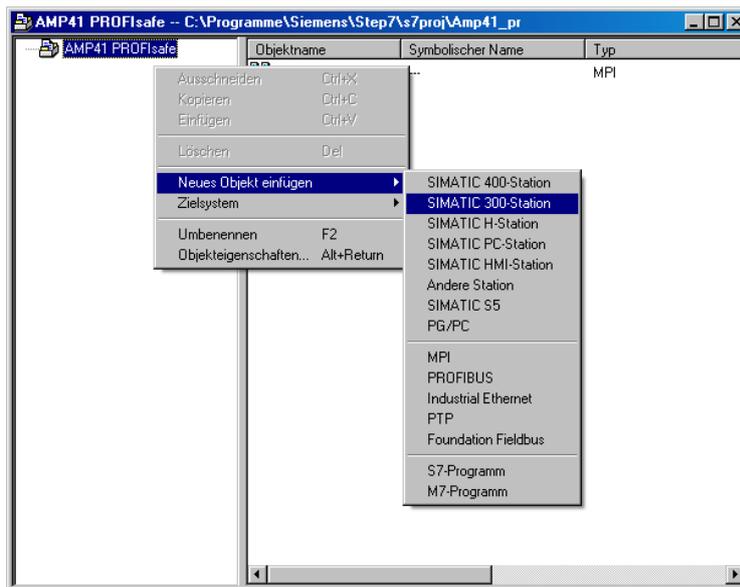
- Hardware rail
- Power supply "PS307 2A" (307-1BA00-0AA0)
- F-CPU unit "CPU317F-2 PN/DP" (317-2FK13-0AB0)
- Digital output assembly "SM 326F DO 10xDC24V/2A" (326-2BF01-0AB0), is not actively used in the following security program, and is provided for customer-specific outputs, for instance to display the variable statuses of the F periphery module: PASS\_OUT, QBAD, ACK\_REQ, IPAR\_OK etc.
- Digital input assembly "SM 326F DI 24xDC24V" (326-1BK01-0AB0), is used to carry out an Operator Acknowledgement.

## 7.2 Hardware configuration

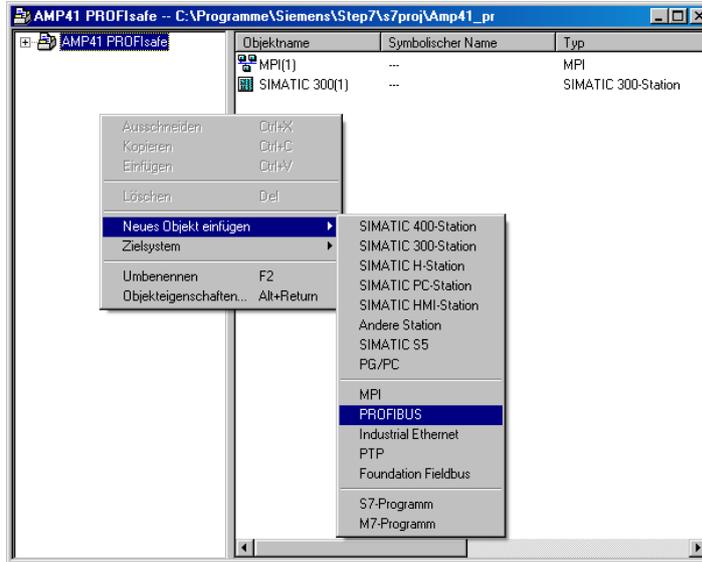
- Start SIMATIC Manager and create a new project.



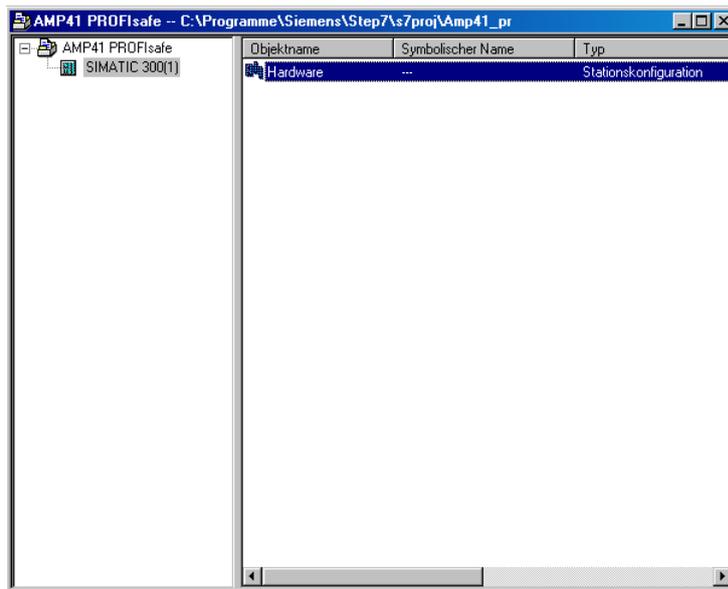
- Right click in the project window to insert the SIMATIC 300-Station as a new object.



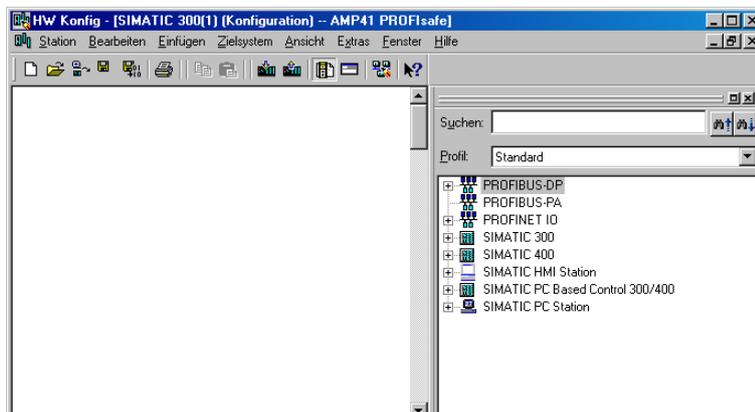
- Use the same process to create a PROFIBUS as a new object. Also add an Industrial Ethernet as a new object here if necessary.



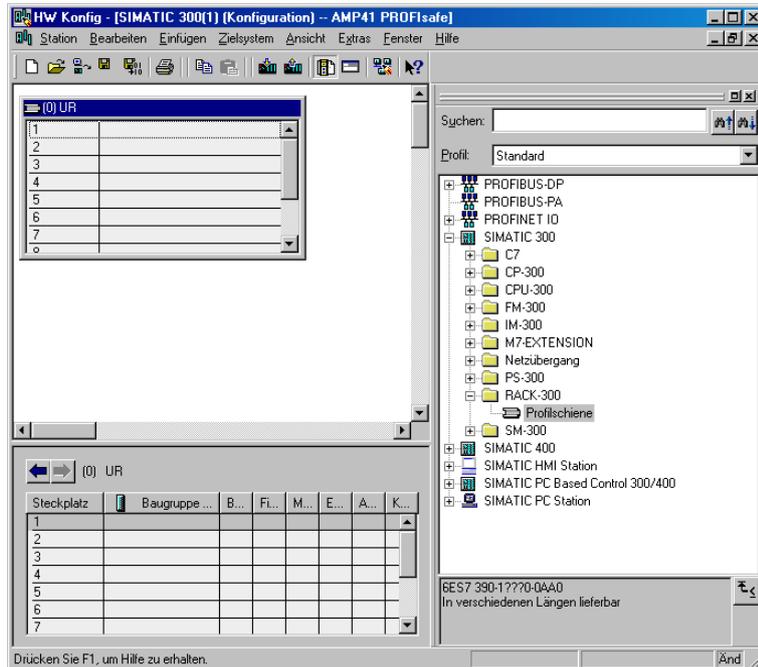
- Double click the Hardware entry to start the hardware configurator HW Config.



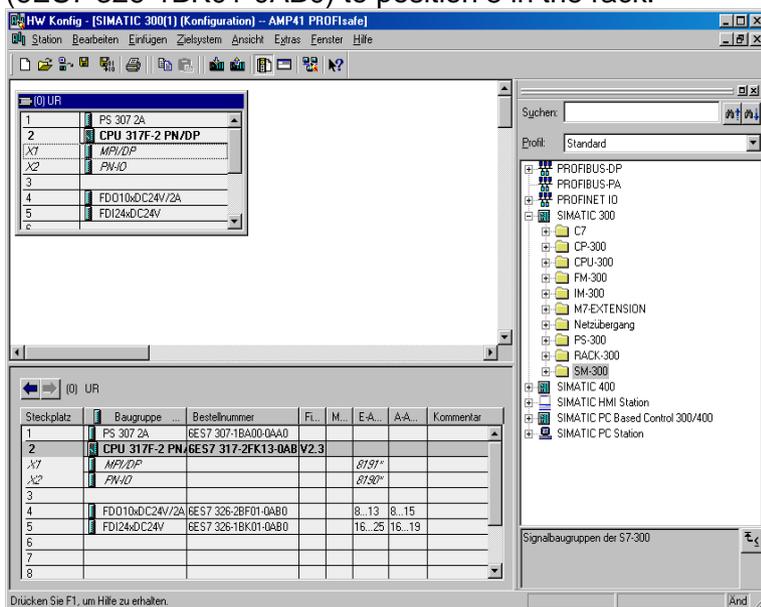
- If the hardware catalogue is not shown at the right side, it can be displayed using the View → Catalogue menu.



- Drag a profile rail into the project window to include the hardware components.



- Drag power supply PS 307 2A in the SIMATIC 300 → PS-300 → PS 307 2A catalogue to position 1 in the rack.
- Drag CPU 317F-2 PN/DP in the catalogue via SIMATIC 300 → CPU-300 → CPU 317F-2 PN/DP → 6ES7 317-2FK13-0AB0 → V2.3 to position 2 in the rack. If necessary, the properties of the Ethernet interfaces should also be entered here.
- Drag digital output assembly SM 326F DO 10xDC24V/2A in the catalogue via SIMATIC 300 → SM-300 → DO-300 → SM 326F DO 10xDC24V/2A (6ES7 326-2BF01-0AB0) to position 4 in the rack.
- Drag digital input assembly SM 326F DI 24xDC24V in the catalogue via SIMATIC 300 → SM-300 → DI-300 → SM 326F DI 24xDC24V (6ES7 326-1BK01-0AB0) to position 5 in the rack.



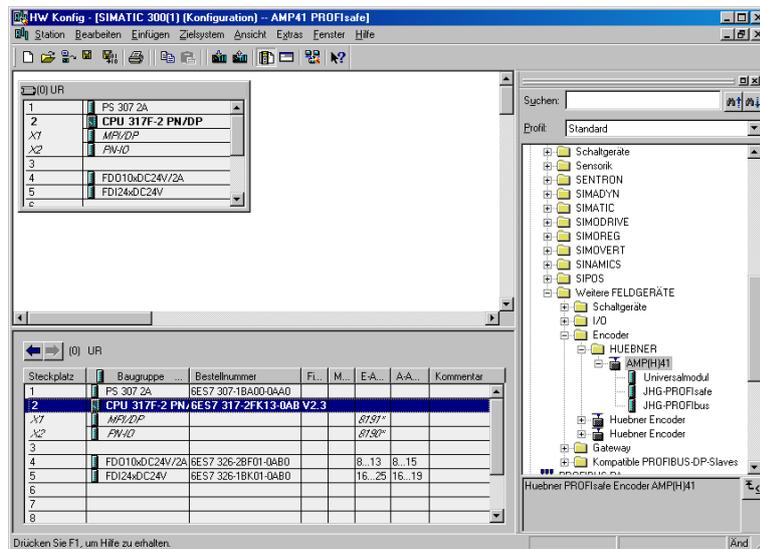
The hardware components to be included in the rack are now complete.

The GSD file HUEB0E3F.GSD associated with the SPB must be installed in the next step. This is copied into the installation directory for the SIMATIC Manager: ...\\S7DATA\\GSD. The bitmap file HUEB\_BDE.bmp associated with the SPB is copied into the following directory: ...\\S7DATA\\NSBMP. Please note that the directory structure may vary.

- Install the GSD file HUEB0E3F.GSD in the stored directory via the menu Extras → Install GSD files...

The SPB will now appear in the catalogue as a new entry:

PROFIBUS-DP → Additional field devices → Encoder → HUEBNER → AMP (H) 41



The individual configuration options are listed under this entry:

- JHG-PROFIsafe see page 21
- JHG-PROFibus see page 28



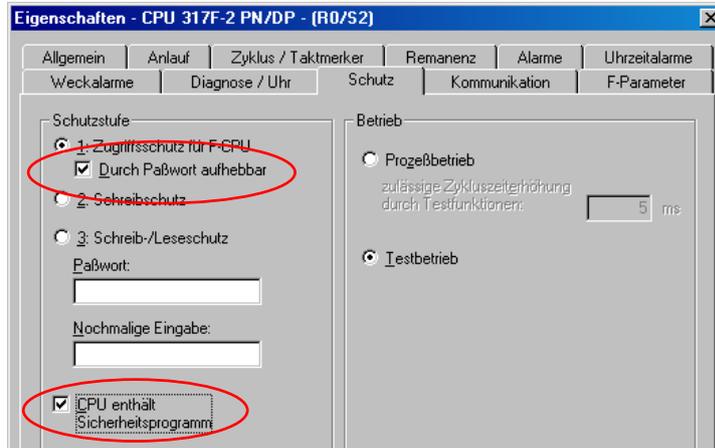
**NOTE!**

The entry **Universal module** is incorrectly provided automatically by some systems, but may not be used!

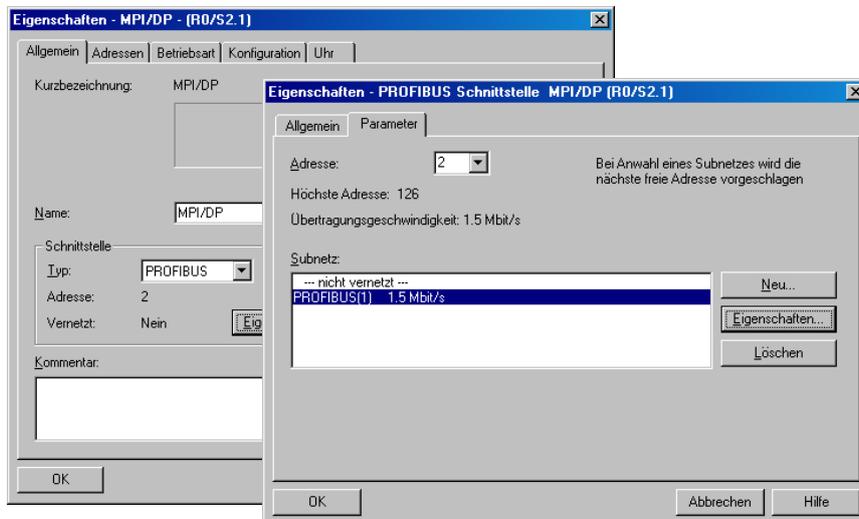
### 7.2.1 Set the hardware configuration properties

The object properties of the individual hardware components are set to the relevant position in the rack or slot by right clicking the position:

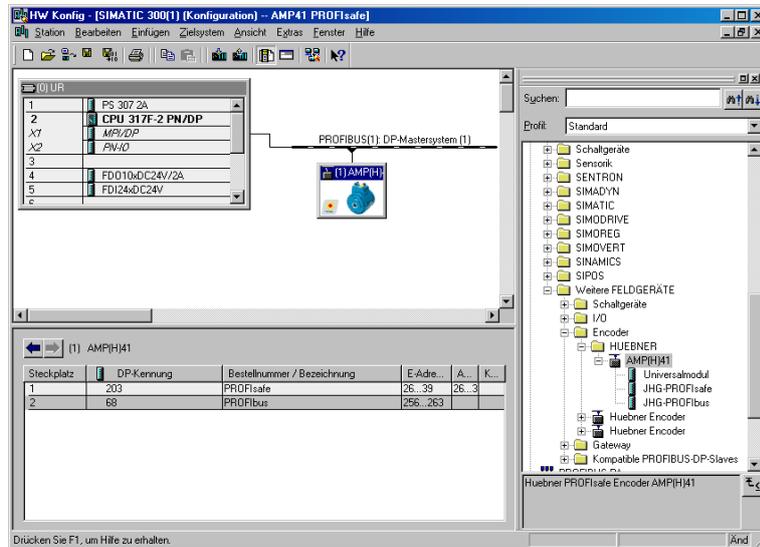
- Protection class 1 and a password must be planned for the CPU in the Protection tab. The Operation field is not relevant for safety operation.



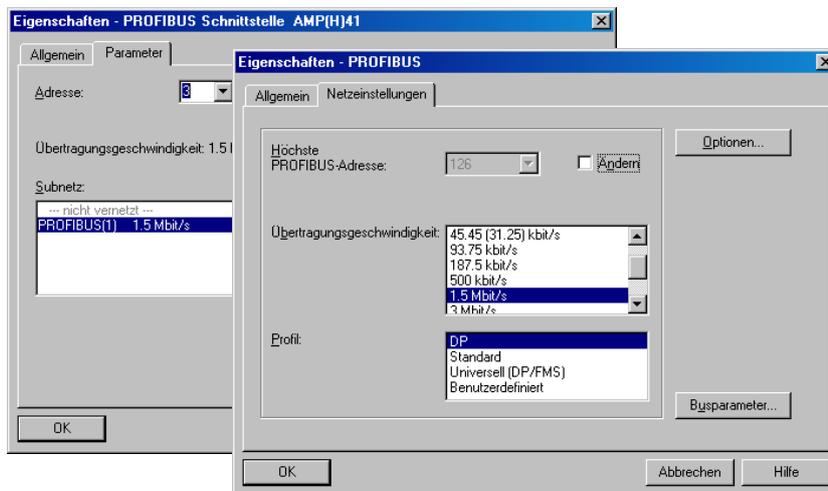
- Select the type PROFIBUS for the CPU in the sub-entry MPI/DP, General → tab in the Interface field.
- In the properties window for PROFIBUS interface MPI/DP, project the transmission speed of 1.5 Mbit/s.



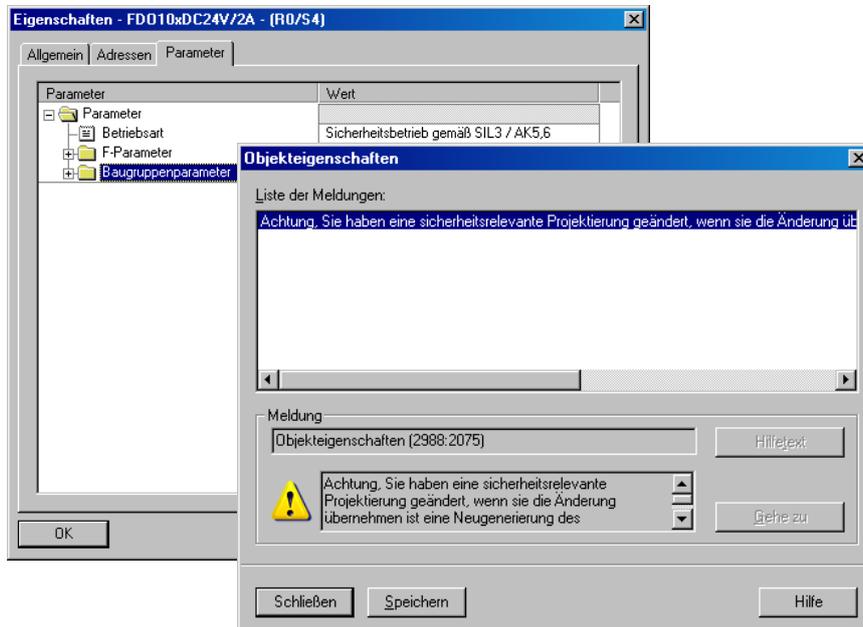
- Connect the SPB AMP (H) 41 from the catalogue to the available bus line via drag&drop to the DP master system.



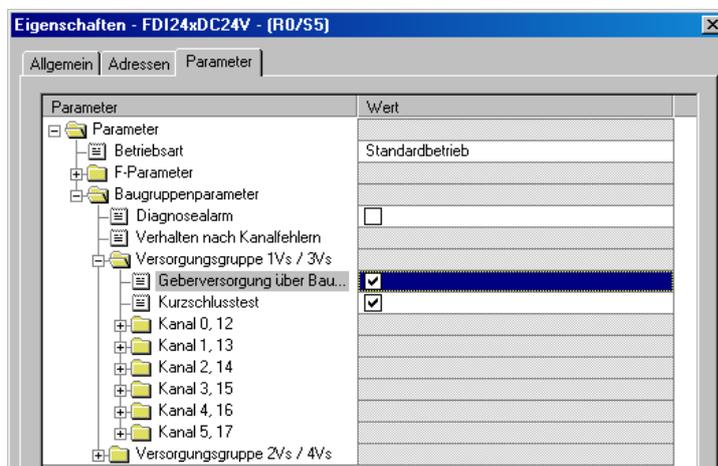
- When the SPB is connected to the master system, the desired address can now be planned in the properties window for the PROFIBUS interface AMP (H) 41 in the Parameter tab.
- Use the switch Properties... → Network settings tab to select the desired transmission rate (1.5 Mbit/s), and set the entry DP for the Profile.



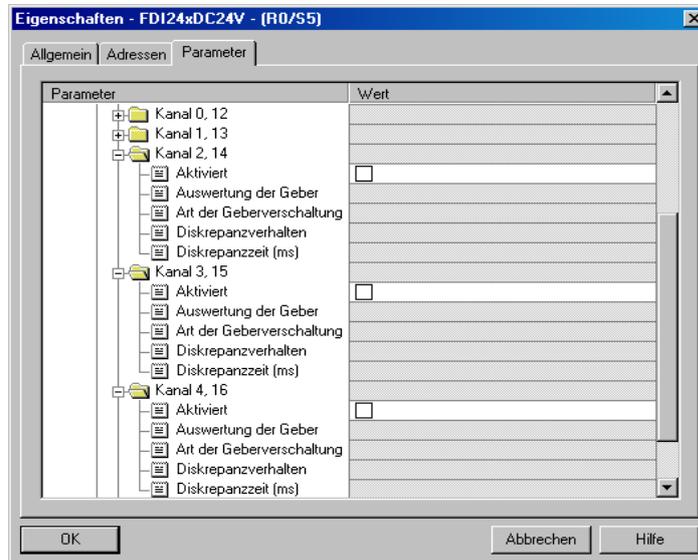
- In the Parameter tab, the operating mode → Safety mode according to SIL3/AK5, 6 must be planned for the project for the digital output assembly. Confirm the following window by pressing Close.



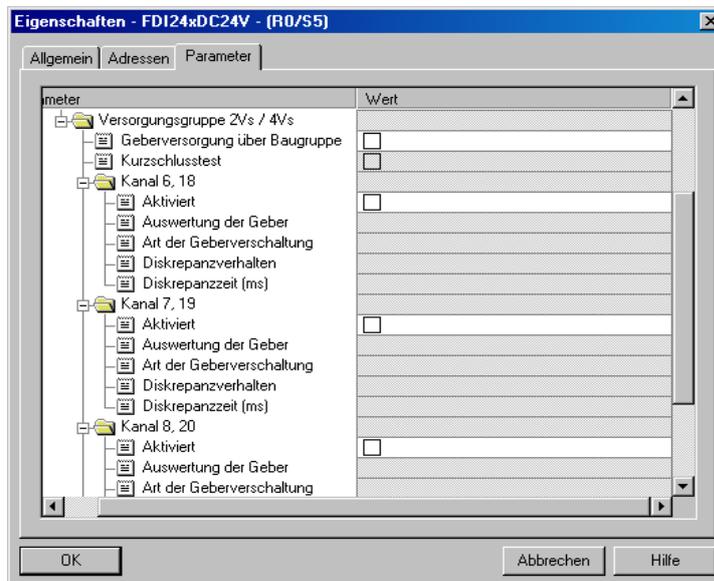
- In the Parameter tab, in the Parameter → Assembly parameters → Supply group 1Vs/3Vs folder structure, the entries Encoder supply via assembly and short circuit test must be checked.



- The settings for channels 0, 12 and 1, 13 remain unaffected. For the channels 2, 14 / 3, 15 / 4, 16 and 5, 17 the check under the entry *Activated* must be removed for each channel.



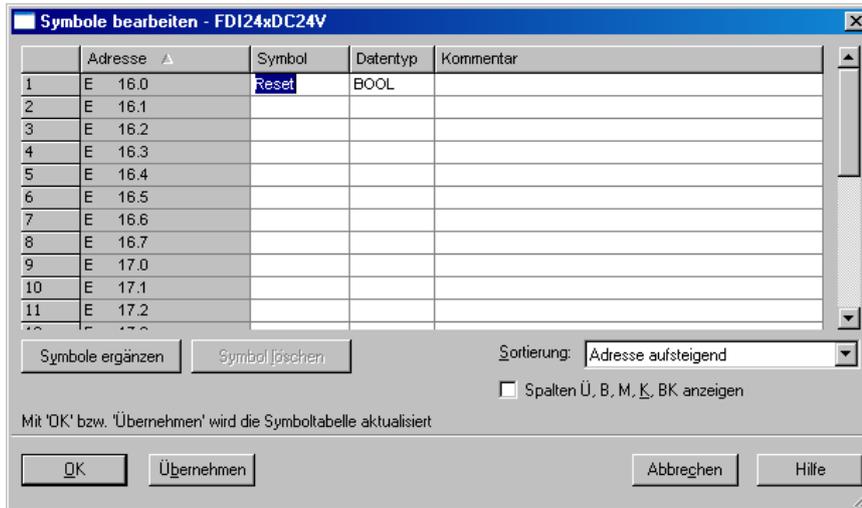
- In the supply group 2Vs/4Vs sub-folder, for all channels 6, 18 / 7, 19 / 8, 20 / 9, 21 / 10, 22 and 11, 23 the check under the entry *Activated* must be removed for each channel.



A RESET symbol is required for the digital input E 16.0 for the F-periphery Operator Acknowledgement.

- To do so, right click the entry *FDI24xDC24V* in the rack or the slot and select *Edit symbols....* The symbol name *Reset* is entered under the *Symbol* column, and the data type *BOOL* is then automatically adopted.

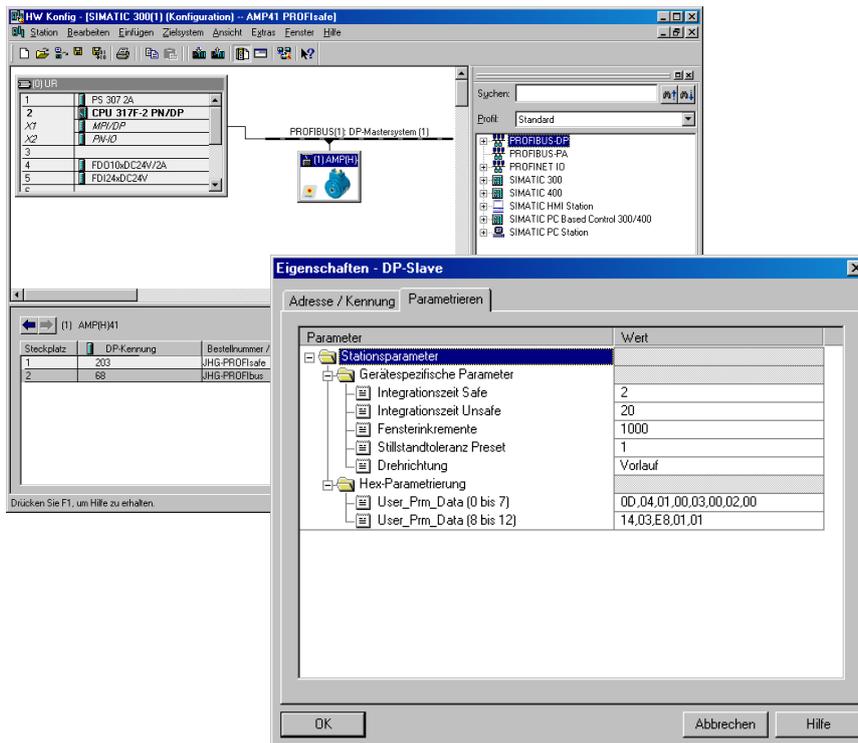
➤ Update by pressing OK.



## 7.3 Parameterisation

### 7.3.1 Setting the iParameters

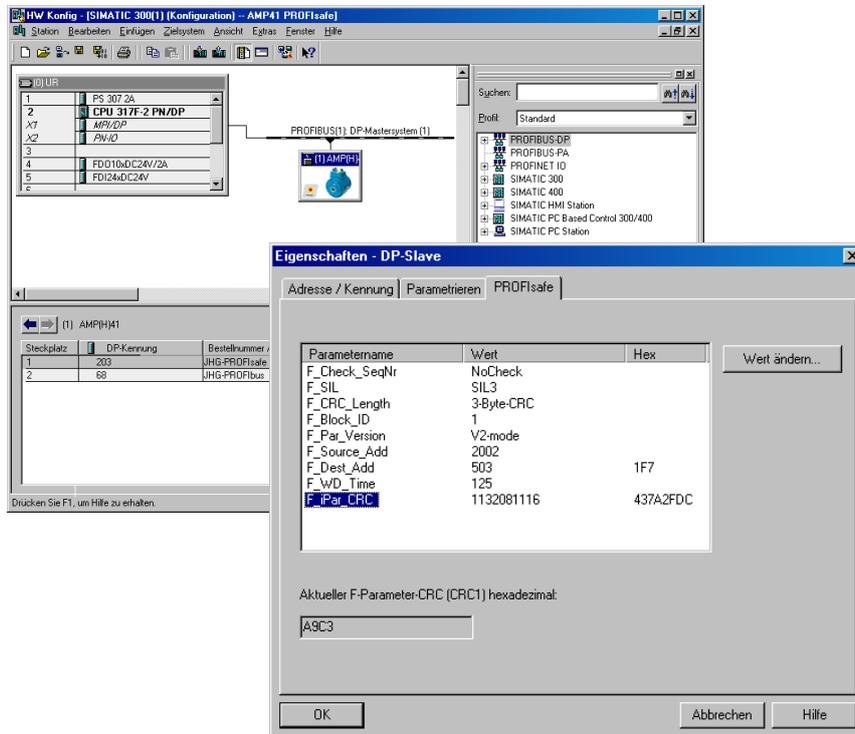
➤ The iParameters can be set by marking the symbols for the SPB → Double click on the slot entry JHG-PROFibus → Select the tab Configure.



If deviating parameter values are required, as shown above, then an  $F_{iPar\_CRC}$  calculation must be completed for this new parameter data set, see chapter 6. The calculated value must then be entered in the parameter data set for F-parameters under  $F_{iPar\_CRC}$ , see chapter 7.3.2.

### 7.3.2 Setting the F-parameters

- The F-parameters can be set by marking the symbols for the SPB → Double click on the slot entry JHG-PROFIsafe → Select the tab PROFIsafe



The value for the parameter `F_iPar_CRC` is determined from the set parameter data set for the iParameter and the calculated CRC value, see chapter 7.3.1.

The hardware planning is then complete. To ensure the security program can be generated automatically, the menu `Station` → `Save and translate` must be used to translate the hardware configuration.

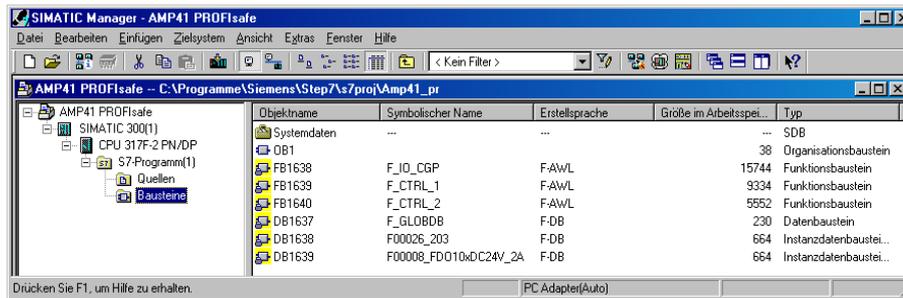
The `HW Config` can now be closed.

## 7.4 Setting the missing (F) modules

The previously automatically created modules are available for viewing in the SIMATIC Manager project folder under:

AMP41 PROFIsafe → SIMATIC 300(1) → CPU 317F-2 PN/DP → S7-Programm(1) → modules.

All failsafe modules are highlighted yellow, to differentiate them from modules in the standard user program.



### 7.4.1 Program structure

Access the F-CALL from the standard user program to enter the security program. The F-CALL is accessed directly, for instance in the wake alarm-OB OB 35.

The advantage of wake alarms OBs is that interrupt cyclical program processing in the OB 1 of the standard user program at set intervals, for instance the security program is accessed and processed at set intervals in a wake alarm OB.

After the security program is run, the standard user program is continued.

### 7.4.2 F runtime group

For ease of use, the security program consists of an “F runtime group”. The F runtime group is a logical construct from multiple associated F modules, formed internally by the F system.

The F runtime group consists of:

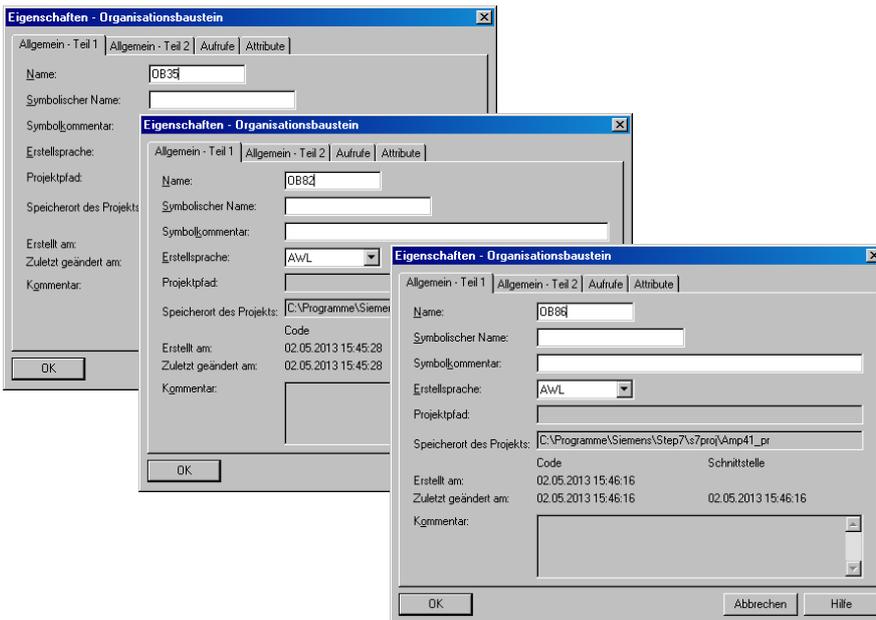
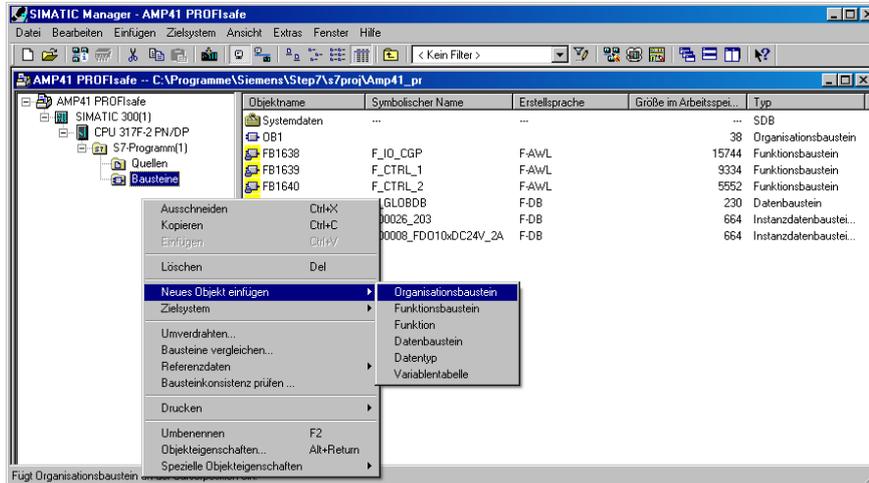
- an F-call module F-CALL, “FC1”
- an F-program module to which the F-CALL is assigned, “FC2”
- other F-FBs
- multiple F-DBs
- F-periphery DBs
- F-system modules F-SBs
- automatically generated F modules

### 7.4.3 Generating object modules (OBs)

Then, the required organisational modules OB35 and OB82 to OB86 are generated.

- The organisational modules are inserted by right clicking in the project window `Insert new object` → `Organisational module`.

The language in which all organisational modules is created is `AWL`.

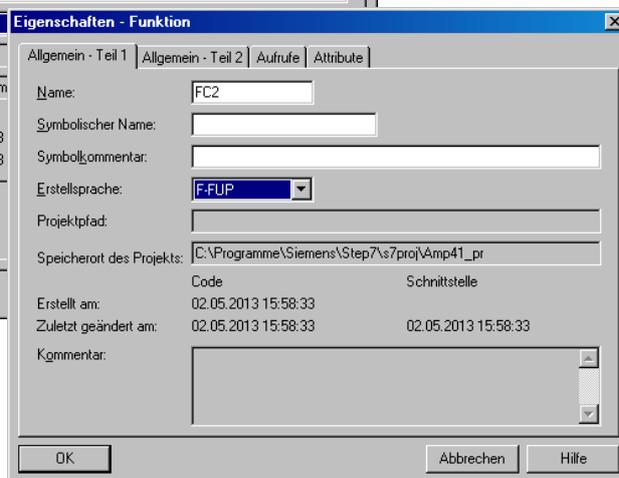
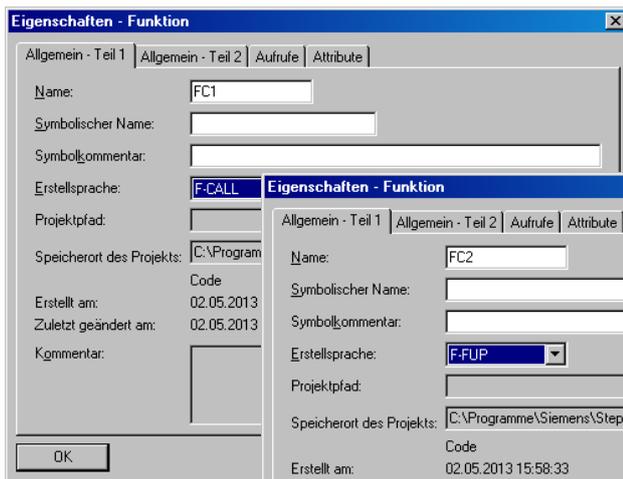
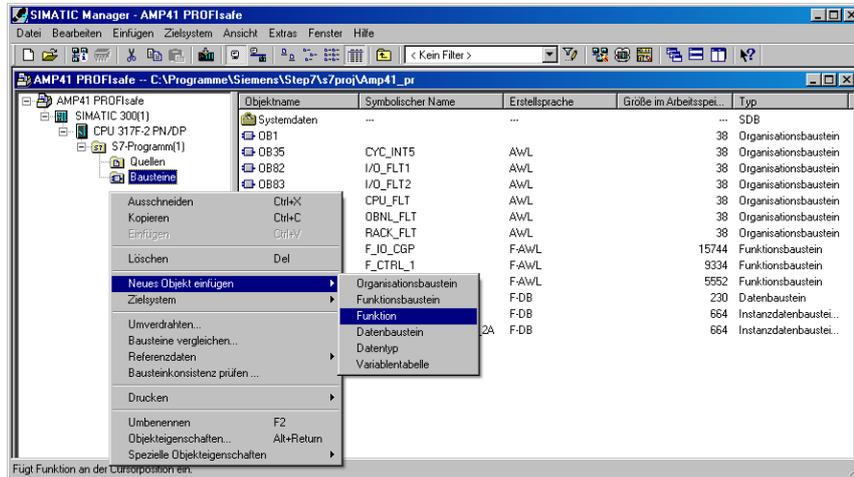


### 7.4.4 Generating the functions (F-FCs)

Then, the required functions FC1 and FC2 are generated.

- The functions are inserted by right clicking in the project window `Insert new object` → `Function`.

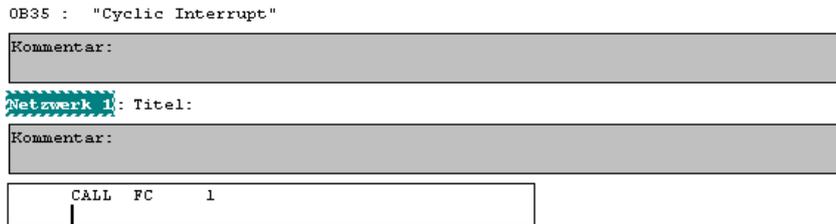
The language for FC1 is `F-CALL`, for FC2 `F-FUP`.



### 7.4.5 Programming the F-modules

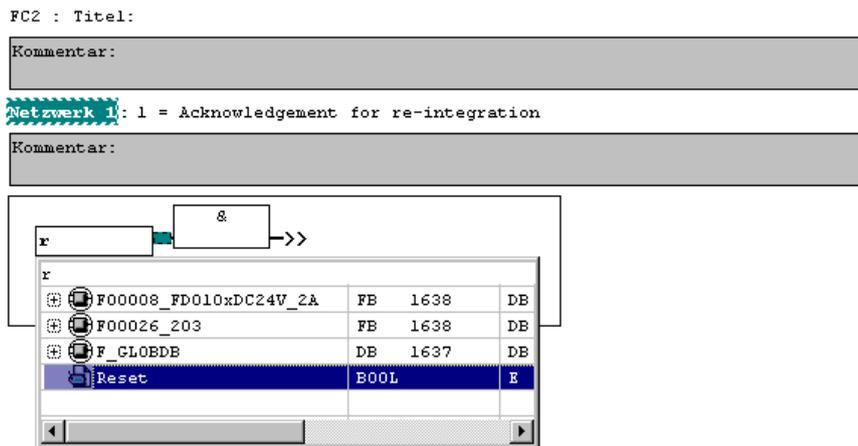
Then programming and adjustment are carried out for the modules OB35, FC1 and FC2.

- The security program can be accessed in OB35 by double-clicking the object name entry OB35 in the project window. The instruction CALL FC1 must be entered in the window KOP/AWL/FUP which opens. Then save the entry and close the window again.



The variable ACK\_REI of the F-periphery DB must be connected to the digital entry E 16.0 RESET of the digital input assembly for operator acknowledgement of the F-periphery after correcting errors. The function FC2 must be programmed accordingly for this purpose.

- An And box must be inserted from the symbol bar and the second entry must be assigned the Reset symbol.



- Two assignments are inserted from the symbol bar, one assignment is assigned to the variable "F00008...".ACK\_REI and the other to the variable "F00026...".ACK\_REI.

FC2 : Titel:

Kommentar:

**Netzwerk 1:** 1 = Acknowledgement for re-integration

Kommentar:

Variable	Data Type
"F00008_FD010xDC24V_2A".ACK_REI	FB
F00008_FD010xDC24V_2A	FB
F00008_FD010xDC24V_2A.ACK_NEC	Bool
F00008_FD010xDC24V_2A.ACK_REI	Bool
"F00026_203".ACK_REI	FB
F00008_FD010xDC24V_2A	FB
F00026_203	FB
F00026_203.ACK_NEC	Bool
F00026_203.ACK_REI	Bool
F00026_203.ACK_REQ	Bool
F00026_203.IPAR_EN	Bool

- Then, the Assignment that is not yet interconnected is interconnected to the output of the And-box via a branch. Save the programming and close the window.

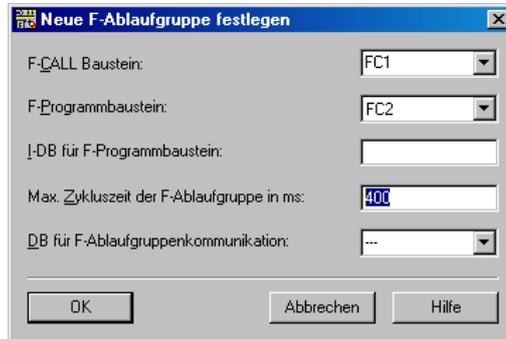
FC2 : Titel:

Kommentar:

**Netzwerk 1:** 1 = Acknowledgement for re-integration

Kommentar:

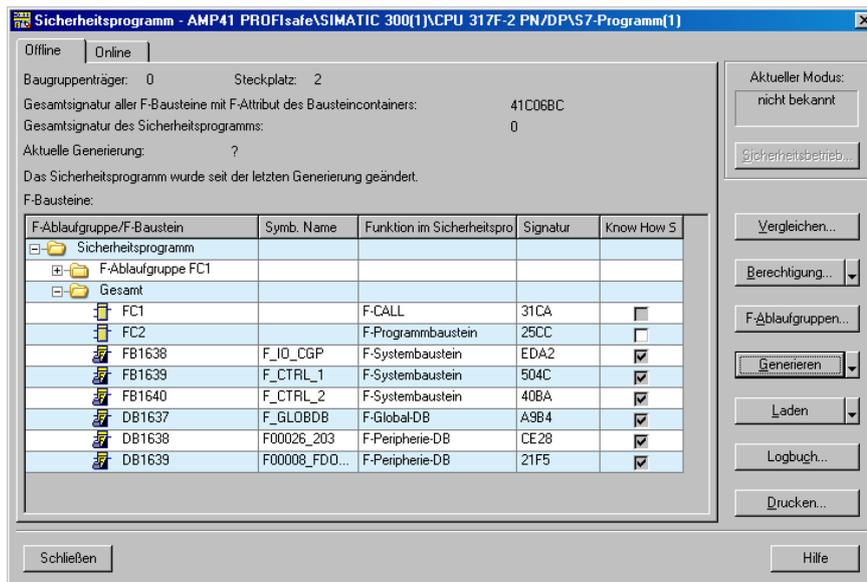
- Determine the run time group using the function FC1. In the field Max cycle time of the F-run time group in ms: enter the value 400 and confirm with OK. Also confirm the window Edit F run time groups which opens by pressing OK.



Programming and adjustments are then complete.

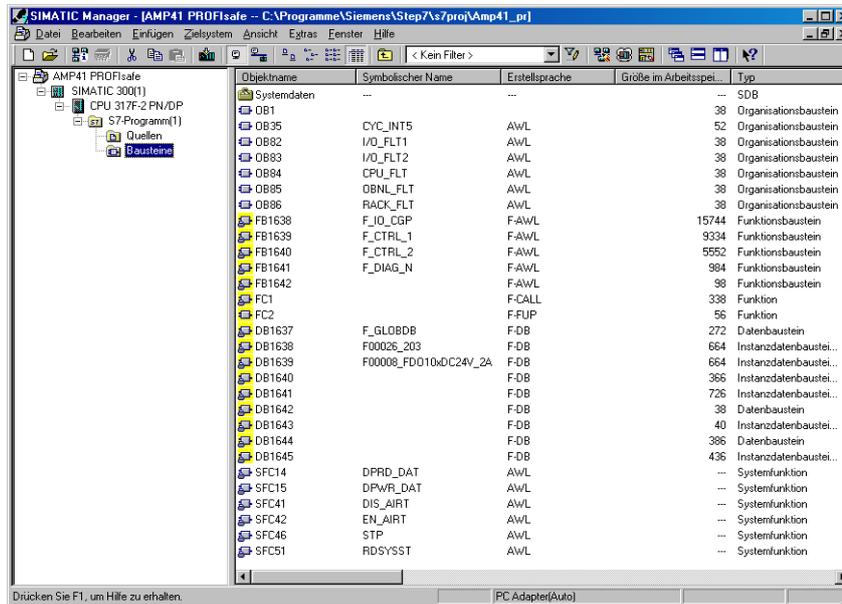
### 7.5 Generating the security program

- To create the security program, enter the dialogue Security program in the SIMATIC MANAGER → using the Extras menu and Edit security program. Press the Generate button to translate and generate the security program.



If the translation is successful, 0 warnings will be displayed and the window can then be closed.

Now, all required modules are displayed in the project window:



## 7.6 Load security program

After the security program has been generated, it can be loaded to the F-CPU. We recommend transferring the entire security program to the F-CPU in STOP operating mode. This ensures that a consistent security program is loaded. Loading is completed as follows:

Menu Extras → Process security program → switch Load.

## 7.7 Test security program

After creating the security program, a complete functional test must be completed according to the automation task in question.

After changes are made to a security program that has already undergone full functional testing, it is sufficient to just test the changes.

## 8 Access to the safety-related data channel

Access the safety-related data channel in the module JHG-PROFIsafe via the process map, as for a standard peripheral device. Direct access, however, is not permitted. Access to the safety-related data channel of the SPB is allowed only from the created F-runtime group.

The actual communication between the F-CPU (process map) and SPB to update the process map is hidden in the background via the PROFIsafe protocol.

The SPB covers a larger area of the process map than necessary for the function of the SPB in the JHG-PROFIsafe module due to the PROFIsafe protocol. The F-Parameter-Block contained there in the process map is not considered part of the user data. When accessing the process map in the security program, access is permitted only to the user data itself.

### 8.1 Output of passivated data (substitute values) in case of an error

The safety function requires, that the substitute value (0) is used when passivating in the safety-related channel in the module JHG-PROFIsafe in the following cases, instead of the cyclically output values.

This status is reported via the F-Periphery DB with `PASS_OUT = 1`, see below.

- When starting up the F system
- When there are errors in safety-related communication between the F-CPU and SPB via the PROFIsafe protocol
- When the value set for iParameters for the window increments has been exceeded, and/or the internally calculated PROFIsafe telegram is faulty
- When the permitted ambient temperature range indicated under the relevant article number has been exceeded or has not been met
- When the SPB is unplugged in RUN mode, the F-Host is reconfigured, and then the SPB is plugged back in

## 8.2 F-periphery DBs

During translation in HW Config, an F-Periphery DB is generated for each F-peripheral device, SPB and digital output assembly.

In relation to the created security program, see chapter 7, this are the modules DB1638 for the SPB and DB1639 for the digital output assembly.

The F-periphery DB contains variables that can be analysed in the security program or that can or must be written. The exception is the variable DIAG, which can only be analysed in the standard user program.

Changing the initial/actual values of the variables directly in the F-periphery DB is not possible, since the F-periphery DB is Know-How protected.

The variables of the SPB F-periphery DB must be accessed in the following cases:

- Operator acknowledgement of the SPB after communication errors or after the start-up phase
- When executing the preset function
- When analysing whether passivated or cyclical data is output
- When the cyclical data of the JHG-PROFIsafe module should be passivated depending on specific states of the security program, such as group passivation

### 8.2.1 SPB F-periphery DB “DB1638” - Overview of variables

Variable	Data type	Function	Access
PASS_ON	BOOL	1 = Passivating the cyclical of the JHG-PROFIsafe module via the security program	read/write Default value: 0
ACK_NEC	BOOL	1 = Acknowledgement for Operator acknowledgement, required for F-periphery errors	read/write Default value: 1
ACK_REI	BOOL	1 = Acknowledgement for Operator acknowledgement after communication errors or after the start-up phase	read/write Default value: 0
IPAR_EN	BOOL	Variable for executing the Preset function	read/write Default value: 0
PASS_OUT	BOOL	Passivation output	read
QBAD	BOOL	1 = Substitute values are output	read
ACK_REQ	BOOL	1 = Acknowledgement request for Operator acknowledgement	read
IPAR_OK	BOOL	1 = Executing of the preset function completed successfully	read
DIAG	BYTE	Service information, only available in the standard program	read
QBAD_I_xx	BOOL	1 = Substitute values are output on the input channel	read
QBAD_O_xx	BOOL	1 = Substitute values are output on the output channel	read

#### 8.2.1.1 PASS\_ON

The variable `PASS_ON = 1` can be used to passivate the safety-related data of the JHG-PROFIsafe module, depending on certain states in the security program. Passivation is not handled directly in the SPB; instead, the status of these variables is registered by the FHost and the host then activates passivation first via the data in the security program. The SPB continues to output cyclical data.

If passivation is completed via `PASS_ON = 1`, the preset function is switched off.

### 8.2.1.2 ACK\_NEC

The official use of this variable would be an operator acknowledgement for the SPB after F-periphery errors. However, there is no process defined for the SPB for which this process is permitted. For security reasons, these errors must be corrected first, and then the supply voltage must be switched OFF/ON, see chapter 10.

### 8.2.1.3 ACK\_REI

If the F system detects a communication error for the SPB, the SPB is passivated.

For an operator acknowledgement of the SPB after correcting the error, a positive flank is required on the variable `ACK_REI` of the F-periphery DB, which is linked to the input of the digital output assembly → E 16.0, Symbol name: "RESET"

**An operator acknowledgement is required:**

- After communication errors
- After the start-up phase

Acknowledgement is only possible if the variable `ACK_REQ = 1`.

An operator acknowledgement must be provided in the security program for each F-periphery via the variable `ACK_REI`. This specification has already been taken into consideration for the SPB or digital output assembly.

### 8.2.1.4 IPAR\_EN

The variable `IPAR_EN` is used to execute the preset function.

The process sequence for executing this function is described in chapter 9.

An exact description of when the variable must be set/reset during reconfiguring failsafe DP Normslaves/IO Normdevices is provided in the *PROFIsafe Specification* from V1.20 or documentation on the failsafe *DP Normslave/IO Normdevice*.



**NOTE!**

`IPAR_EN = 1` does not trigger passivation of the SPB!

Observe the warning in section 9 with respect to executing the preset.

### 8.2.1.5 PASS\_OUT/QBAD/QBAD\_I\_xx/QBAD\_O\_xx

The variables `PASS_OUT = 1` and `QBAD = 1` indicate a passivation of the SPB.

The F-System sets `PASS_OUT`, `QBAD`, `QBAD_I_xx` and `QBAD_O_xx = 1`, for as long as the SPB outputs substitute values (0) instead of the cyclical values.

If passivation is carried out via the variable `PASS_ON = 1`, however, only `QBAD`, `QBAD_I_xx` and `QBAD_O_xx = 1` are set. `PASS_OUT` does not change its value in case of passivation via `PASS_ON = 1`. `PASS_OUT` can, therefore, continue to be used for group passivation of further F-periphery devices.

### 8.2.1.6 ACK\_REQ

If the F system detects a communication error for the SPB, the SPB is passivated. `ACK_REQ = 1` signals that an operator acknowledgement of the SPB is required.

The F-System sets the variable `ACK_REQ = 1` once the error has been corrected and operator acknowledgement is possible. After acknowledgement, the variable `ACK_REQ` is reset to 0 by the F-system.

### 8.2.1.7 IPAR\_OK

The variable `IPAR_OK` is used to indicate successful execution of the preset function. The process sequence for executing this function is described in section 9. An exact description of how the variable can be analysed during reconfiguring failsafe DP Normslaves/IO Normdevices is provided in the *PROFIsafe Specification* from V1.20 or documentation on the failsafe *DP-Normslave/IO Normdevice*.

### 8.2.1.8 DIAG

The variable `DIAG` is used to provide non-failsafe 1-byte information regarding errors that have occurred for service purposes. Access in the security program to this variable is not permitted. Encryption and use of this variable are described in the SIEMENS manual ***S7 Distributed Safety - Project planning and programming***, document order number: ***A5E00109536-04***.

## 8.3 Access to variables of the F-periphery DBs

During translation in `HW Config`, an `F-Periphery DB` is generated for each F-peripheral device, SPB and digital output assembly, and a symbolic name is also entered into the symbol table.

The symbolic name is formed from the fixed prefix “F”, the initial address of the F-periphery and the `Object properties` in `HW Config` for the name entered for the F-periphery device, a max. of 17 characters.

Variables for the F-periphery DB of an F-periphery device can only be accessed from an F runtime group and only from the F runtime group from which access to the channels of these F periphery devices is provided, if there is access.

The variables of the F-periphery DB can only be accessed by providing the symbolic name of the F-periphery DB and the name of the variable: “Fully qualified DB access”

Ensure that, in the `SIMATIC Manager`, in the `FUP/KOP-Editor` and the menu `Extras → Settings...` the option “Cross access from error report” is not activated in the `General` tab. Otherwise, access to variables of the F-periphery DB will not be possible.

## 8.4 SPB - Passivation and operator acknowledgement

### 8.4.1 After starting up the F system

After starting up the F system, communication between the F-CPU and SPB via the PROFIsafe protocol must be established. The SPB is passivated during this time.

While using the substitute value (0), the variables are `QBAD`, `PASS_OUT`, `QBAD_I_xx` and `QBAD_O_xx = 1`.

Operator acknowledgement of the SPB, e.g. the output of cyclical data to the failsafe outputs, occurs independent from the standpoint of the F-host from the setting for the variable `ACK_NEC`, and automatically at the earliest after the 2nd cycle of the F-runtime group after starting up the F system. Depending on the cycle time of the F-runtime group and PROFIBUS-DP, operator acknowledgement is only possible after several cycles of the F runtime group.

If it takes longer to establish communication between the F-CPU and SPB than the monitoring time set for the F-periphery in

HW Config in the Object properties dialogue, then there will be no automatic operator acknowledgement. In this case, operator acknowledgement with a positive flank on the variable `ACK_REI` of the F-periphery DB is required, which is linked to the input of the digital input assembly → E 16.0, Symbol-Name: "RESET".

### 8.4.2 After communication errors

If the F system detects an error in safety-related communication between the F-CPU and SPB via the PROFIsafe protocol, then the SPB is passivated.

While using the substitute value (0), the variables are `QBAD`, `PASS_OUT`, `QBAD_I_xx` and `QBAD_O_xx = 1`.

Operator acknowledgement of the SPB, e.g. an output of cyclical data to the failsafe outputs, is completed only if:

- There are no more communication errors and the F-System has set the variable `ACK_REQ = 1`.
- An operator acknowledgement with a positive flank on the variable `ACK_REI` of the F-periphery DB has been completed, and is linked to the input of the digital input assembly → E 16.0, Symbol-Name: "RESET".

## 9 Preset function

	<p><b>WARNING! CAUTION!</b></p> <p><b>Danger of death, serious physical injury and/or property damage due to uncontrolled start-up of the drive system when executing the preset function.</b></p> <ul style="list-style-type: none"> <li>• The associated drive systems must be locked against automatic start-up</li> <li>• We recommend securing triggering of the preset by the F-host through further protective measures, such as a key switch, password query, etc.</li> <li>• After executing the preset function, check the new position</li> </ul>
---	--

The preset function is used to set the current output position value to any position value within the measurement range. This makes it possible to set the displayed position to a machine reference position through purely electronic means.

Executing the preset function is a critical process, since the resulting jump in actual value, for instance when using a controller, may result in uncontrolled machine movements. Therefore, the preset function may only be executed when the system component in question is at a secure standstill. After completing the preset process, check whether the position output by the SPB matches the position transferred to the SPB.

The preset function is already locked in the SPB and can only be activated via the variable `IPAR_EN` in the F-periphery DB `DB1638`. Even if all the pre-conditions are fulfilled from the standpoint of the F-Host, the preset function is only executed if the SPB's shaft is stopped. A certain amount of flank jitter, however, - for instance due to machine vibrations - is permitted within a tolerance window. This tolerance window can be set via the `iParameters Standstill tolerance preset`, see chapter 5.6.2.4.

## 9.1 Procedure:

- Requirement: The SPB is engaged in a cyclical data exchange.
- The tabs `Preset Multi-Turn` and `Preset Single-Turn` in the output data of the `JHG-PROFI-safe` module are set with the desired preset value.
- The F-Host must set the variable `IPAR_EN` in the F peripheral DB to 1. The rising flank then switches the SPB to ready to receive.
- A rising flank in bit `20 Preset_Request` in the `Control` tab adopts the preset value. Receipt of the preset value is acknowledged in the `Status` tab by setting the bit `20 Preset_Status`.
- After receiving the preset value, the SPB checks whether all requirements to execute the preset function are fulfilled. If this is the case, the specified value is written as a new position value. If there is an error, execution is denied and an error message is output via the `Status` tab by setting the bit `215 Error`.
- After successfully executing the preset function, the SPB sets the variable `iPar_OK = 1` in the F peripheral DB and thereby indicates to the F-Host that preset execution is complete.
- The F-Host must reset the variable `IPAR_EN` in the F peripheral DB to 0. The falling flank then also resets the variable `iPar_OK` and the bit `20 Preset_Status` in the `Status` tab. The bit `20 Preset_Request` in the `Control` tab must be reset manually.
- Finally, the F-Host must check whether the new position corresponds to the new target position.

## 10 Troubleshooting and diagnostics

### 10.1 Visual displays

Assignment and location of status LEDs, see chapter 4.4.2.

LED1	Cause	Corrective action
off	No power supply	Check the power supply, wiring
	Hardware error, SPB defective	Replace SPB
flashing green 3x with 5 Hz	<ul style="list-style-type: none"> <li>The SPB could not synchronise with the F-Host during the start-up phase, and requests an operator acknowledgement.</li> <li>An error in safety-related communication or a configuration error was detected and has been corrected.</li> </ul>	A positive flank is required on the variable <code>ACK_REI</code> of the F peripheral DB for operator acknowledgement of the SPB, see sec. 8.4.
flashing green 1 Hz	F configuration faulty, e.g. PROFIsafe target address set incorrectly <code>F_Dest_Add</code>	<ul style="list-style-type: none"> <li>Check the PROFIBUS address set via the hardware switch. The address set there indicates the required PROFIsafe target address + 500, (see chapter "Bus addressing" in the operating and assembly manual).</li> <li>Compare the required safety class <code>F_SIL</code> for the system and SPB, see sec. 5.6.1.2.</li> </ul>
to	SPB ready for operation, connection with the PROFIBUS master established.	-
flashing yellow/red 1 Hz	<ul style="list-style-type: none"> <li>No connection to the PROFIBUS master</li> <li>PROFIBUS address set incorrectly</li> <li>Incorrectly planned <code>F_iPar_CRC</code> value</li> </ul>	<ul style="list-style-type: none"> <li>The PROFIBUS address set via the hardware switch must match the planned PROFIBUS address.</li> <li>The checksum calculated for the set iParameter set is incorrect, or was not taken into account in project planning, see chapter 6</li> </ul>
red	A safety-relevant error was found. The SPB was transitioned to a failsafe state and outputs its passivated data:	<ul style="list-style-type: none"> <li>To restart operation of the SPB after passivation, the error must first generally be corrected, and then the supply voltage must be switched OFF/ON.</li> </ul>
	Error in safety-related communication	<ul style="list-style-type: none"> <li>Use the variable <code>DIAG</code> to attempt to limit the error Section 8.2.1.8.</li> <li>Check whether the value set for the parameter <code>F_WD_Time</code> is suitable for</li> </ul>

LED1	Cause	Corrective action
		the automation task, see chapter 5.6.1.7 <ul style="list-style-type: none"> <li>Check whether the PROFIBUS connection between the F-CPU and SPB is disrupted.</li> </ul>
	The value set for the parameter <code>Window increments</code> was exceeded.	Check whether the value set for the parameter <code>Window increments</code> is suitable for the automation task, see chapter 5.6.2.3
	The permitted ambient temperature range was exceeded or was not met.	Suitable measures must be taken to ensure that the permitted ambient temperature range can be upheld at all times.
	The SPB was unplugged in RUN mode, the F-Host is reconfigured, and then the SPB is plugged back in	The configuration may only be transmitted to the SPB in STOP state during the start-up phase.
	The internally calculated PROFIsafe telegram is faulty.	Supply voltage OFF/ON. If the error persists after these measures, the SPB must be replaced.
	The PROFIBUS address set via the hardware switch was set to "0".	Valid PROFIBUS addresses: 1 – 99

## 10.2 Using PROFIBUS diagnostics

The PROFIBUS masters provide process data to a so-called host system, such as a PLC CPU in a PROFIBUS system. If a slave cannot or can no longer be accessed on the bus, or if the slave reports a fault, then the master must inform the host system of the fault in some manner. There are several ways to do so, and the application in the host system alone is responsible for analysing these.

Generally, a host system cannot be stopped if just one component on the bus fails; instead, it must react to the failure in a suitable manner according to safety requirements. Normally, the master first provides the host system with a diagnostic overview, which the host system reads from the master in a cyclical fashion, and which is used to inform the application of the status of the individual devices on the bus. If a device in the diagnostic overview is reported to have a fault, the host can request additional data from the master (slave diagnostics), which will then allow for a more detailed analysis of the causes of the fault. These notifications can then have been generated by the master if the slave in question does not, or no longer answers requests from the master, or can come directly from the slave if the slave itself reports a fault. Generating or reading the diagnostic message between the master and slave runs automatically and does not have to be programmed by the user.

The SPB delivers an expanded diagnostic message with module status information in addition to the standard diagnostic information.

### 10.2.1 Standard diagnostics

The diagnostics in accordance with the DP standard are structured as follows. Information is always provided from the perspective of the master to the slave.

	Byte no.	Meaning	
<b>Standard diagnostics</b>	Byte 1	Station status 1	General section
	Byte 2	Station status 2	
	Byte 3	Station status 3	
	Byte 4	Master address	
	Byte 5	Manufacturer code HI-byte	
	Byte 6	Manufacturer code LO-byte	
<b>Expanded diagnostics</b>	Byte 7	Length (in bytes) of the extended diagnostics, including this byte	Device-specific additions
	Byte 8 to Byte 241 (max.)	Additional device-specific diagnostics	

### 10.2.1.1 Station status 1

Standard diagnostics byte 1

Bit		Description
Bit 7	Master_Lock	Slave was configured by another master (bit was set by the master).
Bit 6	Parameter_Fault	The last transmitted parameter telegram was rejected by the slave.
Bit 5	Invalid_Slave_Response	Set by the master if the slave cannot be addressed.
Bit 4	Not_Supported	Slave does not support the requested functions.
Bit 3	Ext_Diag	Bit = 1 means that there is an expanded diagnostic message from the slave.
Bit 2	Slave_Cfg_Chk_Fault	The configuration ID(s) sent by the master were rejected by the slave.
Bit 1	Station_Not_Ready	Slave is not ready to exchange cyclical data.
Bit 0	Station_Non_Existent	The slave was planned, but does not exist on the bus.

### 10.2.1.2 Station status 2

Standard diagnostics byte 2

Bit		Description
Bit 7	Deactivated	Slave was removed from the Poll list by the master.
Bit 6	Reserved	
Bit 5	Sync_Mode	Set by the slave after receiving the SYNC command.
Bit 4	Freeze_Mode	Set by the slave after receiving the FREEZE command.
Bit 3	WD_On	Address monitoring of the slave is activated.
Bit 2	Slave_Status	Always set for slaves
Bit 1	Stat_Diag	Statistical diagnostics
Bit 0	Prm_Req	The slave sets this bit when it needs to be re-parameterised and reconfigured.

### 10.2.1.3 Station status 3

Standard diagnostics byte 3

Bit		Description
Bit 7	Ext_Diag_Overflow	Overflow during extended diagnostics.
Bit 6-0	Reserved	

### 10.2.1.4 Master address

Standard diagnostics byte 4

The slave enters the station address of the master that first sent a valid configuration telegram in this byte. For the PROFIBUS to function correctly, the configuration and parameterisation information for multiple masters must match exactly if there is congruent access to multiple masters.

#### 10.2.1.5 Manufacturer code

Standard diagnostics byte 5 + 6

The slave enters the manufacturer-specific ID number in this byte. This is unique for each device type, and is reserved and saved for the PNO.

The ID number of the SPB is **0x0E3F**.

#### 10.2.1.6 Length (in bytes) of the extended diagnostics

Standard diagnostics byte 7

If there is additional diagnostics information available, then the slave enters the number of bytes here (including this one) to follow in addition to the standard diagnostics.

#### 10.2.2 Extended diagnostics

In addition to the diagnostic message in accordance with the DP standard, the SPB also delivers an extended diagnostics message that contains the module status:

Status block

Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
Header	Status type	Slot no.	Status ID	Module status
0x09	0x82	0x__	0x00	0x00 or 0x03

- Header:  
Number of bytes in addition to the standard diagnostics, including this byte 7
- Status type:  
Status block with module status
- Slot no.:  
The faulty slot number
- Status ID:  
No further differentiation
- Module status:
  - 0x00 = valid data from this module
  - 0x03 = invalid data, missing module – Reported by the SPB if there is a CRC error in the F parameters or iParameters.



**NOTE!**

Bytes 12 to 15 are reserved for service purposes.

## 11 Functional safety

### 11.1 Safety parameters

Determined parameters according to DIN EN ISO 13849-1.

Architecture	Category	PL	MTTF <sub>D</sub> [a]	Service life
1oo2 (2-channel)	3	d	303.0	20 years

Parameters set according to IEC 61508 and DIN EN 62061.

PFD <sub>AV</sub>	PFH [FIT]	DC <sub>avg</sub> [%]	SIL
3.66E-05	0.42	95.9	2 (high demand)

Calculations for the safety parameters of the overall system are provided in the configuration manual.

### 11.2 Information on functional safety

#### 11.2.1 Safe state

If a safe position cannot be output due to an error detected by the SPB, the PROFIsafe data channel is automatically switched to a failsafe state. In this state, PROFIsafe outputs so-called "passivated data". see chapter 8.1

Passivated data is:

- PROFIsafe data channel: All outputs are set to 0.
- PROFIsafe status: Error bit 2<sup>1</sup> Device\_Fault is set.
- PROFIsafe-CRC: valid

**When passivated data is received, the F-Host must transfer the system to a safe state. This error state can only be exited by correcting the error and then switching the supply voltage off and back on again.**

The process data channel addressed via PROFINET-IO is not necessarily affected by this. If the internal diagnostics in the master channel do not detect an error, process data will continue to be output. This data, however, is not secure in the sense of a security standard.

### 11.2.2 Required security reviews / measures

Measures during commissioning, changes	Error reaction F-Host
Application-dependent configuration or determination of required <code>iParameters</code> , see chapter 6.1.	–
When parameters are changed, check whether the measure is executed as desired.	STOP

Review by F-Host	Error reaction F-Host
Cyclical consistency check of current safety-related data from the <code>JHG-PROFIsafe</code> module with previous data.	STOP
Travel curve calculation and monitoring using the cyclical data from the <code>JHG-PROFIsafe</code> module.	STOP
Monitoring of cyclical data from the <code>JHG-PROFIsafe</code> module or process data from the <code>JHG-PROFIsafe</code> module.	Receipt of passivated data → STOP
Timeout: Monitoring of SPB answer time. For reviewing, for instance, broken cables, voltage drops, etc.	STOP

## 12 Accessories

### 12.1 Replacement parts

Designation	Order number
USB programming cable	ID 69629
PROFIBUS terminal (M12 plug, B coded, 220 Ω) 	ID 68746  (The PROFIBUS terminal is not included in the scope of delivery)

## 13 Transportation, packaging and storage

### 13.1 Transportation safety information

	<p><b>CAUTION!</b>  <b>Property damage due to improper transportation!</b>          These symbols and information on the packaging must be observed:          Do not throw, risk of breakage, protect against wetness</p>
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### 13.2 Incoming goods controlling

The delivery must be checked promptly for transportation damage and to ensure it is complete upon receipt.

If there is transportation damage, the carrier must be informed directly upon delivery (take photos as evidence).

### 13.3 Packaging (disposal)

Packaging will not be taken back, and must be disposed of according to applicable statutory specifications and local regulations.

### 13.4 Storing packages (devices)

	<p><b>Protect against wetness!</b>          Protect packages against wetness, store in a dry and dust-free location.</p>
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In case of long storage times (> 6 months), we recommend packaging the devices in protective packaging (with desiccants).

### 13.5 Returning equipment (repair/goodwill/warranty)

Service requests (repair/goodwill/warranty) can be initiated directly via the following online form:

<https://www.huebner-giessen.com/en/service-support/after-sales-service/>

There you will also find contact details for our service, as well as questions and answers regarding the processing.

Devices that have come into contact with radioactive radiation or materials will not be taken back.

Devices that have come into contact with biological or chemical substances that could be hazardous to health must be decontaminated before they are returned.

A clearance certificate must be enclosed.

### 13.6 Disposal

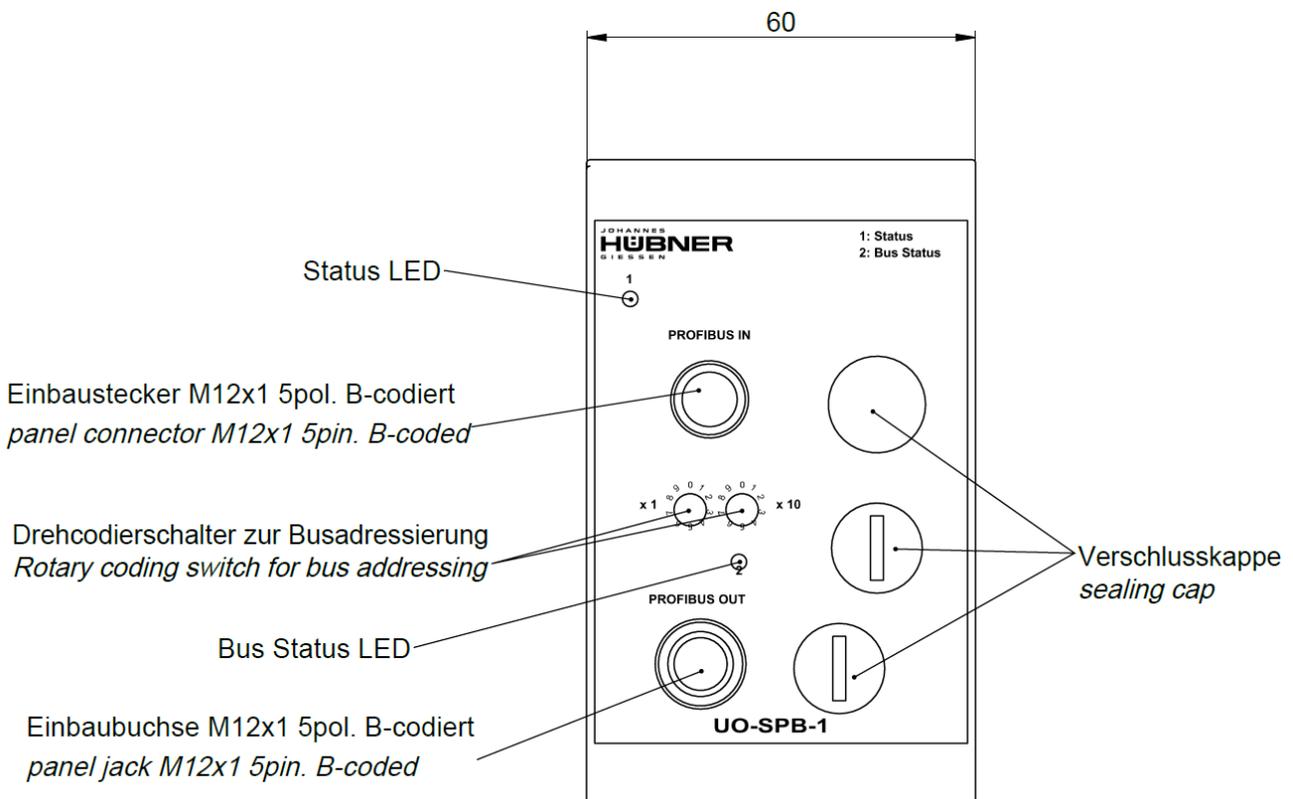
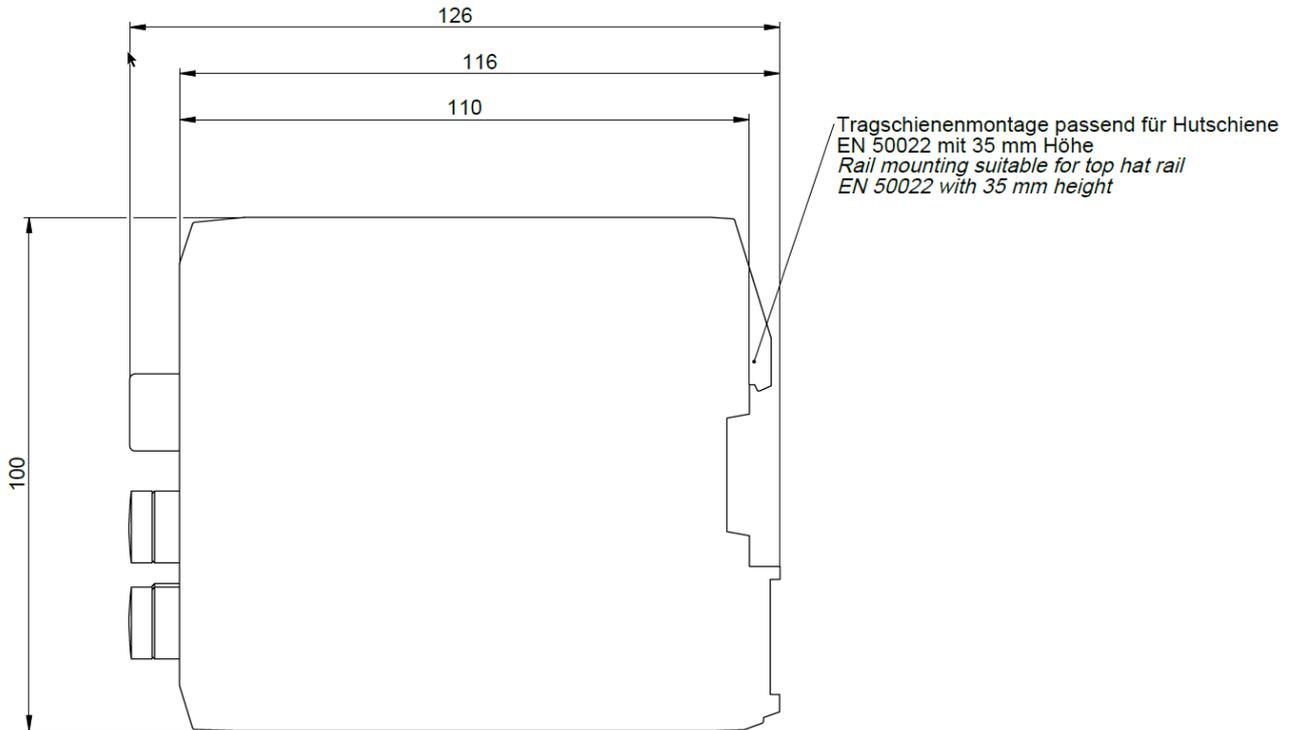
The manufacturer is not obligated to take back the devices.

The module must be treated as special electronic waste, and must be disposed of according to specific national law.

Local municipal authorities or speciality disposal companies can provide information on environmentally-appropriate disposal.

## 14 Documents

### 14.1 Dimensional drawing



## 14.2 Wiring diagram

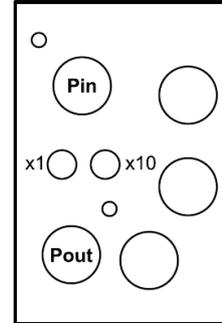
Steckerzuordnung  
connector assignment

### Kabelspezifikation / Cable specification

#### Datenleitung / Data cable

Kabelspezifikation: min. 0,25mm<sup>2</sup>, paarig verseilt und geschirmt

Cable specification: min. 0.25mm<sup>2</sup>, stranded in pairs and shielded



M12-Stecker		Anschlussplan		PN165-412	
M12 plugs		Connection diagram		PN165-412	
PROFIBUS / PROFIBUS					
Pin	Stift, M12x1, 5 polig Pin, M12x1, 5 pole B-coded		1	N.C.	-
			2	PROFIBUS, Data A	PROFIBUS_IN, grün PROFIBUS_IN, green
			3	N.C.	-
			4	PROFIBUS, Data B	PROFIBUS_IN, rot PROFIBUS_IN, red
			5	N.C.	-
			Gewinde Thread		Schirmung Shielding
Pout	Buchse, M12x1, 5 polig Socket, M12x1, 5 pole B-coded		1	+5V	für Terminierung for termination
			2	PROFIBUS, Data A	PROFIBUS_OUT, grün PROFIBUS_OUT, green
			3	GND	für Terminierung for termination
			4	PROFIBUS, Data B	PROFIBUS_OUT, rot PROFIBUS_OUT, red
			5	N.C.	-
			Gewinde Thread		Schirmung Shielding